



**Exploring Social Learning
within the Context of Community-Based Farming:
Implications for Farmers' Agency and Capabilities**

**Thesis submitted in fulfilment of the requirements of the
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ABSTRACT

This thesis, ‘Exploring social learning within the context of community-based farming: Implications for farmers’ agency and capabilities’, provided an opportunity to investigate how community-based farmers engaged a social learning process in adjusting their practices to the observed climate change and variability risks and vulnerabilities. The social learning and pedagogic trajectory towards climate change adaptation, involved a multi-sectoral approach in a community of practice that was inclusive of extension service, developmental agencies, a university, climate change activists, a primary school, a university, the agro-industrial community, the urban open market and the local standards association. Social learning, in this community of practice, took place during field days, field tours, focus groups and observations in a multi-case study approach.

The main research question addressed in this thesis was ‘How can and does social learning facilitate or constrain the conversion of resources into functionings and new adaptation capabilities of communal farmers in Muchena village in the face of increasing climate change and associated climate variability related socio-ecological risks and vulnerabilities?’ In order to address this main research question and its corresponding sub-questions, two main categories of climate change adaptive agricultural practices, crop and non-crop, were studied in the context of social learning and collective and individual capabilities and agency. The research ontology and epistemology were grounded in critical realism, with the epistemic work in the multiple case study being drawing on a constructivist approach where eleven Farmers’ Case Stories [FCS] from crop and non-crop community-based farmers were purposively followed throughout this thesis journey, while the ontological dynamics were pursued through critical realist depth ontological enquiry.

The theoretical framework for this thesis encompassed Bhaskar’s (1998; 2016) dialectical critical realist MELD schema, which underlabours conversion factors from Sen’s (1993; 2005) capabilities theory mobilised via the six sequential moments of the pedagogic practice of social learning as articulated by Wals (2007). This gave the theoretical framework a multi-dimensional facet. In this multi-dimensional theoretical framework, the ontologically influential generative mechanisms identified at **1M**, were droughts, food insecurity, economic poverty, poor farming methods, floods, pests, socio-political stress, socio-cultural and intergenerational knowledge transfer, government policies and market forces. Effort was made to absent these ills at **2E**,

through knowledge co-creation within the communities of practice, through individual and collective reflexivity and was guided by the six sequential moments of Wals' (2007) social learning pedagogic trajectory and by the three capabilities conversion factors; personal, environmental and social. At **3L**'s totalities (laminated) and false totalities and compromises, the community-based farmers came to realise, appreciate and utilised the benefits of individual and collective agency as knowledge generation. In the theoretical framework, the social learning process was a product of collective and individual agency, a product of co-creation, co-sharing and co-monitoring and mentoring of each other's work in a non-linear process towards transformation at **4D**.

The thesis identified the following capability sets and their corresponding functionings: education with the new achieved functionings of knowledge on market oriented economy with more functionings such as apiary, dendrology, aqua-culture and horticultural practices, partnerships including contract farming and company registration; health as a capability set had the new functionings of improved people's and soil's health from organic and conservation production practices; nutrition as a capability set with new functionings of organic and conservation farming as well as, through testing of products and soils to ascertain nutritional parameters, nutritional functionings. These identified capability sets as valued beings and doings all attempted to absent climate change induced droughts, food insecurity and economic poverty through the social learning process. The new achieved functionings of knowledge on related market oriented economy, were used for food security as farmers were able to buy maize, the staple food, which has been constrained by climate change induced droughts and pests. The new capability sets and achieved functionings in alternatives to maize crop farming could be viewed in this thesis as a positive emancipatory cyclic movement in the community-based farmers from non-being to agency [**1M** to **4D**]. The thesis found that for the social learning process to be transformative, the community-based farmers had to reflect as individuals and collectively as a community from T^1 [social learning layer 1] to T^{00} [social learning as multi-layered and infinite]. Learning starts from T^1 by engaging the ontological and epistemological question 'what?' and the pedagogical question, 'how?', in order to understand existing ills and how best to absent them. Tensions existed as the community still take maize meal as their staple food and yet maize production is less resilient to droughts in the absence of water harvesting for irrigation. Despite realising the nutritional value of small grains, the research findings claimed that small grains were difficult to process into a mealie-meal and so, could not replace maize as a staple food.

Theoretical contributions from this thesis entailed both epistemological and ontological implications as the community-based farmers started to question positivism as the only benchmark for organic standards by sending what they self-perceived as ‘organic’ products and soils, for verification from observed laboratory tests. This might have indicated a recognised shift in the epistemology of the poor community-based farmer, who are widely viewed in literature, as non-being and subsistence, towards an organised transformative market oriented practice. In this regard, transformative social learning catalysed by the thesis, contributed towards an organic practice characterised by absented synthetic fertilisers and certain heavy elements from the soils and from the products, thereby adapting and mitigating to global climate change at a micro-scale.

The study, though small scale, might be viewed as having global policy implications. For SGD:2 FCS 1, **VS** absented hunger by transforming from zero tonnage in 2012 to an estimated harvest of four tonnes in 2017. For SDG:3, FCS 3, **LN** produced close to a tonne of organic peas that passed through laboratory testing for nutritional parameters and testing against heavy metals during the 2018 and 2019 farming season. SDG: 1 could be assessed and reflected through improved livelihoods from income raised under market gardening as shown in FCS 3, **LN**; FCS, 4 **SM**²; FCS 5 **SS** and FCS 6 **JM**². Also from SDG 1, were alternatives to maize crop farming and climate change adaptation market oriented apiary practiced by FCS 7, **LM**² & FCS 8, **LM**³ and market oriented dendrology from FCS, 10, **VC** & FCS 11, **JC**. FCS 10, **VC**, managed to register a small company while FCS 11, **JC** managed to get contracts from reputable tobacco companies in the country and he also managed to access bank loans to purchase a small truck to absent the transport ills that constrained the youths who finally moved out of the achieved functioning of dendrology. FCS, 3, **LN** and the group of youths valued sending their products and soils for laboratory tests, an indicator of the quality of education that they attained through Social learning process’ communities of practice engagement. By supplying part of their products as raw materials to an agro-industry, the newly achieved functioning of market oriented agriculture from FCS 3, **LN** and FCS 4, **SM**² could be viewed as a move towards SDG: 9. In terms of SDG: 12, the farming practices studied in this thesis were deemed environmentally friendly, green and so were adaptations to climate change which could be read along with SDG: 13. The thesis findings thus could be viewed as those that could open up some ways of assessing and providing practical implementation pathways for some of the sustainable development goals as well as providing a platform to interrogate other ways of understanding critical realism’s

underlying generative mechanisms as enablers and constrainers to shaping social learning and people's measurable functionings in the context of education for sustainable development and the global action programme (GAP) and its immanent successor, the ESD Agenda 2030 framework. The research is therefore well poised to inform this agenda.

The study concludes that in order to enhance community-based farmers' social learning and agency towards climate change adaptation, extension service, the standards association institution, agro-industry, the university as well as the media, might need to engage pro-actively with the farmers' capabilities and agency. The thesis also attempted to inform the university institution's community engagement, thereby giving practical meaning to the whole institution approaches to ESD as promoted in the UNESCO ESD Global Action Programme, and the emerging ESD 2030 Agenda. The thesis therefore has potential to inform pedagogic practices at the formal, non-formal and the informal learning sectors. The thesis concludes that the social learning process, when coupled with critical realism and the capabilities theories, could facilitate the conversion of resources into new adaptive functionings. The social learning process is transformative, reflexive and recursive, but might have to start from **1M** to **4D** and from T^1 to T^{00} . Moreover, the thesis concludes that poverty remained one of the major disablers of the farmers' capabilities and agency in this thesis.

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DEDICATION

To all community-based peasant farmers around the world,
time for agency!

To my late mother Elizabeth and my late sister Esteri,
for voluntarily providing the agricultural demonstration sites
for the benefit of the community and of this thesis.

I always think of you with these words from the late Dr. Martin Luther King Jr's

“I’ve been to the mountaintop” (April 3, 1968):

“Let every valley be lifted up, and every mountain and hill be made low, and let the rough
ground become a plain, and the rugged terrain a broad valley”

Isaiah 40:4

And my favourite

“I will lift up mine eyes unto the hills, from whence cometh my help”

Psalms 121:1

Whenever I see the green pristine and beautiful mountainous terrain
of Manicaland Province of Zimbabwe (*kuMakomoyo*),
I am inspired to value the earth together with interested others.

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Transcriptions

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List of Acronyms

Agritex	Agriculture and Extension and Technical Services
AN	Ammonium Nitrate
BHM	Before Harvest Meetings (Before Harvest Field and Demonstration Day)
CA	Capability Approach
CCE	Climate Change Education
CEP	Cultural Emergent Power or Property
CONEX	Conservation and Extension Department
CoP	Communities of Practice
CR	Critical Realism
CT	Capability Theory (also CA)
DCR	Dialectical Critical Realist
DESD	Decade for Education for Sustainable Development (2005-2014)
DSDTE	Department of Science Design and Technology Education
DREI(C)	Description, Retroduction, Identification, Iterative Correction helps us to resolve analytical complexity or tensions
EE	Environmental Education
EEASA	Environmental Education Association of Southern Africa
ELRC	Education Learning Research Centre
EMA	Environmental Management Agency
ESD	Education for Sustainable Development
FAO	Food and Agricultural Organisation
FDD	Field Demonstration Day
FiBL	Research Institute for Organic Agriculture
GAP	Global Action Programme
GMB	Grain Marketing Board
IFOAM	International Federation of Organic Agriculture Movements
IUCN	International Union of the Conservation of Nature and Natural Resources
MDGs	Millennium Development Goals
MELD	A schema in the dialectical critical realism (1M; 2E; 3L and 4D)
MESA	Mainstreaming Environment Sustainability in African universities
NGO	Non-Governmental Organisations

PMR	Philosophy of Meta-Reality, and its adjectival form
RRREI(C)	Resolution, Redescription, Retrodiction, Elimination, Identification and Correction
SARUA	Southern African Regional Universities Association
SD	Sustainable Development
SDGs	Sustainable Development Goals
SEP	Societal or Structural Emergent Power or Property
SL	Social Learning
SR	Scientific or Transcendental Realism and its adjectival form
TDRC	Transcendental or Scientific Realism, and its adjectival form
TTL	Tribal Trust Lands
UNACTAD	United Nations Capacity Building Taskforce on Trade, Environment and Development
UNEP	United Nations Environment Programme
UNITAR	United Nations Institute for Training and Research.
WCED	World Commission on Environment and Development
WSSD	World Summit on Sustainable Development
ZCFU	Zimbabwe Commercial Farmers Union
ZINWA	Zimbabwe National Water Authority
ZOPPA	Zimbabwe Organic Promoters and Processors Association

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1 PERSONAL HISTORY, CONTEXTUAL BACKGROUND AND MOTIVATION

In today's knowledge-based societies, questions on what learning should be like for knowledge acquisition, are topical, especially for knowledge on climate change risks and vulnerabilities. Educationists today engage with several types of learning that include but are not limited to self-regulated learning, context-bound learning, hybrid learning, lifelong learning, formal learning, non-formal learning, and informal learning, with some of these having become basic elements of education (Manuela du Bois-Reymond, 2003, p. 5). It is the last three categories of learning (formal, non-formal and informal) that underpin this contextual profile and the thesis. The contextual profile is biographically framed, but focusses on these three categories of learning, as experienced by myself over time, which led me to this study and its research questions.

This study is situated in the field of climate change education and which is studied under Education for Sustainable Development (ESD). ESD is therefore key to this thesis on climate change education. Chapter 36 of Agenda 21 on ESD emerging from the Rio Earth Summit in 1992, identified the same three categories of learning when developing a public understanding of ESD (UNESCO, 2006). My contextual profile as it informs my thesis entitled 'Exploring social learning within the context of community-based farming: Implications for farmers' agency and capabilities' is thus guided by these three UNESCO categories of ESD learning.

Let me distinguish community-based farming, as used in this thesis, from other typologies of farming in Zimbabwe. Community-based farming refers here to agricultural activities [cropping and non-cropping] within communal areas. My study interest on farmers' social learning and capabilities is thus based on communal lands (Rukuni & Eicher, 1984) whose maize crop farming activities are exposed to the risks of climate change and climate variability. Community-based farming is characterised by subsistence practices and so is different from large-scale commercial farming, small-scale commercial farming and also from the Zimbabwe fast-track land redistribution programme of the year 2000. The community-based farmers in the communal lands are often found in marginal areas where

there are infertile soils, poor transport infrastructure and where they often rely on seasonal rainfall, thereby making them vulnerable to observable climate change and climate variability.

1.1.1 Formal Education Biographical and Contextual Antecedents to this Study

At secondary school in 1984, I participated in the then Young Scientists Exhibition showcasing scientific talents. My project (which did not win an award) was based on epidemiological data that I had collected from a local communal clinic on trends and episodes of preventable diseases such as diarrhoea, cholera, typhoid and dysentery. I had questioned in that project if the (studied) diseases were preventable, why people were not preventing them (agency). That might have marked my early interest in social sciences and in studying generative mechanisms and ills (Bhaskar, 2016) that often constrain people from practising their freedom and agency (Sen, 1993) for good health, their capabilities. I also participated in marathon running (road racing) between 1984 and 1987. I participated in a few races of varying distances; the Pronutro International 20 miler (1984), the Rakodzi Marathon Boys open 32.5 km (1984), Marondera road racing 16km (1984) and Stork marathon 8km (1984). The longest distances that I participated in were 42km (the Lions Mountain Marathon Mutare in 1985 or the then Vumba Mountain marathon) and the OK Peter Gradwell Marathon, 42.2km in 1987. Long distance running, like this PhD thesis, demanded endurance and perseverance as I had to endure the long distances up steep gradients, round sharp curves, down steep hills, to the finishing line, with a never-quit approach that I gained from marathon running! Winning in a marathon race, as is the case with community-based farmers when they transform from old to new practices as a result of social learning in this thesis, was the ultimate generative mechanism that called for individual and collective best efforts. In 1984, while my expatriate teacher, Justice, worked hard in training us in long distance running, his expatriate colleague my English Literature teacher then, Wallace, would use his massive video camera to shoot videos of the entire races. We would then gather in the school library to review the videos and discuss with the coach, Justice, where we did well and where we could improve. The video became a very powerful mediating tool for reflexive learning that I appreciated back in 1984, and continued to appreciate in my thesis journey and life-long career. From the lessons on how we collectively won races as a junior team of 1984-85 through individual and collective effort (agency), I then grew up questioning why the community-based farmers often failed to eradicate food insecurity [i.e. did not exercise their

agency] and adapt to climate change and climate variability when there were many farmer-agents to observe and ask for help and, where drought is mere absence of rain water and yet water is still present as streams, rivers and underground sources (Amin, 1972; Ampaw, 2002; Bauer, 2000; Freire, 2005; De Sousa Santos, 2007; Andrews, 2009). So, could there be any lessons that the community-based farmers could get from the experience of collective efforts from teams of marathon runners who endure long distances along rugged, rough terrain and steep gradient? I continued through this thesis to unravel insights into these questions.

After the completion of my secondary education, I trained as a secondary school teacher in Geography and Building which I completed in 1990. I attained my Bachelor of Education degree in Geography in 1996 and a Master of Science in Population Studies in 2000. It was during my master's thesis that I revisited my 1984 interest of studying disadvantaged communities, and, this time, I chose to study the demography of a holding camp (displaced populations). I spent six months literally staying in the camp, visiting the holding camp early in the morning (to observe, learn and interact with their early morning survival livelihood strategies) and left late in the evening (after observing how they normally concluded their day's activities) every day, documenting in detail their socio-economic and political structures, their capabilities and innovations, their demographic structure and mobility patterns and collecting in detail their life stories and more, how they learnt survival strategies. Such issues were not open to the mainstream population in Harare and Zimbabwe in general. Displaced populations in holding camps were often perceived as lazy and troublesome. Now I had enough time to interview, observe and document some of the generative mechanisms that I had questioned in 1984 on why preventable diseases continued to cause havoc amongst the poor, where primary health care was in place. During my master's study of epidemiology, I also encountered two important terms that later shaped part of my thesis, the self-perceived {internal} morbidity and observed {external} morbidity (Murray and Chen, 1993; Sen, 2002b). Thus my interest in studying special populations in this thesis, the community-based farmers (the rural poor), has been with me for a long time.

After my master's degree, I left the classroom to join the research division of the Zimbabwe School Examinations Council between 2000 and 2004 where I worked as a researcher and later was promoted to research manager in the humanities section (Mandikonza, 2016). In 2001 when I was carrying out a pretesting exercise, I noted that most Grade 7 children were orphaned. I kept a database of this cohort in ten of the schools that I pretested, numbering 423

children (both orphaned and non-orphaned), with the hope of developing a tracer study one day, to understand better the quality of life concerns of orphaned children compared to their non-orphaned counterparts. Five years later, I used my new educational capabilities (Sen, 2006) of research and consultancy to secure funds to do a tracer study of my 2001 cohort. My interest in disadvantaged people grew from preventable diseases (1984) to displaced populations in a holding camp (1999) to orphans in schools (2001-2006) and in this thesis journey, community-based farmers' social learning and their adaptive practices to the risks of climate change.

I left the national school examinations council to take up a Climatology in Education lecturing post at the University of Zimbabwe from February 2005 to date. The functions of the university under education 3.0 thrust were to teach, research and do community engagement (Hoppers, 2017) as well as innovations and industrialisation in a 5.0 thrust (www.uz.zw). I started to query the geography education climatology curriculum that I was using to teach, which I viewed as being too scientific since it looked at climatological and meteorological processes but lacked a human face, a curriculum that lacked a wider ecologies of knowledge perspective (De Sousa Santos, 2007). The need to research such epistemological and ontological absences when studying climatology and climate change at my university, therefore marked the early precursor to this thesis. It was imperative as a teacher-researcher (Ahmedabad, 2007) to participate in community projects as part of my university mandate. Here I worked and assisted the community in knowledge building with the knowledge acquired filtering into the university curriculum (Mandikonza, 2016; Hoppers, 2017).

I enrolled for the Rhodes University/SADC Regional Environmental Education Programme course at the Environmental Learning Research Centre (ELRC) at Rhodes University in 2010 (Mandikonza, 2016; Mandikonza and Lotz-Sisitka, 2016). This ESD course bolstered my love for Education for Sustainable Development and Climate Change Education in particular. Through my change project within the course, I adapted the use of a video camera as a mediating tool for learning within my community engagement activities which I was using to extend my university curriculum, and to broaden the knowledge perspectives in the Climatology course (Mandikonza and Lotz-Sisitka, 2016). I learnt a lot from my community-based change project in the course and more: that the university is not knowledgeable in everything, but can make valuable input as an expert-other and partner, to help in the

knowledge conversion process or in reshaping the community based knowledge to improve university functionality (Hoppers, 2017). This is a process that Hoppers (2017) argued as important for revisiting the role of African universities' in their societies. Up to this point, I had learnt about how to use the knowledge learnt from the community in the university classroom and so I had to be a researcher and participant in this knowledge generation process in line with Education 5.0. But, I knew very little about how the community-based farmers were learning their practices, and what mechanisms constrained them from learning sustainable practices in the face of a changing climate. This was the curiosity that led me into this thesis journey.

1.1.2 Non-Formal Education Biographical and Contextual Antecedents to this Study

The second segment of ESD learning in my contextual profile relates to engagement with non-formal education. I chose, for my university community engagement, to work with how community-based farmers learn their practices. But there was a conflict of academic disciplinarity (Osborne, 2015), which I had to address. My teacher training was in Geography and Building pedagogies and not Agriculture. How could I claim expertise in an area I had no formal training in, apart from having studied the subject area at school? My efforts were boosted by the Zimbabwe Organic Producers and Promoters Association (ZOPPA) of which I am an affiliate. ZOPPA recommended that I enrol for an online course on successful organic production and export that was sponsored by UNITAR, UNEP, and UNACTAD (Lopes and Abaza, 2009). This allowed me to move from being an agriculture enthusiast to a certified organic producer and exporter, a move from non-being to being in the words of De Sousa Santos (2007). With the right content in place, the social learning pedagogy of community-based farmers was now easy to study. My completion of this online organic farming course generated more questions than answers which helped to shape this thesis enquiry; I became interested in studying similar organic farmers, in a case study, in order to dig deeper and unravel different absences through potential social learning responses.

I grew up in an area of forestry plantations so my interaction with forest extension service started at a young age. As a result of such interactions and non-formal education, I planted my first tree woodlot (102 trees) in December of 1982 at my rural homestead in the same village as the one in this study. At that time, due to the colonial system, rural people did not plant exotic trees at their homesteads (Dirwai, 2008a; Dirwai, 2009) as they feared

compulsory land acquisition by the then political system for agro-forestry purposes. I planted thousands more trees in subsequent years and by the year 2008 with funds from a donor agent (Fondazione Basso, Sezione Internazionale <http://www.fondazionebasso.it/2008/sezioneinternazionale/>), I made my 1982 tree planting efforts a big community project. This also marked my interest in environmental protection which became central to my thesis. Thus the combination of formal education at school and the non-formal education from the foresters and agriculture extension services in agro-forestry also shaped this thesis; I traced stories of two tree nursery producers (dendrology) in my thesis. The three pillars of ESD (social, economic and environmental protection) could be visualised from this type of non-formal education that I attained since 1982.

The observations that I made from this contextual profile finally helped me to categorise farming activities in my thesis as crop and non-crop. Crop farming is further split into two more categories, conservation farming under rain-fed cropping and organic farming which engages with basic marketing under simple home-based adaptive irrigation techniques. The non-crop farming activities are classified into aqua-culture, dendrology (tree seedling nursery growing) and apiary (bee-keeping). Central to all these categories in my thesis then, was social learning linked to these new farming practices. This thesis also took shape around my professional area of work: university teaching, research, community engagement, innovations and industrialisation (education 5.0 thrust) within the area of climate change adaptation in education.

1.1.3 Informal learning Antecedents to this Study

I was socialised in a family of carpenters, blacksmiths, peasant farmers and potteries, since the early 1970s. Learning of practical skills was situated on the job and through sharing practical skills and ideas with the older and experienced adults (intergenerational) in an extended family set up (big family). Each task had specialised terminology and tools that one had to learn through engaging with the practice. This included learning of the proper use and handling of tools to reduce damage to the tool and injury to the user. I learnt to plane along the grain through careful reflection and analysis of how to tackle knots in such a way that one didn't harm the plane blade (tool) or oneself. I learnt through this carpentry process that care would be needed when handling social issues through the social learning trajectories in this thesis journey.

Shaping iron as a blacksmith was another specialised task in our family cottage industry. The basic ‘metal work’ included the production of hoes from disused tractor plough discs, axes shaped from scrape iron bars, double-edged swords, the half-moon axe (*gano*), the *hlabuya*, arrows and various other traditional metal artefacts. Metal work tasks too, had their own specialised tools, the forge (*mvuto*), various types and sizes of hammers and a tool-kit to repair the machine. I needed to be a user and a technician too. Learning during this process was done as a community and shared from the experienced to the novices, on the job and this marked my interest in social learning and the communities of practice model (Wals, 2007; Wenger, 2010) in this thesis. To supplement income from carpentry, iron shaping and pottery, we practised mixed farming, field cropping of mainly traditional crops such as maize, *rapoko* many others and rearing of animals such as cattle, goats and sheep. These were all part of my socio-economic and socio-cultural background. At Tbilisi (1977) nations adopted the importance of environmental education in the preservation and improvement of the world’s environment, as well as in the sound and balanced development of the world’s communities and, this was an aspect I embraced from how I was socialised. I continued to explore environmental education issues such as these throughout this thesis.

1.1.4 All Antecedent Learning Experiences in Focus during the Economic Crisis in Zimbabwe

All the lessons I gained from my formal, non-formal and informal learning as discussed above, were put to the litmus test during the 2006-2008 economic hardships and deteriorating political atmosphere in Zimbabwe during that time. By 2008 most schools, colleges, universities and factories in Zimbabwe had shut down. I observed that whenever the government tried to control prices in a sky-rocketing inflationary economy, food would be plenty on supermarket shelves today, but the following morning, all shelves would be empty (where did the food go overnight? Back into the warehouses maybe, I wondered with an empty stomach, as I continued to face empty shelves in shops where food was once fully stocked the previous day), so many of the rural and urban poor went hungry. I was hungry too!

This raised my interest in studying the generative mechanisms that produced this human suffering and the question on how best I could, as part of the rural poor (since I too was vulnerable), help myself and others to absent such suffering should they arise again in the future, or in any other geographical space and time similar to ours in Africa. Indeed

Zimbabwe experienced a repeat of a similar scenario of 2006-2008 in the period 2018-2019. So, looking at generative mechanisms that enabled and disabled community-based farmers to learn about food sustainability, became one space that I sought to explore through the community-based farmers' social learning process that unfolded in this thesis. I tried therefore to find the social learning trajectories towards food security and sustenance by interrogating and understanding better the influence of local and global market forces that are operational in our society (Amin, 1972; Bauer, 2000; Ampaw, 2002; Harvey, 2005; Andrews, 2009). The economic and food insecurity situation in Zimbabwe of 2006-2008 was made worse by a deteriorating and oppressive political environment and an education system that, in the words of Hoppers (2017), oriented the population into looking for formal employment, in a country where jobs were very difficult to get for both the highly educated and the never-went-to-school category of our people. By then my own siblings and very close relatives and other local youths, had migrated, looking for a better life. But, we could not all choose to leave the villages. Some had to remain behind, looking after goats and cattle while at the same time, exploring other survival strategies [capabilities and functionings in Sen's language], and so I remained behind. I remained behind on Gupta's (1988; 1991) assertion that the higher the physical, technological, market, or socioeconomic stress, the greater the probability that disadvantaged communities and individuals generate innovative and creative alternatives for resource use. This is what kept me going – and many others who had stayed in the villages. Both urban and rural people had to survive on government and donor food handouts (BACCOSI, Basic Commodities Supply Side Intervention, was an initiative introduced by the Reserve Bank of Zimbabwe to alleviate the acute shortages of goods in supermarkets), which was not a sustainable practice either (Amin, 1972; Bauer, 2000; Ampaw, 2002; Harvey, 2005; Andrews, 2009) as the people were not productive. Freire (2005) had this to say on such dependency by the peasants:

... until they concretely 'discover' their oppressor and in turn their own consciousness, they nearly always express fatalistic attitudes towards their situation. Thus the peasant begins to get courage to overcome his dependence when he realizes that he is dependent. Until then, he goes along with the boss and says 'What can I do? I'm only a peasant... Self-depreciation is another characteristic of the oppressed, which derives from their internalization of the opinion the oppressors hold of them. So often do they hear that they are good for nothing, know nothing and are incapable of learning anything, that they are sick, lazy, and unproductive and that in the end they become convinced of their own unfitness. (Freire, 2005: 59, 61)

But all hope is not lost for the community-based farmers as Freire (2005) argued:

It is striking, however, to observe how this self-depreciation changes with the first changes in the situation of oppression. I heard a peasant leader say in an *asentamiento* meeting, ‘They used to say we were unproductive because we were lazy and drunkards. All lies. Now that we are respected as men and women (being), we’re going to show everyone that we were never drunkards or lazy. We were exploited!’ (Freire, 2005: 62)

So, why do the peasants fail to emancipate themselves from being dependent on food handouts when faced with the risks of climate change, remained a question that this thesis had to unravel through understanding farmers’ social learning around their capabilities and how they could absent absences in order to transform.

As noted before, during the harsh economic hardships of 2008, I won a project grant to start a community-based tree seedling production venture in the village of study and for various personal reasons (reflections), only 52 households came on board with over 400 households opting to continue waiting for food handouts from the government and NGOs. As part of my contextual profiling building up to this thesis, I wondered why able bodied people would not want to exercise their freedom to work, raise their own income and empower themselves to buy food of their choice, when the choice was open to them (Amin, 1972; Bauer, 2000; Ampaw, 2002; Freire, 2005; Harvey, 2005; Andrews, 2009). Such mind searching questions led to the inclusion of Sen’s capabilities theory in this thesis journey. The capabilities theory (CT) gave me the lens to explore enablers and constraints to people’s freedoms and capabilities. Critical realism in this thesis thus underlabours CT as the capabilities theory on its own lacked the power to absent absences. For this, I engaged the power of dialectical critical realism (cf. Chapter Two for further insights into this theoretical aspects of the thesis).

The year 2012 marked the start of this thesis journey on a part-time basis with Rhodes University. Therefore from my socio-economic background and as shared via this contextual profiling of the antecedent influences on the thesis and its emergence, I have learnt to respect people in their communities. It seems local communities have many unheralded knowledges that are embedded in their culture and in their local (traditional) knowledge systems: “the *natura naturans* and not *natura naturata*” (De Sousa Santos, 2007, p. 17) which formal education could benefit from. I want to sum up my educational background as well as my entry into education for sustainable development, engagement with social learning and critical realism, with a few quotations. The Chinese proverb, ‘S/he who blames others has a

long way to go on her/his journey, s/he who blames himself is halfway there but s/he who blames no one has arrived!' (Anonymous). Staying in the blaming realm can actually be a disabler of people's capabilities and freedom. Hoppers also sums this up well when she said, "The problem then becomes, not just one of harping on the problem, whining about it, or indulging in hapless polemics about it, but to work strategically to usurp the very tools that have been inculcated in us, and to collectively transform it with the goal of seeking self and collective empowerment" (Hoppers, 2017, p. 4). This, remained a big issue that I grappled with in this thesis journey as I continued to look for voice (dialogue in Freire 2006's language) of the 'voiceless' community-based farmers.

1.2 WIDER EDUCATIONAL RESEARCH CONTEXT: CLIMATE CHANGE EDUCATION AND ENVIRONMENTAL EDUCATION/EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD)

My research topic, 'Exploring social learning within the context of community-based farming: Implications for farmers' agency and capabilities', is situated in the wider field of ESD which encompasses environmental education and climate change education, in particular. Environmental issues, safety and health issues, disaster management, enterprise, sexuality, HIV and AIDS, heritage, climate change and financial literacy, gender and technology are cross-cutting themes in the updated Zimbabwean School Curriculum (Dirwai, Sibanda & Kakono, 2018). Climate change is thus recognised as one of the ten cross-cutting themes that need to be taught and integrated in every subject of the curriculum at secondary school level in Zimbabwe. Climate change is evolving and still debatable. However, its effects on the less developed countries that often rely on rain-fed agriculture, are real, and so is the case of Zimbabwe. Climate change adaptation and social learning practices are therefore studied within the context of Environmental Education (EE) and subsequently Education for Sustainable Development (ESD) (United Nations, 1992; UNESCO, 2014).

Education as a way of closing the human-environmental gap was articulated in 1972 at the UN Conference on the Human Environment (Stockholm Declaration, 1972) where emphasis was on education as a way of addressing human-environmental problems. It was proclaimed that, to defend and improve the environment for present and future generations, was an imperative goal for mankind. The Stockholm undertaking urgently called for new strategies, to be incorporated into development and in developing countries, this was going to be policy prerequisite for any improvements (ibid). The world's first intergovernmental conference on

environmental education then organised by UNESCO in cooperation with the United Nations Environmental Programme (UNEP) was convened in Tbilisi, Georgia (USSR) from 14 to 26 October 1977. Adopted at Tbilisi was the important role of environmental education in the preservation and improvement of the world's environment, as well as in the sound and balanced development of the world's communities (Tbilisi, 1977). The Tbilisi Declaration argued that Environmental Education had to start looking outward to the community, which is reflected in this thesis. The understanding of Environmental Education at Tbilisi was based on problem solving and awareness of environmental problems for all ages in communities through formal and non-formal learning (Chimbodza, Manyinyire, Dirwai & Kakono, 2013). The Tbilisi conference introduced the possibility that environmental education could create a new pattern of behaviour of individuals, groups and society as a whole towards the environment.

The term, sustainable development, was popularised in *Our Common Future*, a report published by the World Commission on Environment and Development (WCED, 1987), also known as the Brundtland Commission and Report. Sustainable development was defined as “development that meets the needs of the present without compromising the ability of the future generations to meet their own needs” (WCED, 1987, p. 43). Three intertwined dimensions were noted: societal, economic and environmental protection. But the use of the term ESD emerged in 1992 when global leaders set out the principles of sustainable development at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil (UNCED, 1992). It was generally accepted therefore that sustainable development calls for an understanding of the three pillars of development which are economic development, social equity, and environmental protection. Agenda 21 was the document adopted at the United Nations Conference on Environment and Development (UNCED) at the Rio summit (UNCED, 1992). Chapter 36 of Agenda 21 benchmarked the ethos of ESD, ‘Promoting education, public awareness and training’. Thus ESD for promoting education, public awareness and training remained the backbone of this thesis journey.

Agenda 21 identified four major thrusts of ESD which are: improve basic education; reorient existing education to address sustainable development; develop public understanding, awareness; and training (UNCED, 1992). These four, as major tenets of Agenda 21, benchmarked my social learning study where lessons learnt from community engagement

could possibly find a way into reorienting education in the university lecture room during my teaching. The ESD international framework and policy therefore informs my thesis. ESD issues from Chapter 36 of Agenda 21 (UNCED, 1992) were followed up at the World Summit for Sustainable Development in Johannesburg South Africa (WSSD, 2002). At this conference, the establishment of a Decade of Education for Sustainable Development (DESD, 2005-2014) was recommended to the United Nations General Assembly. After the WSSD of 2002, the Ahmedabad Declaration on Environmental Education (Ahmedabad Declaration, 2007; UNESCO, 2007) called for giving more attention to action or agency, a concept I explored in this thesis. Through education, people could learn from indigenous and traditional patterns of living that respect and honour the earth and its life-support systems, reflecting also the sentiments of people in the global South. This encompasses natural farming methods such as organic, conservation and perma-culture (Mukute, 2010). It was at the Ahmedabad International Conference on Environmental Education (a 30-year follow-up to Tbilisi), that the climate change crisis, central to this thesis, was noted as a world problem that needed to be acted upon as people reviewed their quality of life. The concept, ‘we are all learners as well as teachers (educators)’ (Ahmedabad Declaration, 2007) became the cornerstone to the social learning that I engaged in with the communities in my study and was also a dominating concept in the Environmental Education Association of Southern Africa (EEASA) conferences and deliberations for some time then (since 1992 when it emerged from the NGO Forum principles at the Rio Earth Summit) (EEASA, 2007). After the Bonn Declaration of 2009, which was released by UNESCO to mark the mid-way of the UNDESD, countries developed their national ESD policies with Zimbabwe completing its national policy and action plan for 2014 and beyond, in 2013, after deliberations had started in 2006 (Chimbodza, Manyinyire, Dirwai & Kakono, 2013). I participated in that process. The UNESCO ESD Global Action Programme (GAP) was later adopted at the 69th session of the United Nations General Assembly following the DESD final conference in Aichi-Nagoya-Japan in 2014. The ESD GAP was aimed at strengthening the lessons, experiences and achievements of the DESD (UNESCO, 2014). The overall goal of the ESD GAP was to generate and scale up action in all levels and areas of education and learning in order to accelerate progress towards sustainable development. This includes community based social learning which is the focus of this thesis. Of interest to this thesis is the second priority area of the ESD GAP, namely whole-institution approaches to ESD. This goes beyond the reorientation of teaching content and methodology, but proposes whole institution

management be in line with sustainable development. In my study, the whole institutions approach requires all members of the CoP, inclusive of agro-based industry and the different faculties of the university where I teach, to be in line with sustainable development ethos to achieve what the Ministry of Higher Education is naming 'Education 5.0'. I therefore argue for ESD in this thesis from a socio-economic and environmental perspective through a social learning pedagogy. This work feeds well into the emerging ESD Agenda 2030 which will be released in 2020. It also emphasises whole institution approaches to ESD and argues for strengthening these (Lotz-Sisitka, pers. comm, 2019).

1.3 RESEARCH FOCUS AND PROBLEM STATEMENT

The focus of this thesis was to identify the underlying generative mechanisms shaping the social learning trajectory in the context of farmers' capabilities, adaptive practices and agency in response to climate change risks and vulnerabilities. Zimbabwe is a tropical country affected by observed seasonal changes and subsequently, climate change. The situation is exacerbated by the country's over-reliance on rain-fed farming (IPCC, 2014). Climate change is an evolving phenomenon that has been subjected to much debate. However, more evidence of a possible warming climate on earth has been brought to the forefront by the IPCC reports of 2007, 2014 and 2018, with ever more certainty. In all of these reports, it is noted that climate change data at a local scale is still difficult to come by and there is increasing demand for downscaled analysis, monitoring and modelling according to the SARUA report of 2014. Of importance in this thesis, are the locally observable seasonal changes (climate variability) that have resulted in a high frequency of floods, droughts and a heating earth. Such phenomena had not been very common a century or even a few decades before. A trend in increasing surface temperatures to the magnitude of 2 to 3 degrees Celsius have been noted on maximum and minimum temperatures in Zimbabwe during the past 100 years (Zimbabwe Meteorological Services Department, 2010). This indicates a statistically observable change in the climate, with the IPCC report of 2007 putting the figure on rising mean annual temperature in southern Africa at 3.7⁰C which is much higher than the rest of the world, figures which have since been confirmed in the IPCC 2014 report, with reports of already increased temperatures of 1 degree and more emerging in the southern African region (SARUA, 2014). Temperature increases of about 1.5⁰C were noted for southern Africa where Zimbabwe is located (IPCC, 2018). All this is indicative of a general warming of temperatures in southern Africa and Zimbabwe in particular.

To complement this, a decline in rainfall has been noted in the last 90 years (Unganai, 1996). Unganai, using a linear regression model, concluded that rainfall had declined by 10% between 1900 and 1994 in Zimbabwe. Droughts that used to recur roughly every 10 years in the run-up to the 1960s and 1970s, a scenario Mazvimavi (2010) argued to be the longer term natural cycles of droughts and wet seasons, has seen the frequencies increased to every 4-5 years by the 1980s and late 1990s. In the 2018-2019 agricultural season, Zimbabwe faced its most devastating drought in four decades after recording its lowest rains in four decades according to regional hunger watchdog, the Famine Early Warning Systems Network reporting in the month of March (FEWS NET, 2019). After recording a devastating drought in four decades in the 2018/2019 season, in the same month of March, 2019, Zimbabwe experienced a severe tropical cyclone named Idai, killing over 300 people and many others were reported missing with many homes and infrastructure destroyed in the Manicaland province, the same province where this study is located. Torrential rains amounting to over 600mm were experienced in Manicaland province in a very short space of time causing rock falls, land and mud slides, flooding of rivers and washing away of bridges, resulting in deaths and destruction of homes and other infrastructure (ZMSD, March 20, 2019). From these major observable changes, it is the issue of climate variability where seasons have shifted with a delayed onset of rainfall and more concentrated intensive rainfall in a few months (i.e. shorter period), frequent flooding activities and severe tropical cyclones (Elene in 2000 and Idai in 2019), that makes rainfed agriculture a complex venture to plan for (ZMSD, 2010; 2019).

Lotz-Sisitka and Urquhart (2014) in the SARUA country report on Zimbabwe, reiterated that the country is experiencing more hot days and fewer cold days than before as a result of climate change and variability with a projected increasing temperature of about 2.5⁰C by 2050. This shows that Zimbabwe is most likely to face recurrent severe food security challenges and disease insurgence together with pests and weeds that can be resistant to current control methods, if laminated measures, are not in place. In order to cope with the climate variability challenges, farmers often engage in adaptive practices through learning with and from others within their own communities and from others elsewhere (Mukute 2010; Mawere, Madziwa & Mabeza, 2013). By learning socially within the context of their communities and those of others elsewhere in similar climatic risks and vulnerabilities, the community-based farmers could evoke the identification of their valued beings and doings

(capabilities and functionings) (Mukute, 2010). Thus the main problem statement is hinged on social learning of climate change or variability induced risks and vulnerability that community-based farmers in Zimbabwe face in crop and non-crop farming activities.

1.4 RESEARCH OBJECTIVE

To investigate the potential of social learning interactions to enhance farmers' agency to convert resources into new functionings and capabilities to cope with and respond to increased climate change induced risks and vulnerabilities.

1.5 RESEARCH QUESTION

How can and does social learning facilitate or constrain the conversion of resources into functionings and new adaptation capabilities of communal farmers in Muchena village in the face of increasing climate change and associated climate variability related socio-ecological risks and vulnerabilities?

1.5.1 Sub-questions

- 1) What are the current farming practices and resources used by communal farmers? What do the communal farmers currently value as being and doing? How are they currently learning their farming practices?
- 2) How are the social learning interactions in a climate responsive community of practice (involving multiple stakeholders) currently supporting or constraining communal farmers to learn new adaptive farming practices?
- 3) Do, and how do, the learning processes and practices in the community of practice promote or constrain conversion factors (personal, social, environmental) for turning resources into new functionings and capabilities that respond to socio-ecological climate variability and longer term climate change induced risks amongst farmers?
- 4) What generative mechanisms shape the social learning and the conversion of resources into new functionings and capabilities associated with adaptive farming practices?

The research intended to contribute towards a better understanding of capabilities' conversion factors to adaptive and transformative practices as a response to climate change/variability

risks and vulnerabilities in the communal farmers through a social learning pedagogy. The research also intended to contribute to the general understanding of the underlying generative mechanisms as enablers or constrainers to shaping social learning and people's measurable functionings in the context of ESD and the ESD global action programme (GAP) and the ESD Agenda 2030 that is currently emerging as global policy for ESD. To the community of practice, the project intended to contribute to the development of agency among the community-based farmers, the agriculture extension officers, NGOs, agro-based industry, schools and in terms of my university practice in a 5.0 thrust towards ESD under a whole institution approach of the GAP. While not initially intended, the study also contributed towards another way of looking at organic standards inclusive of laboratory tests and stories by the rural poor.

1.6 RESEARCH SITE

In this thesis, social learning interactions of community-based farmers, NGOs, farmer agents, forestry agents, climate change agents and agro based industry, were studied within the context of farmers' capabilities in Muchena Village of Mutasa district of the Manicaland province of Zimbabwe shown in Plate 1.1.

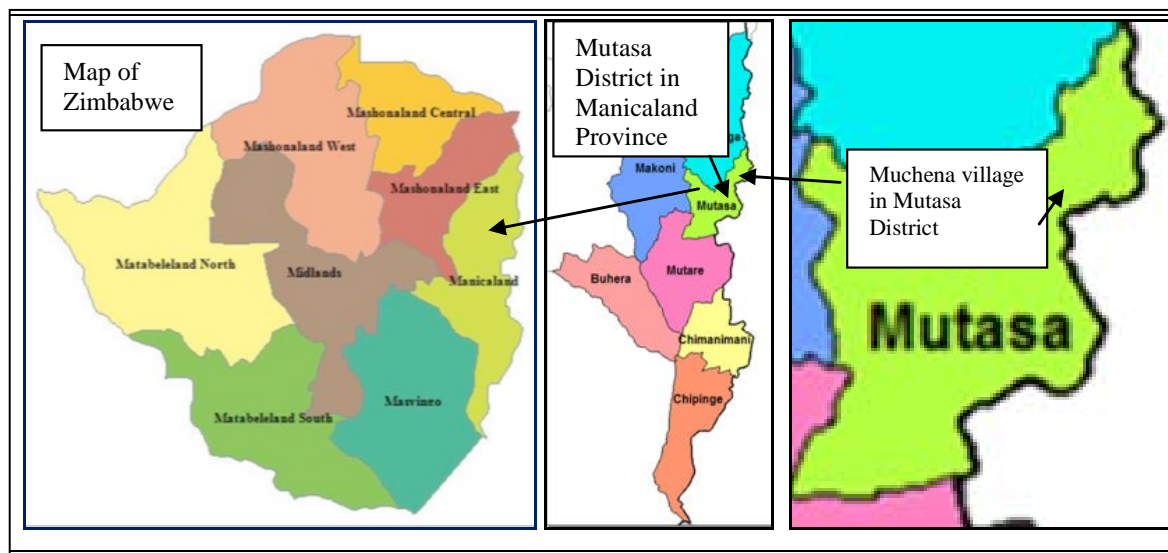


Plate 1.1: Map of the study area and its relative position in Zimbabwe

In Plate 1.1 the map of Zimbabwe is shown in the far left and at the centre is the provincial map of Manicaland where the case study is located. To the far right is an exaggerated Mutasa

district map showing the relative position of the village of study, some 16km off the Mutare to Harare highway along the Christmas Pass to Odzani road. In this case study a plate denotes a group of pictures (e.g. pictures of people, artefacts or maps that are grouped together) and a diagram, chart or single photo, is referred to as a figure. Thus the study area shown in Plate 1.1, before the modification of the agro-ecological regions of Zimbabwe due to climate change¹, can be described as located in Agro-Ecological Region One. This area of study used to receive over 2000mm annual rainfall, with cool to moderate annual temperatures due to high altitude (Unganai, 1996). Today, the region experiences less than 2000mm of rain per year with much warmer temperatures (Unganai, 1996; ZMSD, 2013). Two perennial rivers, Tsambe and Mutare, are mostly silted today due to recurring hydrological droughts. The socio-political and administrative structure of the village is as follows: the kraal head (*Ishe Muchena*) is the overall kraal head who oversees the entire village on behalf of the paramount Chief, Mutasa. The village is further divided into eight branches of approximately a hundred households (homesteads-*misha*) each, giving an estimated entire village population of close to or over a thousand households. In each branch, the households (*misha*) are headed by a *sabhuku* or equivalent of the village development committee (vidco) chairman (Nyambara, 2003) also referred to as village head in this thesis. The village development committee were given power to administer land in rural areas by the Communal Land Act of 1981 (Nyambara, 2003). Of the eight branches, this case study was purposively selected from one *Nyasukwa* named after *Nyasukwa* Mountain and headed by another of the Muchena clan. This branch had sufficient number of farmers in the different farming categories selected for the purpose of this thesis; crop and non-crop. The community leadership that is the kraal head, village head and to some extent, the ward councillor, attend and grace the village functions including those related to social learning of the community-based farmers in this thesis.

The Zimbabwean government and development partners (since independence in 1980) have always funded national projects through farming inputs and assistance during major disasters such as droughts, tropical cyclones, floods and pests. But, this kind gesture by government and development agencies might have resulted in an over dependence syndrome amongst the community-based farmers (Bauer, 2000; Ampaw, 2002; Andrews, 2009). Households raise their own means of survival since there is no monthly social grant for able bodied persons in the country. Water in the community is a free commodity, unless when it is pumped into

¹ Note that this re-zoning process was taking place during this study period.

one's yard or house by the local authority. In terms of farming practices, most households in Nyasukwa branch under study, rear cattle, goats, and chickens (road-runners and broilers²). Apart from agriculture, other informal economic activities in this village include saw-milling, carpentry, building and iron-shaping (Dirwai, 2008a).

Socially, the majority of households live in extended families (cf. Section 1.1). Such a big family set-up might enhance or constrain the farmers' collective capabilities. In terms of dwelling units, most village houses are built of brick and cement and roofed by thatch, asbestos or corrugated iron sheets. The source of lighting at night varies from old paraffin lamps, candles to cell phone torches while a few use solar power and some are connected to the national grid (electricity) (Dirwai, 2008a). Culturally, every rural homestead has a conical shaped grass thatched-roof hut that is detached from the main housing unit. Household cooking, cultural ceremonies and important family decisions³ are carried out in this round cultural hut, which in my thesis, symbolises a strong base for the *dare remusha* or for important family decisions (Layer 2 reflections) and guarded family secrets. The cultural hut thus symbolises an important space where home-grown solutions are reflected at an individual level (Layer 1 reflections) and at a family level (Layer 2 reflections) before collectively done with the outsiders (Layer 3 collective reflections).

1.7 MAPPING KEY CONCEPTS IN THE STUDY

The key terms used in this thesis are briefly introduced in this section. These key terms are organised into four main categories guided by the three main types of education in focus in this study, and the three main theoretical perspectives that underpin this study: critical realism (philosophy), social learning (educational theory) and capabilities (development theory)⁴.

1.7.1 Formal, Non-formal and Informal learning

Education is a broad and holistic process (as shown in Section 1.1) that is compartmentalised into formal, non-formal and informal modes (Swett, 1975; UNESCO, 2006; Melnic & Botez, 2014). For the individual, the three main categories of education are integrated into a life-long learning process, which attunes with the ESD Agenda 2030 aims to strengthen ESD

² These are types of chickens favoured by local people.

³ Referring to collective reflections at family level. I differentiate between Layer 1 (individual), Layer 2 (family) and Layer 3 (extended family and other community member) reflections in this thesis.

⁴ The key terms under each theoretical perspective take the format of a third level heading while its sub-categories are structured via fourth or fifth levels depending on the number of sub-categories the concept has.

within a lifelong learning framework as part of Sustainable Development Goal 4. Learning processes and theories are further explored in Section 2.4.

1.7.2 Ecologies of Knowledges

De Sousa Santos (2014, pp. 11-12) argued for an ‘ecologies of knowledge’ in his post-abyssal thinking and recognition of the existence of a plurality of knowledges beyond scientific knowledge. De Sousa Santos also argued that one of the challenges is the legacy of a situation where only the problems for which science could have an answer were deemed worthy of consideration (De Sousa Santos, 2016, p. 171). This can render knowledges from the south including those generated by community-based farmers’ social learning system as ‘non-existent’. De Sousa Santos thus recognised other knowledges such as the innovations generated by community-based farmers as also contributing to solving global challenges such as food security and climate change. In this thesis I also give special attention to knowledges and innovations from the community-based farmers.

1.7.3 Critical Realism

“Critical realism is a philosophy that underlabours scientific knowledge and partly in virtue of this, it argues more generally for practices oriented to human well-being and flourishing” (Bhaskar, 2016, p. 2). Critical realism is regarded as critical because any attempts at describing and explaining the world, while aiming for alethic truth⁵, are oriented towards emancipation (Scott, 2005). Connected to critical realism is immanent critique, dialectic critical realism, relationships and generative mechanisms, the MELD schema, RRREIC schema, abduction, abduction and abstraction, and all are further explored in more detail in Chapter Two.

1.7.4 Social learning process (SL)

Wals (2007, p. 43) argued that “social learning can be either a spontaneously emerging property of people interacting together or as an intentionally introduced and facilitated process of change that not only allows for commodities and social cohesion to form, but provides space for engaging with disagreement and dissensus”. In this perspective, community-based farmers’ social learning and participation, much like in many other social

⁵ Truth that takes ontology into account (i.e. standpoints are possible based on real reference e.g. increased drought or global warming, as experienced by farmers who may have different epistemological understandings of this reality).

learning sequential moments, depends on difference, dissonance, conflict, antagonism and more, and on convergence too. In this thesis I take social learning as a critical pedagogical process (Knowles, 1975) since it is used as lens to understand how the community-based farmers learn their practices.⁶ Social learning together with other forms of learning are explored in more detail in Chapter Two.

1.7.5 Capabilities

“The capability approach (CA) or theory (CT) is a broad normative framework for the evaluation of individual well-being and social arrangements, the design of policies and proposals about change in society” (Robeyns, 2003, p.5). Sen (1999) considered capabilities as the various functionings that a person can choose to adopt, according to her or his values in order to achieve expected lifestyles. The basic capabilities (opportunities) are **education, health, nutrition, shelter** and these may be used to show deprivation and so may be used in assessing the extent and nature of poverty in developing countries (Sen, 1999). Unlike Sen who had a list of basic capabilities, Goerne (2010) talks about capability sets which contain an individual’s capabilities, the materialised options or life chances of an individual. This conceptual distinction is based on the assumption that certain functionings are mutually exclusive, and that individuals (have to) exert choice. Central to the capability theory are the conversion factors which form the personal, environmental and social conditions or characteristics of each individual existence (Sen, 1993 and Robeyns, 2005b).

1.8 LIMITATIONS TO THE STUDY

This is a case study. Like all case studies, the study has limitations in sample size and context and hence cannot be generalised to all rural communities in Zimbabwe. However, the richness of in-depth data collection in this qualitative study and not quantification and generalisability, favours transferability. Also critical realism allows for generalisation at the level of the mechanism (Danermark et al., 2002). The study employs processes of absencing absences and social learning in looking at epistemological (knowledge) and ontological (being) realities in the farmers’ adaptive and transformative practices as realised capabilities. These can possibly be transferred elsewhere. Table 1.1 shows the Thesis Gant chart or

⁶ Social learning has been taken as a process and a methodological framework for working with farmers.

milestones, with index codes and processes being explained in more depth and detail in Chapter Four.

Table 1.1: Gant Chart/Thesis Milestones (explained further in Chapter Four)

Activity Name	Time Scale in Years								
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Contextual data, initial scoping and participant identification									
Interviews and observations with FCS 1 (VS)									
Interviews and observations with FCS 2 (BC)									
Interviews and observations with FCS 3 (Youths led by LN))									
Interviews and observations with FCS 4 (SM ²)									
Interviews and observations with FCS 5 (SS)									
Interviews and observations with FCS 6 (JM ²)									
Interviews and observations with FCS 7 (LM ²) Apiary									
Interviews and observations with FCS 8 (LM ³) Apiary									
Interviews and observations with FCS 9 (FN) For apiary and aquaculture									
Interviews and observations with FCS 10 (VC) Tree nurseries (dendrology)									
Interviews and observations with FCS 11 (JC) Tree nurseries									
Transcriptions (Explaining the main developments in the field)									
Mainly analysis writing up of the study (Mechanism and MELD analysis; Field engagement with organic accreditation system)									
Submission of full draft to supervisor and working on corrections									
Submission of Thesis for External Examination									

1.9 CONCLUSION AND SUMMARY OF CHAPTERS

CHAPTER ONE introduces the study. This is the orientation to the study, and includes contextual profiling and the research questions, purpose and an initial mapping of the key terms.

CHAPTER TWO provides an immanent critique of critical realism and capabilities theories as well as social learning process as they relate to each other. The key concepts in the two theories and in the social learning process are critiqued.

CHAPTER THREE provides the theoretical framework. Dialectical critical realism is used as lens to interrogate what and how the community-based farmers learn and transform from old to new farming practices and capabilities under social learning and as communities of practice.

CHAPTER FOUR provides an orientation to the research methodology and data management throughout the study as well as the ethical issues and how issues of credibility and transferability were dealt with.

CHAPTER FIVE provides the research findings for research questions 1 and 2. This is based on farmers' capabilities and conversion factors and contradictions or tensions as guided by the capabilities analysis.

CHAPTER SIX interrogates research findings for research question 3. The focus is mainly on farmers' social learning processes as guided by the six sequential moments of social learning.

CHAPTER SEVEN looks at critical realism's generative mechanisms and dialectical transformation for question 4. The chapter lays out the dialectical MELD schema as the analytical tool.

CHAPTER EIGHT looks at knowledge generation from the study using the RRREI(C) schema, the research summary, and reflections to the research process, outlines the contribution to new knowledge, and surfaces limitations, contradictions and needs for future research.

CHAPTER NINE provides the recommendations and the general conclusion of the study.

CHAPTER TWO

CONCEPTUAL AND THEORETICAL FRAMEWORK: CRITICAL REALISM, CAPABILITIES AND SOCIAL LEARNING PROCESS – AN IMMANENT CRITIQUE

2.1 INTRODUCTION

This chapter provides an immanent critique of, and clarifies the presuppositions of, each of the two theories – critical realism and capabilities as well as the social learning pedagogic process, as applied in this thesis. This chapter, building on the introduction to some key concepts provided in Chapter One, further interrogates and deepens understanding of concepts in critical realism, capabilities and the social learning pedagogic process as used in this study on climate change education. Immanent critique is not focussed on criticising a theories but rather, it seeks to analyse some of the presuppositions of the theories and concepts studied (Cruickshank, 2003) in order to deepen internally reflexive analysis of the theoretical perspective and its relevance in a given situation. In this thesis I do this by looking for issues that could help the concepts and theories, work better in order to bring out the community-based farmers' social learning issues and the capabilities' conversion factors for emancipatory agency. In order to elaborate on immanent critique, Bhaskar (1998), in discussing immanent critique of scientific empirical ontology had this to say:

One assumes at the outset the intelligibility of science and asks explicitly what the world must be like for those activities to be possible. This programme (immanent critique) not only yields new insight into the structure of scientific knowledge, but enables us to see the tacit presupposition (of a closed world, completely described) on which the traditional problem of its rationality was hung is inconsistent with its very possibility. (Bhaskar, 1998, p. 8)

Here Bhaskar was starting with the underlying assumptions of scientific practice, and then he used this to criticise it using these assumptions. In my study, I consider each concept and theory in this way in order to deepen my own critical engagement with each theory and its application in this thesis.

2.2 CRITICAL REALISM

In Chapter One sub-section 1.7.3, I introduced the term critical realism (CR), also well known for its role as ‘underlabourer’ for the natural and social sciences (Bhaskar, 2016), posing and answering transcendental questions about what the world and human beings must be like for science to be possible: “The background of (CR) is understood as a combination of transcendental realism, a general theory of science and critical naturalism, a special theory of social science” (Bhaskar, 2008b, p. 2). The original critical realism is a philosophy of and for the natural and social sciences which stresses the crucial role that being (ontology) plays in our understanding of how knowledge (epistemology) is possible. Critical realism has been developing for some years (Bhaskar, 1978; 1979; 1986; 1993; 2016), in response to the fundamental difficulty of maintaining a realist position in the face of criticisms of an empirical and naturalist view of science. In critical realism Bhaskar (1993; 1994) qualified the use of the word ‘critical’ by arguing that no social theory can be purely descriptive, it must be evaluative, and thus there can be no split between facts and values.

Critical realism (the way things are) is becoming influential in a range of disciplines (geography, economics, sociology, international relations) (Lawson, 1997; Reed, 2007; Layder, 1993; Archer, 1995; Sayer, 1997). Critical realism insists on the importance of ontology (being) and it maintains the centrality of an understanding of being in the natural and social worlds that “grounds, but does not guarantee, our efforts to understand the way things are” (Norrie, 2010, p. 22). Critical realism in this study allows for the examination of complex social systems in which it is difficult to isolate components and study them under controlled conditions as noted by Sayer (1997; 2000). Critical realism is thus an appropriate ‘underlabourer’ for this case study as its strength lies in analysing generative mechanisms in causal explanation and in following up connections to situate the case study within the wider context, thus illuminating “part-whole relationships” (Sayer, 2010). The defining feature of critical realism is the belief that there is a world existing independently of our knowledge of it (Sayer, 2000).

2.2.1 Critical Realism’s Three Main Domains (A Layered Ontology)

Science is seen as the systematic observation of event regularities, the description of these regularities in the form of universal laws, and the prediction of particular outcomes from the laws (Mingers, 2006). In general a realist understanding of science takes the view that

certain types of entities, be they objects, forces, social structures, or ideas, do exist in the world, largely independent of human beings; and that we can gain reliable, although not perfect, knowledge of them (Mingers, 2006). Bhaskar (1978, p. 56) argued that events must occur independently of the experiences in which they are apprehended. Structures and mechanisms then are real and distinct from the patterns of events they generate, just as events are real and distinct from the experiences in which they are apprehended. Mechanisms, events and experiences thus constitute three overlapping domains of reality, viz. the domains of the real, the actual, and the empirical. Figure 2.1 shows Bhaskar's (1978) three main ontological domains.

	Domain of the Real	Domain of the Actual	Domain of Empirical
Mechanisms	X		
Events	X	X	
Experiences	X	X	X

Figure 2.1: Bhaskar's three main domains: Populating entities

Source: Bhaskar, R. (1978, p. 13)

In Figure 2.1, critical realism distinguishes not only between the world and our experiences of it, but between the real, the actual and the empirical (Sayer, 2000).

➤ **The domain of the real**

In Figure 2.1 Bhaskar's account of cause is focussed on the role of causal mechanisms, which he identifies as part of the domain of the real (Bhaskar, 1978) and these mechanisms 'exist as the causal powers of things' (Bhaskar, 1978, p. 50). These causal mechanisms, both in their real and their actual forms, take a level-abstracted form: but they can only be applied in the actual in combination with a multiplicity of causal mechanisms from other levels of the ontological strata (ibid.). In considering actual natural and social events, Bhaskar argued that people must accept that different causal mechanisms and the interactions between them account for different aspects of the events concerned, and that no single law 'determines' the whole result (Bhaskar, 2016). Bhaskar's conceptualisation of the real includes everything in the actual, and all those events and entities that could possibly happen or exist but have not done so, the unrealised. It seems, then, that "Bhaskar uses the domain of the real to achieve at least two different things: that is: the introduction of negativity, in the shape of unrealised possibilities, i.e. events that have not actually occurred, and secondly the introduction of

transfactuality, in the shape of causal mechanisms, and by implication entity types” (Elder-Vass, 2004, p. 12). It is against this background that I could examine the development and contribution of critical realism as a significant philosophy of science able to underpin (underlabour) social learning trajectory and pedagogy and community-based farmers’ capabilities and agency (Mingers, 2006).

➤ **The domain of the actual: Events**

From Figure 2.1, the domain of the actual involves the behaviour of things, or entities (events). The events which populate Bhaskar’s ‘domain of the actual’ are downwardly-inclusive and multi-levelled and this clearly corresponds to Bhaskar’s conception of the actual as that domain of reality in which a vast range of particular causes interact to cause events. Elder-Vass (2004) also argued that the actual includes not only the events that are unobserved by virtue of the absence of an observer, but also those levels of downwardly-inclusive events that are unobserved by virtue of operating below (or above) the perceived levels of reality. While the real refers to the structures and powers of the objects, the actual refers to what happens if and when those are activated (causing events to happen), to what they do and what eventuates when they do, such as when the previously idle person does some work. Events in this thesis include the achieved functionings and new capabilities of farmers.

➤ **The domain of the empirical**

In Figure 2.1 the domain of the empirical treats the world as consisting of observable atomistic objects, events and regularities among them, as if objects had no structure or powers, and in particular, no unobservable qualities. Berkeley (1995) argued that we only actually know objects through our ideas and perceptions of them and that, therefore, is all we can actually take to exist (domain of the empirical). In the domain of the empirical, knowledge is open to the senses and can be observed by others as empirical evidence as is the case with the natural sciences. That which cannot be observed directly through instruments, ultimately cannot exist (Mingers, 2006). But, in social sciences there are certain types of entities, be they objects, forces, social structures, or ideas, that exist in the world, largely independent of human beings, and that we can gain reliable, although not perfect, knowledge of (Mingers, 2006; Bhaskar, 1978, 1979, 2010). The empirical is therefore defined as the domain of experience and while one may be able to observe things such as the structure of an

organisation or a household (the real), as well as what happens when they act (the actual), some structures may not be observable, but they exist. Observability may make people more confident about what we think exists, but existence itself is not dependent on its observability. In virtue of this, then rather than rely purely upon a criterion of observability for making claims about what exists, realists accept a causal criterion too (Collier, 1994). Realist ontology therefore makes it possible to understand how one could be or become many things which currently one is not: the unemployed could become employed (actual), the ignorant could become knowledgeable and so on (Sayer, 2010, p. 12).

2.2.2 Dialectical Critical Realism

Dialectic critical realism (DCR) is the further development of basic critical realism introduced above. In DCR, Bhaskar reworked the Hegelian dialectic, drawing on the ontology of basic critical realism, foregrounding and developing an ontological theory of absence and emergence within a constellational totality involving four moments (1M-4D) – explained below, with the dialectical emergence of agency in absenting processes, being what Bhaskar referred to as dialectical ‘pulses of freedom’ (1993). Bhaskar defined dialectic as the ‘axiology of freedom’ or:

Absenting absence; and, since all ills can be seen as absences and absences as constraints, as absenting constraints. Furthermore, since all lack of freedoms can be seen as constraints (and vice-versa), the definition of dialectic as absenting absentive agency ... (Bhaskar, 1993, p. 176)

Norrie (2010) on Bhaskar’s dialectic had this to say: “Dialectic, at its philosophical core lies a theory of absence, which Bhaskar combines with his pre-existing arguments from critical realism for the significance of ontology. This is the basis for a realist understanding of human being in society and in nature which, through the account of absence, is aligned to a theory of becoming and change in a spatio-temporal world” (p. 18). Dialectical critical realism (DCR) is envisaged to sustain the development of a general metatheory for the social sciences which would make it capable of “functioning as agencies of human self-emancipation” (Bhaskar, 2008b, p. 2). In my study I viewed DCR as the metatheory in understanding farmers’ emergent powers towards adaptive practices and how these are shaped by absences and emergence in the farming history, historical structures or farmers’ social learning structures (extension services) and other support systems. How these historical structures undermine the

present and possibly future structures and practices in a world that is socially structured and historically evolving (Norrie, 2010) is important to my study.

Being is understood not only as being open, differentiated and stratified (Basic Critical Realism) but permeated by negativity (notably absences), and temporality including change (being is spacio-temporal-causal). In DCR, Bhaskar offers four categorical moments of dialectic as non-identity (1M), negativity or absence (2E), totality (3L) and transformative agency (praxis) (4D) (Bhaskar, 2008b) and these help shape the analytical arguments in my thesis under the term MELD schema (ibid.). Real negation is “most simply first considered as the presence in some more or less determinate region of space-time that is comprising as a relational property of the system of material things, an objective referential grid of an absence at some specific level or context of being of some more or less determinate entity, thing, power, event, aspect or relation, etc.” (Bhaskar, 2008b, p. 369). On absences as presence, Collier (1998, p. 689) argued that “...we don’t doubt that magnetic fields exist though we can’t see them, since they have effects, it should not surprise us that absences can be real: the absence of vitamin C in a person’s diet causes scurvy. ... This should be noted in passing, though, that this presupposes that vitamin C is part of our necessary diet” (ibid.). Collier (1998), on the power of negative thinking, noted drought as absence of rains and also noted the effects of drought on crops and animals. Drought is a generative mechanism that emerges into adaptations (presence or positives), other ways of surviving and many other things. Drip irrigation, aqua-culture, fertility trenches and trenches for draining off flooded terrains through osmosis-pressure, can absent the absence of water for food production or constraints such as droughts (my own emphasis). Dialectic is therefore “the logic of absence-arguments, themes, perspectives, configurations” (Bhaskar, 1998, p. 614), which Bhaskar described as:

Absence → inconsistency → greater completeness

For dialectic critical realism, “non-being is a condition of possibility of being” (Bhaskar, 1993, p. 46) and dialectic is “the process of absencing absence” (ibid., p. 43). Absence is non-being or non-existence and this may refer to the absence of any entity or feature from consciousness or from a space-time region resulting from distancing or mediation, death or demise (Hartwig, 2007). I take absence in my study as constraints such as the three main capabilities conversion factors (including the latent factors) that might be absent in the physical and social space that I study, but could be present somewhere and waiting to be

activated and brought out into the physical social space that I study. Therefore in dialectical critical realism ‘non-being’ is a condition of possibility of being’ and dialectic ‘just is, in its essence, the process of absencing absence (ibid.). Dialectic becomes the great ‘loosener’, permitting empirical “open texture” and structural fluidity and interconnectedness (Bhaskar and Norrie, 1998, p. 564) through **1M**, **2E**, **3L** and **4D**. My study seeks out an emancipatory process, and to answer the question on how farmers learn new practices for food sustainability and sustainable development (key to DCR), whether or not this is directly observable in their community or if they learn it from elsewhere where it is present. But, absence cannot always be positive (Bhaskar, 2016).

2.2.3 The MELD schema

In the section above, I introduced the MELD schema under critical realism. The MELD schema consists of Four Moments or Levels of dialectical critical realism (absenting absences) (Bhaskar, 2016, pp. 112-143) or the “causal ontological axiological chain or just the causal axiological chain, comprising four degrees stadia or a measure of length (stadium). 1M being the first moment, 2E second edge, 3L third level, and 4D fourth dimension” (Hartwig, 2007, pp. 295-296).

➤ **1M Non-being**

Basic critical realism’s MELD schema is present from 1M to 4D (non-being to human agency and practice). 1M (or the first moment), being as such and in general, involves non-identity, difference and structures, it is the real as well as the actual. “1M is the sphere under which we think ontology or being as such, in particular, as non-identity” (Bhaskar, 2016, p. 125). Non-identity plays a very big role in this stadium of dialectical critical realism. Two key concepts of non-identity are those of structure and difference. **1M** analyses elementary discourse, the capacity to work and produce goods and services for ourselves as an example. “1M moment of calling: the knowledge is implicit or enfolded, and preparations can begin for learning to unfold” (ibid.). At **1M**, “understanding thrownness” (Bhaskar, 1993, p. 90) is integral to the understanding of ‘what is’ as well as ‘what is not’ (Schudel, 2016, p. 7). This includes conditions conducive or not conducive to growing food; policies and programmes that do and do not support the meeting of basic needs; and statistics and experiences of those that do and do not have their basic needs met. Exploring ‘what is not’ introduces the notion of absence in my thesis at **2E**. Therefore **1M** involves critical realist concepts such as transfactual efficacy

(effectiveness), emergence and systemic openness and these will be reworked and enhanced at 2E in light of dialectical categories such as negativity, negation, becoming, contradiction, process, development and decline, mediation and reciprocity. Thus **1M** concepts might be seen as implicitly calling for (as explicitly lacking) the dialecticisation they receive at **2E**. **1M** concepts suffice for, e.g. an adequate account of science which abstracts from space, time and the process of change which posits “principles of indifference” (Bhaskar and Norrie, 1998, p. 562). “One’s capacity at **1M** is constrained by the existence of a level that denies or suppresses it, such as the existence of class relations or gross inequalities in the distribution of resources” (Bhaskar, 2016, p. 128). Therefore, all ills including the lack of freedom are identified at 1M and reworked at 2E.

➤ **2E Absenting Absences**

The second moment of the MELD schema is **2E** (or second edge). At **2E**, begins the process of change through absenting and presencing, also generally known in dialectic critical realism, as absenting of absences that is including constraints and ills (Bhaskar, 2016). At this point I also note that the socio-historical aspects of human beings are all marked by what they lack, absence. “There is fundamental bipolarity of absence, so that negativity (or absence) is a condition of positive being, and it is this essential relationship on which dialectic, which may be diffracted into a multiplicity of modes and figures, revolves” (Bhaskar, 2016, p. 121). “...absenting or removing ideological rubbish (absences qua constraints) from the process of absenting absences (qua ills), such as removing ignorance, lack of understanding (of a particular sector or indeed the whole of reality)” (Bhaskar, 2016, p. 122). This second edge, **2E** also denotes negation and negativity, which are “... a cycle of creativity, the ‘I see it! moment’ or the ‘eureka’ moment” (ibid.).

Key to dialectic critical realism (DCR) is absence which is also essential in the analysis of any change, also called transformation. Absence therefore can be taken as the heart of existence as argued by Hartwig (2007) from the dictionary of critical realism. Bhaskar (2016) argued that absence can also be regarded as non-being, and it includes non-existence, also the outcome of a process from **1M** through **2E**. In the same book, Bhaskar (2016) reiterated that absence may also refer either to the absence of any entity or feature from consciousness or to simple non-existence anywhere any time. Thus **1M** absence is the heart of existence, 2E, absenting, is the hub of space, time and causality (Hartwig, 2007).

Absenting of constraints involves absenting absences, for example (Collier, 1998, p. 691) argued that "...if someone hasn't got a job, that is an absence; getting one would be absenting the absence; government policy may be a constraint (i.e. an imposed constraint) on that absenting; getting a different government might absent that constraint". Thus, "ills can always be seen as absences" (Collier, 1998, p. 690). On different types of absenting absences, Bhaskar (2008) also had this to say: "Sophia acts, and so absents" (Bhaskar, 2008, p. 43; Lotz-Sisitka, 2016, p. 334) and this requires reflexive situating and clarification (Norrie, 2010). In the context of my thesis study, I might consider it possible that a community-based social learning trajectory and training by government and development partners could have the power to absent ills identified at 1M such as food insecurity, lack of knowledge on climate change adaptation and lack of political will for economic empowerment. Instead of 'Sophia acts, and so absents', I might want to consider the possibility of community members acting, and so absenting ills and constraints on their freedoms and well-being. For example "...baking a potato absents a potato and eating it absents hunger" (Collier, 1998, p. 691). However, to consider this axiologically, I might want to think of absenting the conditions that create hunger (e.g. absenting poverty or climate change induced droughts) or absenting the constraints that create inequality structures in society.

Lotz-Sisitka (2016) described absences in critical realism as constraints on well-being, or ills (Hartwig, 2007; Bhaskar, 2008). She explained that in socio-environmental change contexts, absences are ills, or constraints on well-being "affecting ourselves, other living beings, and the planet" and "its immensely complex yet beautiful systems" (Lotz-Sisitka, 2016, p. 318). These may occur at sub-individual psychological levels, individual or biographical levels, or at wider social systemic and or civilisational or traditional levels (Bhaskar, 2010). Lotz-Sisitka (2016) also argued that such absences are the object of environmental education processes, as most environmental education processes seek in some way or other to 'address' such absences or ills in society, reflecting 'distinct levels of agency and collectivity with which the social sciences might be concerned' (Bhaskar and Danermark, 2006, p. 289). Therefore, taking a leaf from environmental education in which this thesis is domiciled, at the individual and/or biographical level, I consider it possible that community-based farmers' social learning may potentially absent the absence of ecologically oriented identities and practices.

➤ **3L Totalities (Axiological-values)**

The third level or **3L** denotes being (reality) together or as a whole totality which involves both **2E** plus **1M** (Bhaskar, 2016). Totalities, **3L**, is a process-in-product that is generally understood as maximised by praxis which absents incompleteness. At **3L** an absence or omission, say an incompleteness in a scientific theory, generates a contradiction, split or alienation, which can only be remedied by a resort to a greater totality e.g. a fuller, deeper, wider or more complete scientific theory (Bhaskar, 2016). **3L** thus produces new philosophical accounts of reason, rationally and phronesis (practical wisdom), which then leads to possibilities of the fourth dimension (**4D**), transformative agency.

3L, also referred to as axiological or values oriented, reflects the dialectical possibility of values shaping praxis, emerging from the values perspectives or interpretations of the researcher and that of the research participants (Creswell, 1998). Schudel (2016) viewed totality as a complex of intra and inter-relationships; hence the most important philosophical concept in her view is that of internal relations which includes knowledge of the implications of our choices for ourselves, others and the more than-human world (knowledge of what should be) (ibid.). Schudel (2016, p. 12) further argued that “3L is where, despite all the possible absencing options, it becomes necessary to engage the affective and ethical domains of human reason,” which Hartwig (2007, p. 19) described as “the seat of the moral imagination and optation (e.g. hope), issuing in values and sentiment”. Bhaskar (1993, p. 9) referred to this as the “axiological moment-valuing” where values and sentiments are communicated by “transactions with ourselves and others” (Hartwig, 2007, p. 421).

In this thesis, the community-based farmers upon reflection, for example, might at **3L**, understand that they might have a moral responsibility to feed themselves and others, and to do this without impinging harm on the environment. This catalyses other reasoning and praxis processes such as farmers potentially aligning their praxis to market forces. This might help the community-based farmers achieve this intention, and they then potentially change crop types and times to grow crops as adaptations to climate change/variability, and, to send products to market (i.e. exercising their agency at **4D** in response to axiological drivers at **3L** and absences at **2E** emerging from the context of what is at **1M**). So, totality offers a cycle of formation, the process of binding the new knowledge. “At **3L** totality involves taking two or more things together or as a whole via consideration of internal relations” (Bhaskar, 2016, p. 129). In my thesis context, emergence from what is (**1M**) and identification of absences

(2E) into totality (3L possibility) can possibly be seen if community-based farmers consider transiting from being dependent on rainfed agriculture to small scale irrigation or more sustainable organic farming methods (for instance). This might potentially then represent the moment before full transformation is realised at 4D where the actual practices of small scale irrigation use for organic farming are actualised via the farmers' agency.

➤ **4D Transformative praxis (Transformation-agency)**

The fourth dimension, 4D involves transformative praxis or agency with being (ontology-reality) incorporating transformative practice and human agency and reflexivity with consideration of 3L (totalities). Here the concept of transformative is sustainable and comes from human agency and learning and people are not coerced through punitive measures (Lotz-Sisitka, 2016, p. 321). This is viewed as emancipatory axiology's spontaneous right action. 4D is also product-in-process (Bhaskar, 2016) and can be seen as transformative agency, focussing on the capacity for practical human agency to change the world (Bhaskar 1993; Norrie 2010). 4D reflects knowledge of what real change can be achieved in context (knowledge of what can be) (Schudel, 2016), the achieved functionings (Sen, 1993; 2006; Robeyns, 2006). Schudel further argued that 4D links the onto-axiological chain where the moral relations at 3L require ultimately a 'return to practice' (Bhaskar 1993, p. 8). Upon reflection, it is the moment of deciding what to do and of knowing how to do so (i.e. it is the moment when social learning becomes meaningful and meaningfully enacted). It is the moment of engaging agency and it is the moment of real possibility in terms of 'what can be'. Lotz-Sisitka (2016) argued that the meaningful enactment of agency requires expansive learning in zones of proximal development, which link existing experience and knowledge with new praxis.

The 4D dimension of the onto-axiological chain has a strong interest in contextualisation guided by Bhaskar's (1993, p. 158) argument that: "there is no reason why a single criterion or formula applicable to every situation should be forthcoming, and that the whole point of dialectical practice is that it requires the meta-ethical virtue of phronesis (wisdom), demanding skilful application case by case". This completes the cycle of knowledge making and learning: it's possibility is inbuilt (Bhaskar, 2016). 4D therefore offers further knowledge and insight into 'reasonableness' as it encompasses "the capacity for practical human agency to change the world" (Norrie 2010, p. 12). 4D is the moment of context-sensitive transformative agency where proposed change is specific to a particular individual, group of

individuals and context (Hartwig 2007). Reasonableness at **4D** incorporates context specificity (ibid.). Here, the community-based farmers can potentially realise and actualise sustainable practices like new functionings and capabilities such as organic farming and non-crop production such as apiary and aqua-culture as alternatives to maize-crop farming and subsequently as adaptations to climate change.

➤ **Emancipation**

Emancipation is the removal of hurdles or constraints for achievement of one's goals in life and my study, with its emancipatory intentions, hinges significantly on this concept. Emancipation depends on actions and agency. Actions can therefore be activated or de-activated depending on one's characteristics also called conversion factors which are personal, environmental and social (Sen, 1993; Robeyns, 2005). Thus knowledge as emancipation is envisaged to take one from point **A** to **B** as proposed by Mezirow's (2000) and De Sousa Santos (2016) for transformation to be observed. On knowledge as emancipation, De Sousa Santos (2016, p. 220) also had this to say:

We know that any form of knowledge implies a trajectory or progress from point **A**, designated as ignorance, to point **B**, designated as knowing. Forms of knowledge are distinguished by the way they characterise both the two points and the trajectory that connects them. There is, therefore, neither ignorance in general nor knowing in general. Each form of knowledge recognises itself in a certain kind of knowing to which it opposes a certain kind of ignorance, which in its turn is recognised as such only in contrast with that kind of knowing. All knowing is knowing of a certain ignorance, as all ignorance is ignorance of a certain knowing. (De Sousa Santos, 2016, p. 221)

Thus emancipation is synonymous to transformation, the shift from non-being to being, with this state not being pre-determined, but rather contextually found and emergent, and viewed within the proviso's outlined for emancipation by De Sousa Santos above.

2.2.4 Structure

At 1M, I noted structure as part of non-being in section **2.2.3** and this can be manifested and absented at 2E. Hartwig, (2007) in the dictionary for critical realism noted on structure that science can reveal levels of structure which are knowable in the dialectic. Movement of structures may be eventually empirically identified or otherwise detected via its causal powers to effect perceivable phenomena. Structure is constituted by its causal powers which when exercised, manifest themselves as tendencies. A structure will typically be instantiated

in a multiplicity of structurata. Transfactuality in a structure is the exercise of the causal powers of structure, that is, the working of a generative mechanism such as those that manifest in the operation of all the natural laws known to science. These must be interpreted as applying transfactually, that is to say in closed and open systems alike (Hartwig, 2007; Bhaskar, 2016). The structures I engage with in my thesis are ecological, political, social, educational and training structures influencing the community-based farmers' practice, learning and agency and how these enable and disable the farmers' capabilities and functionings.

2.2.5 Agency

Agency is to act or set in motion (Hartwig, 2007). Agency is synonymous with an emergent form of causality that is human intentional causality or agency as transformative praxis. The bearers of agency are agents who can be involved in absencing absentive agency or transformative negating praxis. Agency always gets rid of an absence or presence. Archer demonstrated that the properties and powers of agency are neither pre-given nor socially bestowed, but realised through emergence from our practical transactions and relations with our natural, practical and social environment (Archer, 2000).

Like Archer (1985), Hartwig (2007) and Bhaskar (2008), Sen (2009) defines human agency as people's ability to act (emergent properties, generative mechanisms or power) in response to, or motivated by goals or concerns (Archer referred to 'ultimate concerns') that matter to them. Sen (2005) also referred to agency as primarily referring to an individual's role as a member of society and the public with the ability to participate in economic, social and political actions (Sen, 1985). Agency in the capabilities approach is therefore crucial to assess one's capabilities, allowing for an examination of whether or not economic, social, political barriers impede a person's ability to pursue substantive freedoms. It can be noted that people need the freedom to be educated, speak in public without fear, have the freedom of expression and association and so forth in order to be agents of their own lives and it is by being agents that people can establish such an enabling environment (Sen, 1985; Robeyns, 2011). Without agency, the emergence of transformation can be difficult. This study has to study farmers' agency in understanding the agential powers to shift from old to new transformative and adaptive practices and how social learning and capabilities and

functionings account for that. In this thesis I considered both individual and collective agency as enablers and constrainers of the community-based farmers' capabilities.

2.2.6 The Transitive and Intransitive Dimension of Knowledge

In critical realism, Bhaskar (1975) made the fundamental distinction between the 'intransitive' and 'transitive' dimensions of knowledge, referring to the objects of science in the sense of the things we study (that is physical processes or social phenomena) form the intransitive dimension of science (Sayer, 2000). The theories and discourses as media and resources of science are part of its transitive dimension, though as part of the social world they can also be treated as objects of study. When theories change (transitive dimension) it does not mean that what they are about (intransitive dimension) necessarily changes too: there is no reason to believe that the shift from a flat earth theory to a round or spherical one was accompanied by a change in the shape of the earth itself (Bhaskar, 2016). In this case study if new knowledge on climate change (transitive dimension) emerges and supersedes what the world already knows, it will not change climate change as a physical phenomenon (intransitive dimension). Thus, for example, the transitive view of springs (water resources) as capability commodities in this study, does not change the intransitive flow of water throughout the year as it has done for a century or more. When researchers change their minds it is unlikely to produce a significant change in the phenomena they study; there are agency-based and structural processes that need to change too for substantive physical changes to occur. The distinction between intransitive and transitive dimensions of science implies that the world should not be conflated with our experience of it, and hence that, strictly speaking, it is misleading to speak of the 'empirical world' (Bhaskar, 1975); hence Bhaskar developed a depth ontological perspective, and differentiated between ontology (realist) and epistemology (relativist), i.e. we can hold different views on the same world or phenomenon, and our knowledge of phenomenon is most often fallible i.e. it can be revised and/or improved, as science has shown over centuries.

The distinction between transitive and intransitive knowledge is important since this thesis deals with a contemporary aspect in climate change where knowledge is still evolving, where capability commodities shift in functionings due to shifts in the conversion factors or characteristics (i.e. climate change education, knowledge production and social learning) are taking place in an open system, but still have the ontological referent of 'climate variability'

as explained above which are less predictable, and more extreme. All in all critical realism has become an “encompassing theory and approach in the social sciences” (Losch, 2009; p. 86). “It is a realist approach since it is asserted that there are objects in the world, including social objects, whether the observer or researcher can know them or not” (Scott, 2005, p. 635).

2.2.7 RRREI(C)

The RRREI(C) schema is an adaptation of the scientific method that was developed for analysing scientific practice (DREIC), and was defined by Bhaskar for application to apply in research contexts such as the research in this study. This method for applied critical realist research is known as the RRREI(C) schema (Hartwig, 2007, pp. 195-196), with RRR in the applied sciences replacing D (description) in the natural sciences method of DREIC. This is elaborated further here as:

- **Resolution** is a level where the participants, after describing relevant component parts of processes, are able to compare or relate the descriptions to infer causal factors that trigger those processes or predict possible outcomes (Bhaskar, 2016; Sabai, 2016).
- **Re-description** is where one describes relevant component parts of processes in a way that makes them relevant or theoretically significant. Re-description is a component part of the events, processes or data that may be compared, contrasted or related by participants at a deeper level. This may yield some significant theoretical insight which may help them to contextualise the nature and extent of discussed issues and pave the way to make inferences back to causal factors that might have produced the events, data or processes and is also a process of retrodiction defined below.
- **Retroduction / Retrodiction** (this is similar to ‘abduction’ and in contrast to induction and deduction) is a characteristic of the realist method of science where one takes some unexplained phenomenon and proposes hypothetical mechanisms that, if they existed, would generate or cause that which is to be explained. Retrodiction is thus explaining the natural and social events by making inferences back to mechanisms that are capable of producing them. Price (2005, p. 93) noted that “**retroduction** is the inference from actual phenomena to structural causes. Critical realists also recognise **retrodiction**, as the inference from events to antecedent causes

(retrodiction presupposes retroductively achieved explanatory theories). People must often infer what might have transpired in the past to bring about the present state of the world, a task called retrodiction (Smith & Vul, undated). Retrodictive reasoning requires using information about the present to infer possibilities about a different period, but that differs in the direction of time. “Retrodiction might involve positing potential past states of the world, then extrapolate the world forward in order to determine which prior configuration is most likely to have given rise to the current state of the world” (Smith and Vul, undated, p. 1). With regard to **retroduction**, Price (2005, p. 93) noted that, “Retroduction, along with induction, is one of a group of types of inferences from observed to unobserved things. In retroduction we ask questions like: how would this be if not...? Could one imagine X including this, without X then becoming something different?” Retroduction involves counterfactual thinking where we use our stored experience and knowledge of social reality, as well as our ability to abstract and to think about what is not, but what might be (Danermark, Ekstrom, Jakobsen & Karlsson, 2005). Counterfactual thinking is fundamental in scientific practice, as we understand what something is in relation to what is not.

- **Eliminating** alternative expressions and explanations that suggest existence of confounding mechanisms (elimination), identifying correct generative mechanisms from those considered (identification), and making any possible corrections (C) through praxis, is the next step. Thus the intransitivity of real structures means that they will always have the potential for effects that go beyond us (ibid., 2005), i.e., are out of our control, and the methodology means that we should aim to eliminate alternative explanations by testing in some way for their potential effects. So the main feature of critical realist approach to science is a fundamental concern for explanation in terms of independent underlying causal or generative mechanisms which may in principle be unobservable. This is in contrast to the empiricist approach which limits itself to empirically measurable events and their abstraction into general laws; or the idealist approach that has difficulty accepting a causally efficacious ontological domain. Alternative minor causal factors, explanations or expressions have to be eliminated, leaving only those that truly explain, trigger or reflect prevailing

conditions and this is the ‘elimination’ stage or the fourth stage of the RRREI(C) model (Sabai, 2016).

- **Identification** is where the participants in the event of observations made, identify those events that are truly correct or most plausible given best efforts at retrodiction and elimination (identification). Identifying the correct or most plausible generative mechanism/s from those considered, and appropriate development of the theoretical base of the explanation is what is in focus in this stage of the scientific process.
- **Correction** – The entire process of applying the RRREI(C) model requires thorough checking of presented explanations and that possible corrections are made at every stage, to ensure that the final input truly reflects the intended objectives and the most plausible truth (Sabai, 2016, p. 187).

2.2.8 Abduction in a Critical Realist Data Analysis Process

As noted above, abduction is closely related to retrodiction and retrodution, but involves processes of recontextualisation that are important for forming retroductive hypotheses. One example of abduction from scientific enquiry noted in the literature is that: “Fossils are found, say remains like those of fishes and whales, but far in the interior of a country (like those found in the Sahara desert) or on top of a very high mountain and to explain the phenomenon, we supposed the sea once washed over this land” (Pierce, 1994, p.155; Fann, 1970, p. 21). One example of abductive reasoning from Zimbabwe is the discovery of a coin at Great Zimbabwe monument that matches those found at an old port of Kilwa in Tanzania, with the best explanation being that there used to be trade between the two states and money could have been one medium of business transaction used. Abduction is context sensitive and behaviour is accounted for rather than predicted (Fann, 1970).

Josephson and Josephson (1996) noted that abduction or inference to the best explanation is a form of inference that goes from data describing something to a hypothesis that best explains or accounts for the data. Abduction is a kind of theory-forming or interpretive inference. Inferences are movements of thought within the sphere of belief. The function of inferences is the acceptance (or sometimes rejection) of propositions on the basis of purported evidence (Josephson & Josephson, 1996). To come up with the best explanation Josephson and Josephson (1996, p. 5) said:

So, one must typically adopt strategy that avoids generating all possible explainers. Pre-screening theory fragments to remove those that are implausible under the circumstances, and makes it possible to radically restrict the potential combinations that can be generated, and thus goes a long way towards taming the combinatorial explosion.

Abduction includes the whole process of generation, criticism, and possible acceptance of explanatory hypothesis (Josephson & Josephson, 1996). On the way to a satisfactory explanation, an abductive process might seek further information beyond that given in the data initially to be explained. This process is found in both my layer 1 and layer 2 analysis where the two theories social learning and capabilities are combined to make sense of the findings through this critical realist scientific process outlined above.

2.2.9 Induction

In this study, I also use induction. I use it particularly to look at how the community-based farmers develop theory by looking at possible related events (correlations), for example as noted by Sabai (2016, p. 183): “Their inductive premise, therefore, establishes a clear correlation between rainfall and fish abundance in the mangroves”. Danermark et al. (2002) argued that induction as a process occurs when people draw general conclusions from observations of individual case stories. According to Gilbert (2008), induction is a process of finding a single case story and observing a relationship, then observing the same relationship in several more case stories and finally constructing a general theory to cover all the case stories. Induction helps us to generate theories by moving from a set of observations to a theory (Jago, 2013).

2.2.10 Deduction

While induction helps people to develop shallow theories of causal constant conjunctions, deduction helps to apply theories (Gilbert, 2008). Deduction is defined as “the process of starting with a theory and using it to explain particular observation” (ibid.). This process helps to take the data about a particular case story and apply the general theory in order to deduce an explanation from the data. According to Danermark et al. (2005), the process of deduction is characterised by two main logics, namely propositional and predictive. The former pursues a relational route (marked with words that examine the validity of a statement or argument such as ‘if’, ‘not’ and ‘or . . . then’), while the latter (predictive logic) usually

employs inferences that use words like ‘all’ and ‘no’. For example, I use an illustration from the fishing (Sabai, 2016, p. 184) context to explain how ‘predictive logic’ may be realised:

Rule: All mullet fishes visit mangrove sites (theory or position).

Case: These are mullet fishes.

Result: These mullet fishes visit mangrove sites.

Deductive reasoning deduces the ‘particular’ from the ‘general’. In other words, it starts with the general to arrive at explaining the ‘particular’. For example, in Zimbabwe traditional knowledge has it that the stacking of food by ants into holes signifies a long and prolonged rainy period that results in floods (Svotwa, Manyanhai & Makanyire, 2007). Each time ants move around stacking foods into holes, people experience prolonged droughts and flooding. The moving patterns of ants predict the coming of floods. Deductive, inductive and abductive modes of inference are found in traditional knowledges of farmers, hence I have included them here as part of the study’s modes of inference.

2.2.11 Limitations to Critical Realism

The transcendental argument for an independent, stratified ontological domain in critical realism, is regarded as the reverse of the traditional syllogism (logical argument), it goes from the agreed occurrence of some phenomena [in this case study, that is scientific experimental activity] backward to an inference about what therefore the world must necessarily be like [independent stratified ontology].

“The intelligibility of experimental activity presupposes then the intransitivity and structured character of the objects of scientific knowledge, at least in so far as these are causal laws. And this presupposes in turn the possibility of a non-human world....and in particular of a non-empirical world” (Bhaskar et al., 1998, p. 26). If ‘intelligible’ simply means understandable or explainable, then this seems quite a weak argument. Mingers questioned whether the use of the word ‘intelligible’ really implies the existence of an external world, or does it simply imply that scientists have that belief, whether or not it is actually true?

However, this is not just a constructivist argument about what scientists believe about what they are doing, but rather raises the realism of the fact that knowledge generated through experimental activity is found to hold outside the experimental situation, as testified by the enormous developments of successful technology and the wider impacts of scientific practice. ... Bhaskar’s transcendental critical realism is always contextual and directed against

particular positions, in this case empiricism and some forms of idealism, rather than being totally general, hence it is an immanent critique. (Mingers, 2006, p 17)

Such immanent critique, and methodology for achieving it is also not a ‘gold standard’ or the ‘final word’ in science or meta-theory, as recognised by Bhaskar himself. Bhaskar accepts that knowledge is temporally relative and will change, and even accepts that CR itself is only “the best explanation so far” and that the ‘transcendental consideration is not deployed in a philosophical vacuum: it is designed to situate, or replace, an existing theory; and may of course come, in time, to suffer a similar fate” (Bhaskar, 1979, p. 6).

Mingers (2006) also pointed out that methodologically, the DREIC formulation has several weaknesses. Given the acceptance of the subjectivity of the transitive domain and the theory dependence of observations, it seems unlikely that one can begin with objectives and agreed descriptions of particular phenomena. The description will already be imbued (filled) with underlying theoretical concepts and in the social sciences will also be highly value laden. This will clearly condition the forms of generative mechanisms that are postulated to explain the phenomenon and make any sort of comparison or contrast very difficult (Mingers, 2006), hence researchers working with critical realism in the social world, can only propose ‘best available’ explanations, rather than definitive explanations. Hence knowledge is always viewed as fallible and open to reflexive engagement in critical realism, thus Price (2016) proposed that researchers give attention to reflexivity in their research.

Mingers (2006) also commented on retrodution. As noted above, retrodution involves thought experiments and transfactual analysis. This itself, while demanding high levels of rigour as outlined in the RRREIC process methodology, is clearly an intuitive and creative process, rather than a purely logical one. As explained by Bhaskar (1979), retrodution as mode of inference is a necessary part of scientific endeavour, and should therefore be recognised, not hidden under inadequate assumptions of logic or empiricism. What makes it difficult to work with, especially in positivist dominated scientific arenas, is that it can result in a proliferation of possible explanations, some of which may well be untestable, or at least irrefutable. This makes explanation complex. Mingers (2006) pointed to the difficulties this poses for social scientists when he asked how the social scientist is to undertake testing that unambiguously rules out or rules in particular hypothetical mechanisms, particularly when such mechanisms may be unobservable, and their powers may be unactualised (Mingers,

2006). The RRREI(C) methodological process analysis is applied in this case study; I have tried to use it as rigorously as possible, but with recognition of these caveats which make social research complex and always fallible. In working with critical realism however, I recognise its possibilities too, considering that all in all critical realism offers “a necessary but insufficient agency of human emancipation” (Bhaskar, 1989, p.191).

Furthermore, critical realism as a metatheory of human emancipation shows the moments from non-being (1M, 2E, 3L and 4D) but does not show the pedagogic trajectory one takes from the first moment to the next as transformation emerges (Lotz-Sisitka, 2016; Schudel, 2017), although Bhaskar does recognise that learning is the ‘kernel’ of the dialectic (Hartwig, 2007; Lotz-Sisitka, 2016). Bhaskar’s views on learning focus mainly on the reflexivity of the individual, and there is need to develop pedagogical process for collective social learning in critical realism (Lotz-Sisitka, 2016). The pedagogic issues in this thesis are addressed in the next section, and via this, this study seeks to contribute to this emerging area of scholarly work in environmental education and critical realism in southern Africa (Price & Lotz-Sisitka, 2016).

2.3 LEARNING PROCESSES

In Chapter One’s section **1.8.1**, I distinguished formal from non-formal and informal learning and I introduced education as “the assembly of measures applied in a systemic way in order to create and develop the individual from an intellectual, psychic, physisic, affective, socio-professional point of view” (Melnic & Botez, 2014, p. 113). In this chapter and section I now look in detail at learning processes and how they are used in this thesis. Learning processes are powered by (1) curiosity, a basic instinct or urge (motive in Vygotsky’s 1979 terms), and (2) desire to gain knowledge/absent error (the dialectic of cognition) in order to meet wants and needs, or absent constraints (Bhaskar, 2016) or absent ills on flourishing (well-being) in Sen’s (2006) language.

2.3.1 Social Learning (SL) process

Wals (2007) argued that the idea of social learning is a bit messy in itself, as it tends to refer to learning that takes place when divergent interests, norms, values and constructions of reality meet in an environment that is conducive to learning, and learning often happens in a

community of practice (Wenger, 1998).⁷ Learning takes place at multiple levels i.e. at the level of individual, at the level of a group or organisation or at the level of networks of actors and stakeholders. I also introduced the social learning process in Chapter One's subsection 1.7.4 as a critical learning pedagogical process (Knowles, 1975) that covers how adults learn. In their introduction to the acoustics of social learning pedagogy, Wals, van den Hoeven and Blanken (2009) noted that social learning processes remind one of an improvising jazz ensemble:

Chaos frequently emerges in a (improvising) jazz ensemble, but structure rules. Everyone musician has her/his own experiences and competences, but also intuition and empathy. Leadership is sometimes essential and therefore provided by one of the musicians or a director, or it sometimes shifts and rotate. (Wals et al., 2009, p. 5)

To avoid calling everything people do together, social learning, Wals et al. (2009) referred to social learning as a special kind of learning that contributes to realising a learning society. Social learning contributes to a 'learning system' in which people learn from and with one another and, as a result, collectively become more capable of withstanding setbacks, of dealing with insecurity, complexity and risks. Such a system needs people who not only accept one another's differences but are also able to put these differences to use (Wals et al. 2009). Thus Wals et al. (2009) suggested that social learning is essentially about bringing together people of various backgrounds and with different values, perspectives, knowledge and experiences, both from inside and outside the group or organisation. Social learning is non-linear or cyclic but central to this learning pedagogy are some 'sequential moments' or activities that might be helpful when trying to design and monitor the social learning trajectory (Wals & Heymann, 2004) and these are as follows:

1. **Orientation and exploration** that is identifying key actors and, with them, key issues of concern or key challenges to address in a way that connects with their own prior experiences and background, thereby increasing their motivation and sense of purpose.
2. **(Self) awareness raising** or eliciting one's own frames relevant to the issues or challenges identified.

⁷ Communities of Practice are also characterised by shared repertoire (mutually understandable set of tools and terminologies) (Wenger, 1998), an important aspect in the current study given the emphasis on "the conversion of resources into functionings.

3. **Deframing or deconstructing** that is articulating and challenging one's own and each other's frames through a process of clarification and exposure to conflicting or alternative frames.
4. **Co-creating** or joint (re)constructing of ideas prompted by the discomfort with one's own deconstruction frames and inspired by alternative ideas provided by others.
5. **Applying/experimenting** or translating emergent ideas into collaborative actions based on the newly co-created frames, and testing them in an attempt to meet the challenges identified.
6. **Reviewing or assessing:** the degree to which the self-determined issues or challenges have been addressed, but also a review of the changes that have occurred in the way the issues/challenges were originally frames, through a reflective and evaluative process.

The social learning pedagogy trajectory of the community-based farmers in this study is thus analysed using these six sequential moments. The most important characteristics in the acoustic of social learning noted by Wals et al. (2009) have included features such as learning from each other; assuming that people can learn more from each other if they do not all think alike or act alike; in other words, people learn more in heterogeneous groups than they do in homogenous groups. Social learning is also about creating trust and social cohesion, precisely in order to become more accepting and to make use of the different ways in which people view the world (Wals et al., 2009). In this thesis, Social learning process thus implies the learning methods of individual community-based farmers together with other farmer agents, through sharing knowledge and developing a common language and a deeper understanding about their farming practice.

2.3.2 Communities of Practice (CoP): Model of Social Learning

In communities of practice as a social learning model, learning can be viewed as a journey through landscapes of practices (Wenger, 1998) and that includes shared repertoire and resources. Today the communities of practice model and concept seems to be widely used by a number of people and organisations. These various sectors focus on communities of practice as key to improving their performance (Wenger, 1998). Communities can be defined here as groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. Communities of practice can also be referred to as a social learning system (Wenger, 1998; Lave & Wenger, 1991). The characteristics of the

communities of practice concept are a shared domain (shared interest), the community itself (people of shared interests learning together), the practice (shared practice, experiences, resources etc.) and the practice, stories and resources as shared repertoire, are a source of knowing.⁸ For instance in this case study and thesis, during the Field and Demonstration Days (Field Days), the community-based farmers would ask each other how best to deal with the different pests using biological means. Where and how to sell organic products and how and where to get the tax certificates? Such questions help to build up farmers' community-based knowledge and also try to close the knowledge gap amongst the community members. The community-based farmers' communities of practice in this case are formally organised with NGOs, arms of government, university and agro-based industry, formally and informally meeting to deliberate on shared practices (adaptive farming practices) and that constitutes learning through reflection on practice (Wenger, 1998). Wals (2007) also emphasised that people learn better in groups than as individuals. In this project it is also argued that ESD is learnt better in groups since climate change issues that underly ESD in this thesis are driven by anxiety, fear and hope – fear for the consequences of unsustainable practices and an unpredictable future and hope for possibility to change (Wals, 2007) hence the need for sharing such anxiety in a group, the communities of practice. All in all, how people learn in a social group is the subject of this study and so six segments of the CoP noted before, are underlaboured by the critical realist lens of the three strata of empirical, actual and the real. The CoP framework above thus helps the study to explore how social learning can advance emancipation underpinned by shaping generative mechanisms in a dialectical movement that involves farmers absencing ills, and developing agency for change (transformative praxis).

2.3.3 The History of Farmers' Social Learning through Extension Service in Zimbabwe

In 1921 Alvord, a missionary based in Mt Silinda (Chirinda) observed that many people had come to the Before Harvest Meeting (today's Field Day) to (learn from others) observe the results of improved tillage methods. Before Harvest Meetings were meetings held alongside one of the demonstration plots prior to harvesting. At these (farmers' social learning) meetings, the results of extension methods could be examined by all farmer agents present (communal farmers and the agriculture demonstration officers). This was the birth of today's

⁸ Shared repertoire is an important aspect of the communities of practice model in the current study given the emphasis on "the conversion of resources into functionings" and so the 'resources' might form part of the 'shared repertoire' within a farmers' community of practice (Wenger, 1998).

Field Day concept which was the platform for the social learning pedagogy in this thesis. The birth of extension service in Zimbabwe as a platform for farmers' social learning, was also politically motivated to increase the carrying capacity of the reserves (rural or communal areas) through increased production (Rukuni & Eicher, 2001). The aim was to keep natives (Black majority population) satisfied in staying in the remote reserves (Kramer, 1997). By 1910 the demand for extension services gained momentum with a committee of Enquiry into African Affairs appointed under Graham, drawing attention to the need for agricultural instruction.

We recommend the establishment by government of central institutions in reserves where teaching may be given by expert instructors, not only in regard to proper methods of tillage, but also to the treatment and rotation of crops and to all other branches of agriculture (Southern Rhodesia, Debates of the Legislative Assembly). (Salisbury Government Printer, 1923 in Kramer, 1997, p. 167)

This marked the beginning of a legislated formal farmer education scheme (non-formal education). It is important to note the interest of the then government set-up in coming up with this type of a structure for the farmer education scheme. Birkhaeuser, Evenson and Feder (1991) argued that agricultural extension represents a mechanism by which information on new technologies, better farming practices and better management can be transmitted to farmers. The fulcrum of this thesis was to interrogate the type of education the community-based farmers receive from extension service and other development agencies in order to develop such practices within an emancipatory learning trajectory as argued above and in Chapter One.

2.3.4 Contradictions in Early Farmers' Social Learning in Zimbabwe

Alvord (1921) was a missionary who wanted to improve agriculture through a kind of organic farming technique and crop rotation with his argument being that such type of farming benefitted the health of both the soil and humans. The then authorities were against such a sustainable way of farming (Kramer, 1997), which today is similar to organic farming practices. Organic farming has generated increasing global interest and it is believed to produce significant social, economic and environmental benefits (Morgera, Caro & Duran, 2012). Organic agriculture, also referred to as green agriculture, apart from accounting for a large global market in billions of US dollars, can provide an additional avenue for climate change adaptation and mitigation. It is considered ecosystem-friendly because of its emphasis

on minimum tillage and reduced use of pesticides, herbicides and synthetic fertilisers (Morgera, Caro & Duran, 2012). But the then colonial government did not want to create a competent and competitive farmer out of the peasants (Kramer, 1997), hence Alvord's efforts towards conservation and organic farming were structurally thwarted. Fear existed that an adoption of improved techniques as advocated by Alvord in Mt Silinda might create a class of independent African commercial farmers who would pose a threat to White farmers who were themselves not fully established at that time (Kramer, 1997). From this literature it can be noted that the creation of a subsistence farmer who often relies on unsustainable methods of farming was structurally designed by the then corporate structures of the day. Peasants although they are small agricultural producers, also value making a living by selling part of their crops or herds (Palmer & Parsons, 1977) and these efforts were structurally destroyed as early as 1903 (Kramer, 1997).

Moyo, Mutuma and Magonya (1989) argued that history has shown that where NGOs support agriculture in Zimbabwe, it has been minimal. The NGOs seem to be concerned with more relief-oriented work rather than developmental services that can be sustainable in the long term context (ibid.). Several NGOs emphasise training as a critical component in development. What is it that the people learn from the agriculture extension agents and NGOs? In a survey report by Moyo et al. (1989) it was noted that 60% of the respondents said that the advice they needed was not forthcoming from the extension worker whilst 88% of the farmers indicated that they received advice from extension workers. The contradiction here emanated from the fact that the advice communal farmers indicated as received from extension workers was mainly on land management and high yields while farmers had their own expectations which were not met by the extension workers and NGOs. Thus, according to the programme by the extension workers (sharing knowledge on land management and high yields) was evaluated as done, but this was not all the farmers wanted. A gap can be noted in the knowledge extension service given to communal farmers against the farmers' knowledge expectations. The brief history of extension service in Zimbabwe thus was marked by a pre-determined programme that was said to be good for farmers mainly on land management and increased yields (Kramer, 1997) while the farmers had their own expectations which were not always met. Such contradictions as social conversion factors are also absences and ills to the community-based farmers' capabilities (Sen, 1993). The

communal farmers could learn practices through others during the before harvest field and demonstration days.

2.3.5 The Success of Social Learning

‘Success’ (in a social learning process) often depends on the people concerned and on the manner in which they became involved. “There are ideas regarding which direction the participants want to go and there are even recurring patterns, but the ultimate result comes about little by little” (Wals, van der Hoeven & Blanken, 2009, p. 6). The success of social learning in a society is hinged on when the society has the power to reflect and to be reflexive. A reflexive society refers to a society that has the capacity to lay existing routines, norms and values on the table, but that also has the ability to correct itself: “A reflexive society requires reflexive citizens who critically review and alter everyday systems that we live by and that we often take for granted” (Wals et al., 2009, p. 8).

Wals et al. (2009) noted that for the success of social learning when people learn from one another, the people need to realise that their various initiatives should not compete but rather strengthen one another. A reflexive society requires reflexive citizens able to participate in and contribute to processes of change (Wals, 2007; O’Donoghue, Lotz-Sisitka, Asafo-Adjei, Kota & Hanisi, 2007). The essence and success of social learning lies in people’s ability to transcend their individual frames, so that they can reach a plane where they are able to find each other and create enough ‘chemistry’ to feel empowered to work jointly on the challenges they come to share.

2.3.6 Problems when Dealing with Social Learning

The success of social learning can be threatened by space protection where people sometimes want to protect their views. Argyris (1990) argued that to prevent themselves from losing face with their colleagues or to avoid the uneasy feelings of doubt, people often ignore (unwelcome) information that collides with their views and expectations or can dismiss the information as irrelevant or false (Wals et al., 2009, p. 13). Social learning as applied in an Integrated Management (IM) and sustainable water consumption project in river basins, a European study, proved that it is not always a success. Wals et al (2009) noted on social learning that:

We learned from both cases that our platform approach (social learning) is not always the solution, and that it can even result in stagnation, ‘particularly if the

parties adopt official standpoints’, says one of the stakeholders. ‘This may be the case if, for example, there is ample consultation, but little room for concrete experiments in practice...’ (Wals et al., 2009, p.17)

Social learning is not simply introduced as a naturally occurring phenomenon but also as a way of organising learning and communities of learners (Parson & Clark, 1995). Divergence of views sometimes threatens group cohesion and that is a problem with social learning. On issues of conflict and dissonance, framing and reframing as already introduced in section **2.4.1**, Wals (2007) noted that: “Given the importance of conflict and dissonance in social learning, it is important to be mindful of people’s comfort zones of dissonance thresholds” (p. 40). Some people are quite comfortable with dissonance and are challenged and energised by radically different views, while others have a much lower tolerance with regard to ideas conflicting with their own. The trick is to be able to learn on the edge of people’s individual comfort zones with regard to dissonance: if the process takes place too far outside this zone, dissonance will not be constructive and will block learning. Put simply, “there is no learning without dissonance, and there is no learning with too much dissonance” (Wals, 2007, p. 40). “An important role of facilitators of social learning is to create space for alternative views that lead to the various levels of dissonance needed to trigger learning both at the individual and at the collective level” (Wals, 2007, p. 40). Frame awareness, frame deconstruction and reframing (Kaufman & Smith, 1999) can be viewed as central steps in social learning. People can become so stuck in their own frames or ideas, ways of seeing things, ways of looking at the world, ways of interpreting reality, such that they might fail to see how those frames colour their judgement and interaction. An important first step in social learning is becoming aware of one’s own frames. Only then can deconstruction (sometimes referred to as de-framing) begin (Wals & Heymann, 2004). Thus one cannot dismiss theories such as critical realism, social learning and capabilities on the road to social learning and emancipation and transformation. Theories such as social learning provide the base to fall back on when faced with hurdles towards emancipation and transformation in future.

2.4 CAPABILITIES THEORY

I introduced the capabilities theory earlier in Chapter One’s section **1.7.4**, as “a broad normative framework for the evaluation of individual well-being and social arrangements, the design of policies and proposals about social change in society” (Robeyns, 2003, p. 5). Sen

(1999) defined capabilities as the various functionings that a person can choose to adopt, according to her or his values in order to achieve the expected lifestyles. Capability in its broad sense refers to the set of valuable functionings that a person has effective (real) access to (Sen, 1999). A person's capability represents the effective freedom of an individual to choose between different functioning combinations, between different kinds of life, that she has reason to value. Sen (1999) identified five interconnected freedoms; namely, economic opportunities, political freedoms, social freedoms, transparency and protective security. When these basic needs and freedoms are denied or not equally accessible to all members of the populace, underdevelopment occurs (Mills, 2009). Sen (1999) introduced the basic capabilities as **education, health, nutrition, shelter** in 1.7.4 and these may be used to show deprivation and in assessing the extent and nature of poverty in developing countries.⁹ Goerne (2010) talks of capability sets which can be the valued beings and doings of an individual and these might necessarily not be on Sen's five basic list.

Achieved quality of life are the achieved functionings (from the word to function or act in a certain way) (Robeyns, 2013). Thus the capabilities theory and approach focuses mainly on what people are able to do and to be. In this context, Sen distinguished between means and what people can obtain from the means. Sen (1990) argued:

Since the conversion of these primary goods and resources into freedom to select a particular life and to achieve may vary from person to person, equality in holdings of primary goods or resources can go hand in hand with serious inequalities in actual freedoms enjoyed by different persons. (p. 115)

Sen's notion of individual freedom has two aspects, the opportunity aspect which is one's advantage over others (Sen, 1985) and the process aspect (Sen, 2002). Individual freedom takes a dual meaning in the evaluation of the freedom (choice) and ability to achieve and the actual achievement. The capabilities framework can also be viewed as the language used for the moral evaluation of social arrangements (Sen, 1993). It puts people's well-being (quality of life) central and that can be either achieved quality of life or the freedom to have a good quality life. It is about evaluating the state, it is about achievements and freedoms to achieve,

⁹ While I am aware that there are substantive debates about capabilities lists being imposed or not, as an educational study, I chose to work with Sen's approach which is to work with communities to articulate their valued beings and doings, rather than impose lists of capabilities in the research setting. My interest is in co-learning and converting functionings into valued beings and doings as expressed by the communities themselves.

it is about the ability to do different things, but not just anything, but things people have reasons to value doing them and being part of them (ibid.). These elements when put together formulate the capabilities approach. In this thesis therefore, understanding the community-based farmers' capabilities as freedoms to achieve functionings, helps in bringing out the transformative practices, learning and agency from old to new capabilities.

2.4.1 Capabilities and Functionings

Capabilities and functionings are related in the capabilities approach. Sen (1987) noted functionings as 'an achievement' and capability, 'the ability to achieve.' Robeyns (2011) viewed functionings and capabilities as the major constituents of the capability approach. Functionings and capabilities are the 'valued beings and doings' of a person, that is to say a person's capability is 'the various combinations of functionings that a person can achieve, a set of vectors of functionings, reflecting the persons' freedom to lead one type of life or another (Sen, 1992). Poverty can be regarded as capability deprivation to achieve different functionings whilst health is a capability of which poor health or lack of health facilities can deprive one the function of operating in a healthy status. Disability can also be a deprivation to one's functionings and this can go hand in hand with lack of education or appropriate education for one to function at a very high level of thinking as a deprivation. The capability approach also emphasises functional capabilities and these are understood in terms of substantive freedoms people have to value (Sen, 2005). Thus if community-based farmers for example get education in aspects they do not value (Moyo, Mutuma & Magonya, 1989) then this is a deprivation of their freedom.

Capability is therefore an approach and a theoretical framework that entails two core normative claims: first, the claim that the freedom to achieve well-being is of primary moral importance, and second, that freedom to achieve well-being is to be understood in terms of people's capabilities, that is, "their real opportunities to do and be what they reason to value" (Robeyns, 2011, p. 1). Sen argued that people have reason to value the freedom or liberty to produce, buy, and sell in markets (Sen, 1993). But, there is also need for other theories to complement the capabilities as advised by Robeyns (2013) and this brings in critical realism theory and social learning pedagogy.

2.4.2 Collective Capabilities and Agency

The capability approach does not account for how the interaction of individuals in groups generate capabilities that can enhance the fulfilment of each member in a way that could not have been achieved without the interaction (Rauschmayer; Bauler & Schapke, 2015). This shows that capabilities can be a collective venture too while capability and agency are inexplicably bound in assessing human well-being and development (Pelence, Bazile & Ceruti, 2015). Collective capabilities seek to shift the analysis of capabilities from the individual to the collective by emphasising the intrinsic and instrumental importance of social structures; and explaining the significance of collective freedoms and collective agency, and pointing out the roles of collective action, institutions and social capital in generating new collective capabilities (Ibrahim, 2006, p.398). Ibrahim further emphasised that collective capabilities can be defined as the newly generated functioning bundles a person obtains by virtue of his/her engagement in a collectivity that help her/him achieve the life he/she has reason to value. There are two main criteria that distinguish ‘collective’ capabilities from ‘individual’ capabilities. First, collective capabilities are only present through a process of collective action. Secondly, the collectivity at large, and not simply a single individual, can benefit from these newly generated capabilities (Rauschmayer et al., 2015). Collective capabilities are “those capabilities that can only be achieved socially ... as a result of social interaction” (Comim & Carey, 2001, p. 17). Evans (2002, p. 56) added that “individual capabilities depend on collective capabilities” as the act of choosing the life that one has reason to value might be a collective rather than an individual act. Sen agreed that “no individual can think, choose, or act without being influenced by the nature and working of the society around him or her” (Sen, 2002, pp. 80-84). He also explained that “the CA depends on public reasoning and democratic processes, as group-based phenomena” (Sen, 2002, p. 78). One weakness of collective capabilities is that it is difficult to assess individual wellbeing on the basis of collective capabilities (Sen, 2009).

2.4.3 Capabilities Conversion Factors

As mentioned above, an important idea underlying the capabilities approach is the conversion factors (Robeyns, 2003; 2011). There are several factors that can affect the conversion factors and these can be physical, personal and social. Physical barriers like climate change can offer barriers to what farmers like to practise and to what they value doing and being. If one is physically challenged (personal), s/he cannot fully utilise the bicycle to transport goods or if

there are no bridges to cross (physical), then the bicycle might not be a good transport system to ferry goods from one bank to the other. Social structures can be enablers or constrainers to the conversion factors. Because of this, the study looked at the conversion factors and how these enabled and constrained the community-based farmers' social learning and capabilities.

2.4.4 Personal and Latent Conversion Factors

In terms of personal conversion factors, Sen (1993) noted a bicycle as an input that needs to be converted to the function of mobility where personal characteristics like having learned to ride a bicycle before, disability, or societal norms against women riding a bicycle, play an important role in the conversion of such a commodity to the function of mobility. On latent conversion factors, Roche's 2009 study in Venezuela noted that the synergy of living in a specific geographical location (physical conversion factors) and belonging to a particular social class, age group and gender (social and personal conversion factors combined), among other social groupings, has a combined effect (generative mechanism) on people's well-being. Such a combination of factors is latent (Roche, 2009). While Sen (1993), looks at personal conversion factors as restricted to the individual, it seems he did not specify the situation the individual dwells in (latent). The completion of a certain level of education can be a latent conversion factor as it influences individual decisions to shift from old farming practices to the adoption of new farming practices. Latent conversion factors can also be viewed from an epidemiological perspective where the health status of the soil or crop can be self-perceived (Murray & Chen, 1993; Sen, 2002b) when people consider the health status of a soil or crop by looking at its physical appearance as compared to observations, when scientific methods are used (to test soil temperature, moisture content, pH, testing against heavy chemicals and so on). Self-perceived morbidity, as latent, is widely used and accepted although Sen (2002b) found it internal and a challenge to people's capabilities of health as compared to observed morbidity which is external. In Meteorology and Climatology, latent heat is that energy which is dormant but very effective (Tarbuck & Lutgens, 2003). For example the latent heat released during condensation is an important source of energy for violent thunderstorms, tornadoes and hurricanes. In this thesis latent personal factors are dormant but have great potential to influence one's agency. Depending on one's latent characteristics, knowledge of soil and crop quality can be viewed as observed morbidity of soil as well as self-perceived morbidity of soil. Self-perceived morbidity of soil is how individual farmers in this study view or perceive the health of their soils while observed morbidity of

soil is based on the scientific test results of soil properties like nutrient and pH levels that the farmers in this study got from modern or scientific laboratories.

2.4.5 Environmental or Physical Conversion Factors

Environmental or physical conversion factors emerge from the physical or built environment in which a person lives. Among aspects of one's geographical location are climate, pollution, the proneness to earthquakes, and the presence or absence of rivers, seas and oceans (Sen, 1993; Stanford Encyclopedia of Philosophy, 2011) as well as infrastructure that is the presence and absence of accessible communication, roads, rail and telecommunication.

➤ Environmental conversion factors: An immanent critique of climate change

The precursor to understanding and to studying climate change in education, is to understand the term climate itself and its basic tenets, the weather elements. In Chapter One section **1.7.4**, I referred to the term 'climate' and in this case study 'climate' or 'climate change' in particular is one environmental conversion factor that either constrains or enables the community-based farmers' capabilities. Climate change refers to a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties (the weather elements), and that persists for an extended period, typically decades or longer (IPCC, 2014). The IPCC (2016) report further reiterated a rise in global surface temperatures by 1.5°C (IPCC, 2017) and this change in climate is denoted by change in temperature which is a weather element. IPCC (2007) concluded that anthropogenic factors were responsible for the warming up of the atmosphere and subsequent climate change over the past 200 years. The same IPCC (2007) report reiterated this assertion with evidence of increased global temperatures. The IPCC report of 2014 recognises the factors outside human intervention as a natural factor to climate change working in conjunction with human factors. This makes climate change a controversial and yet evolving and quite contemporary concept and complex phenomenon.

The term climate change is often used interchangeably with climate variability. I introduced climate variability in Chapter One section **1.7.4**, as variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events (IPCC, 2014). Thus, whereas climate change is the long term change in average statistical weather patterns,

climate variability is the shorter term, such as seasonal droughts, frosts or floods that are visible to the local communities as well as the scientific world. A closer look at climate variability rather than the global climate change helped me understand the problems local communities such as the community-based farmers in this thesis face. Shifts in seasons often make planning by farmers difficult and bring uncertainty to farming as a valued practice and capability (Moss & Schneider, 2000; Manning et al., 2004; Mastrandrea et al., 2010). The purpose of this thesis chapter is to give an alternative face to the climate change/variability debate by interrogating the phenomenon not as the all-out ‘monster’ on earth, but as a physical/environmental conversion factor and generative mechanism for farmers.

➤ **Environmental conversion factors: Zimbabwe climate change adaptation and mitigation**

I hereby introduce the term ‘climate change adaptation’ as the process of adjustment to actual or expected climate and its effects (IPCC, 2014). This section thus distinguishes climate change adaptation from mitigation using examples from Zimbabwe. Adaptive needs are the circumstances requiring action to ensure safety of population and security of assets in response to climate impacts (IPCC, 2014). History shows that Zimbabweans have adapted to droughts (Beach, 1977). The crops that were commonly grown by the Shonas and Ndebeles as adaptation to the then climate variability and subsequently climate change included small grains (Beach, 1977, p. 42; Palmer & Parsons, 1977, p. 223). It is within the scope of this study to look at how farmers adapt to climate change risks and vulnerability. Such climate change adaptations amongst the farmers of Zimbabwe have included conservation farming, organic farming and introduction of alternatives to crop production such as fish pond farming (aqua-culture), bee-keeping (apiary), tree seedlings, shrubs and lawns, goat rearing and chicken rearing (Dirwai, Sibanda & Kakono, 2018). “More, adaptations in agriculture and food security in Zimbabwe have also often included the establishment of early warning systems, conducting vulnerability and adaptation assessments, improving crops and livestock for drought, soil fertility improvement and moisture conservation tween 40% and 60%” (Lotz-Sisitka & Urquhart, 2014, p. 24).

By definition, climate change mitigation includes aspects of alternate sources of green energy such as hydro-electric power and solar that reduce use of fossil fuels (IPCC, 2014). In terms of climate change mitigation, Zimbabwe has used solar power, wind power and hydro-power

in an effort to reduce the use of fossil fuels (Dirwai, Sibanda & Kakono, 2018). In this regard, Zimbabwe has developed a number of small-scale hydro-electric power points in Manicaland province's Nyanga and Chipinge districts, adding more than 35mW into the national grid. A big solar power plant was also established in the Mashonaland East province's Mutoko area, with a capacity of adding 10mW of clean power into the national grid (ibid.).

➤ **Environmental conversion factors: Contradictions in climate change debate**

Climate change can still be regarded as a contemporary a concept that is evolving and scientists still grapple with it. Proponents of climate change blame human activities for the climate change catastrophe leading to the IPCC (2007) report concluding with certainty that the global temperatures are on the increase and the reasons being attributed to anthropogenic activities. Taylor Hill (2015) even argued that the 97 % scientific consensus on climate change is wrong as the consensus is even higher, close to 99.99%, meaning that scientists were very certain about climate change. Centring discussions on whether climate change is real or not, whether or not it is caused by anthropogenic or natural factors, is beyond the scope of my thesis, but understanding the effects of observed shifts in climate is central to farmers' agency.

➤ **Environmental conversion factors: Climate change and variability in Zimbabwe**

Climate change, as an environmental conversion factor, enables and disables farmers' capabilities and functionings. Changing climate is predicted to alter the growing calendar from 2100 and this means that the number of suitable growing days will drop by 11 % on average around the world (Taylor, 2015). For the future 2050 (Davies et al., 2010) found in their analysis that the most sensitive regions to vulnerability were Lesotho, Zimbabwe, Swaziland and Malawi. Current projections for southern Africa indicate 3.4⁰C increase in annual (maximum) temperature (up to 3.7⁰C in spring (hot season in Zimbabwe) when comparing the period 1980-1999 with 2080-2099 (Lotz-Sisitka & Urquhart, 2014, p. 6, drawing on the IPCC 2014 reports). Mean minimum as well as maximum temperatures are likely to exceed those of all other regions and that might generally show warmer winters and warmer summers (ibid.). Figure 2.2 shows the national rainfall deviation 1910 to 2000.

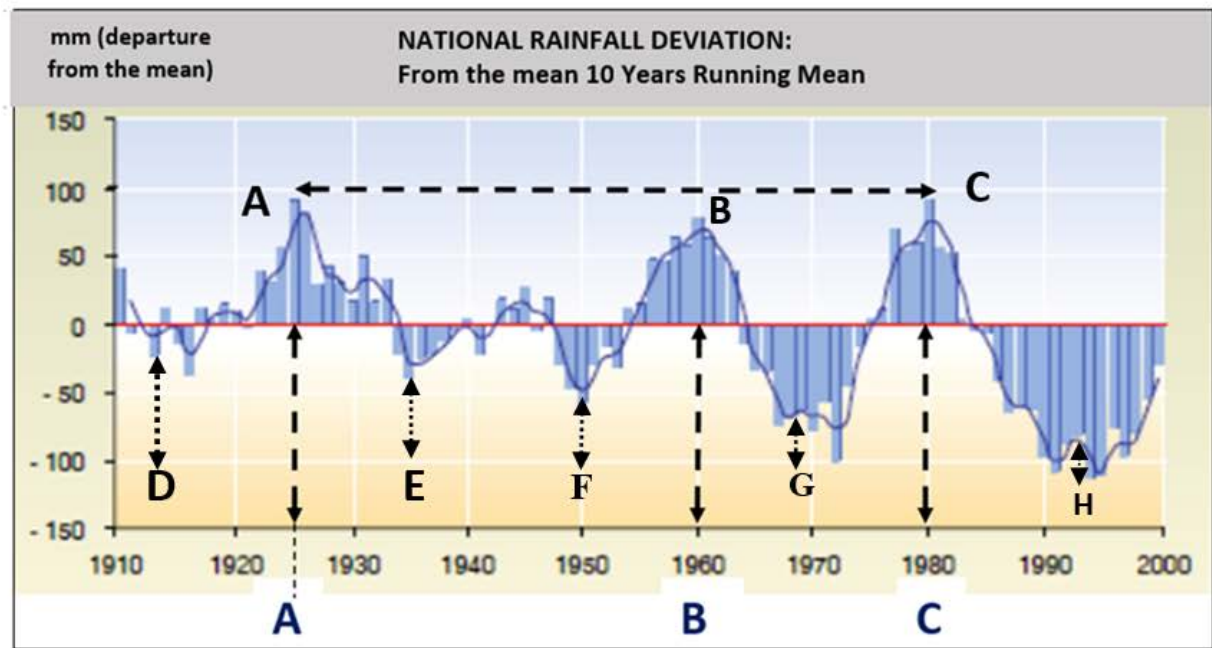


Figure 2.2: The national rainfall deviation for Zimbabwe 1910 to 2000

Source: Dirwai et al. (2018) with data from the Zimbabwe Meteorological Services Department (ZMSD, 2018)

In Figure 2.2, the vertical axis shows the amount of rain that fell in millimetres (mm) while the horizontal axis shows the time period in years. The horizontal arrows A-C shows the peak in rainfall received during that period and the vertical arrows A-C show the drop in rainfall received during the period indicated. The period 1910 to 2000 can be marked with ten years of high rainfall followed by ten years or so of droughts. Three major rainfall peaks are observed at A, B and C, that is between 1920 and 1930; 1955 and 1965; 1975 and 1985. In between are years of major rainfall deficit such as 1965 and 1975; 1985 and 2000, indicating a changing climate pattern. The deviation from the mean between 1910 and 2000 shows a decrease in rains between 1990 and 2000. This is the period that Zimbabwe began to experience the effects of climate change (Dirwai et al., 2018). The deviation from the mean between 1935 and 1955 shows a period of 20 years of major droughts and this is followed by the 1985 to 2000 and above second period of 15 years plus of major droughts. Global warming, has been blamed for the rise in mean temperature. The Global Climate Report (2017) recorded a combined global average temperature over the land and ocean surfaces for March 2017 as 1.05°C. In Zimbabwe, a general increase of temperature has been observed through a decrease in the number of days with a minimum temperature of 12°C between 1950

and 1990 and an increase in the number of days with a maximum temperature of 30°C within the same period. The observed trend of annual average maximum and minimum air temperature shows an increase of 3 and 2 (min and max) degrees Celsius respectively in the past 100 years according to the Zimbabwe Meteorological Services Department (ZMSD, 2010). In Zimbabwe cyclonic activities and floods have increased in occurrence since the year 2000 with Chivi, Mberengwa and Muzarabani districts, severely affected (ZMSD, 2013). In terms of agricultural output, Mazvimavi (2010) argued that climate change/variability exacerbates the fall in agricultural produce in Zimbabwe. Climate change in Zimbabwe is also contributing to a decrease in hydrological water supply as rivers become seasonal and the physical landscape becomes degraded (Mazvimavi, 2010).

Zimbabwe like other countries in southern Africa experienced a surface temperature increase of 0.4°C since 1900 and rainfall declining by 5% during the twentieth century with the driest years being experienced in the 1990s (Southern African Risk and Vulnerability Report, 2012). “The timing and amount of rainfall received in southern Africa, Zimbabwe included, are becoming increasingly uncertain, with the last 30 years having shown a trend towards reduced rainfall or heavy rainfall and drought occurring back to back in the same season” (Lotz-Sisitka & Urquhart, 2014, p. 22). Future scenarios have predicted increases in global mean temperature of between 1.3°C and 4.6°C by 2100, representing global warming rates of between 0.1 and 0.4°C per decade. Zimbabwe, because of its continental interior position, is projected to warm more rapidly in the future than the global average. Research in Zimbabwe has also revealed that “over five million Zimbabweans live in semi-arid zones, and will suffer disproportionately from the emerging impacts of climate change and variability including disasters associated with extreme weather events such as droughts, periodic flooding, disease outbreaks for both human and livestock and loss of crop lands” (Lotz-Sisitka and Urquhart, 2014, p. 23).

➤ **Environmental conversion factors: Different types of droughts in Zimbabwe**

Three types of droughts affect farming in general and the community-based farming of Zimbabwe cannot be an exception. Meteorological drought is one that is determined by a deviation in what is considered as average or normal rainfall. This type of drought is characterised by a long period of time even years. Hydrological drought is experienced when rainfall shortage impacts negatively on water bodies such as a fall in dam levels, a fall in the

water table or a fall in stream-flow. Hydrological drought affect irrigation facilities as water levels are low. Such a drought lasts until there is recharge in the water system. It can take a few weeks or even years before rivers, streams, dams and underground water sources are recharged. Lastly, agricultural drought is a combination of factors from meteorological and the hydrological droughts as these impact on agricultural activities. Agricultural droughts are characterised by a lack of water when it is needed most by crops and animals. It can be temporary lasting a few days or weeks until rains are received or it can be a long period and results in the death of crops and animals (<http://www.drought.unl.edu/whatis/concept.htm>). It is this agricultural drought which has negative impacts on rain-fed farming; even if it is temporary (3-4 weeks) it can have devastating results as it can completely destroy crops due to moisture stress. A farmer who has some form of irrigation as a stop gap measure to replenish hygroscopic moisture, can pull through agricultural drought spells until the rains come using irrigation facilities or though she too can be affected by hydrological and meteorological droughts. This thesis thus looks at the community-based farmers' innovations in coming up with new functionings in water harvesting and moisture conservation to adapt to the different types of droughts. Delay in onset rains (beginning of farming season) exacerbates the situation of droughts in Zimbabwe (Mawere, Madziwa & Mabeza, 2013; Zimbabwe Meteorological Services Department, 2013). I explored in this thesis droughts as an environmental conversion factor that enhances or constraints farmers' capabilities and measurable functions.

➤ **Environmental conversion factors: Contradictions from recommended adaptations**

Many people in the United States of America who buy organic food insist that the food tastes better than factory-farmed meat or chemically-treated fruit and vegetables (Gray, 2015). Gray went on to explain that scientists suggest that new research shows that industrialised organic farming has the potential to harm the planet. As the growing demand for organic products in shops is realised, so is the increase in greenhouse gas emissions from each acre of land that is farmed (Gray, 2015). Although the results have been derived from correlational tests and not from detailed issues of causation, it is important to note that more research into organic farming (environmentally friendly or green practices) is still to be done. McGee (2015) found out that due to cutting corners, use of watered down or ignored organic practices or standards, the move towards corporate organic farming operations has led to intense levels of greenhouse gas emissions, producing a paradox in its intent and outcomes.

The study by McGee (2015) argued that small scale organic farming was sustainable but large scale commercial organic farming was not (Gray, 2015). However, even here, there are contradictions. For example, in my study area, contradictions from small grains included pearl millet (bulrush millet) also known as *mhunga* in the Shona language in Zimbabwe (FAO, 1995) being culturally unaccepted in Mutasa district (Pesanayi, 2007). Thus while such a small grain can be recommended as a good adaptation strategy for food security and animal feeds, culture as a social conversion factor, constrains its production. Organic farming is also evolving and often surrounded with contradictions but its benefits to the health of the soil and that of people cannot be overestimated. Organic farming is often characterised by the absence of the use of artificial fertilisers, pesticides and herbicides. These are seen by the absence of heavy and toxic metals from the soils and from the crops. The following are types of heavy metals often found in nature and their effects on people's health.

- **Arsenic** is the chemical element of atomic number 48, an element found in nature, and in man-made products, including some pesticides. Low levels of arsenic are found in soil, water and air. The element is taken up by plants as they grow and this means that arsenic makes its way into our food. Arsenic compounds, such as Paris green, calcium arsenate and lead arsenate, are often used as insecticides and in other poisons. The lethal dose of arsenic in humans is 2-20 mg/kg, or 140 to 1400 mg for an average-sized adult. A 140-mg potentially lethal dose is the same as 0.145 grams. Less than 1/8 teaspoon can be fatal to a healthy adult, while even less could kill a child, an adult with impaired health, or an elderly person. The organs of the human body that are usually affected by arsenic poisoning are the lungs, skin, kidneys, and liver. Other effects may include darkening of skin and thickening of skin. Chronic exposure to arsenic is related to vitamin A deficiency, which is related to heart disease and night blindness (<https://www.livescience.com/29522-arsenic.html>). The absence of arsenic compounds in peas tested might suggest zero use of pesticides and indicate that the crop is organic.
- **Cadmium** is the chemical element of atomic number 48, a silvery-white metal (<https://www.merriam-webster.com/dictionary/cadmium>). Cadmium is a toxic bluish-white malleable ductile divalent metallic element used especially in batteries, pigments, and protective platings. Food vegetables, like potatoes and leafy vegetables, and cereal grains grown in contaminated soils with high levels of cadmium may

contain small amounts of cadmium (Ibid). "Eating food or drinking water with very high levels can hurt the stomach, causing vomiting or diarrhoea and being exposed to lower levels of cadmium over a long period of time can cause damage to kidneys, lungs and bones and cadmium may cause cancer" (<https://education.jlab.org/itselemental/ele048.html>). Cadmium like arsenic is a poisonous metal that can be found in foods and has the potential to harm people's bodies. The absence of such a metal in the crop produced by community-based farmers can be a sign of a healthy product produced under organic conditions.

- **Chromium** is a chemical element of atomic number 24, a hard white metal used in stainless steel and other alloys and in electroplating (<https://www.merriam-webster.com/dictionary/cadmium>). "Large doses of chromium in supplement form can cause stomach problems, low blood sugar, and kidney or liver damage. Chromium VI is the most dangerous form of chromium and may cause health problems including: allergic reactions, skin rash, nose irritations and nosebleed, ulcers, weakened immune system, genetic material alteration, kidney and liver damage, and may even go as far as death of the individual" (<https://www.medicalnewstoday.com/articles/288177.php>). Chromium can be dangerous to people's health and to the environment and its absence in the crop produced by community-based farmers can be a good sign of healthy soils and healthy food.
- **Lead** is amongst the group of heavy metals that are bad for people's health. Lead poisoning is a medical condition in humans and other vertebrates caused by increased levels of the heavy metal lead in the body. It interferes with the development of the nervous system and is therefore particularly toxic to children, causing potentially permanent learning and behaviour disorders (<https://www.thoughtco.com/definition-of-heavy-metal-605190>).

Apart from heavy metals, there are other environmental parameters such as soil pH, organic matter, nitrogen, potassium, zinc, manganese, copper, nickel, iron and phosphorus which are needed in the soil for healthy organic crops. Good farming practices include laboratory testing for soil quality.

2.4.6 Social Conversion Factors: The Farmers' Socio-Political Deprivation in Pre-Colonial, Colonial and Post-Colonial Zimbabwe

Social conversion factors are also an important dimension of converting resources into achieved functionings. In this section I look at literature on political structure as a social conversion factor constraining or enabling the community-based farmers' functionings in pre-colonial, colonial and post-colonial Zimbabwe. I have referred to the pre-colonial and the colonial era of Zimbabwe in sections 2.3.3 and 2.3.4. Palmer and Parsons (1977, p. 223) noted that "the rainfall of Rhodesia (Zimbabwe), 65% is wasted in runoff and the majority of the soils being sandy of a product of quartz, are easily erodible". This means that in the reserves where the majority of Black farmers were pushed into by the colonial authorities (socio-political structure), much work had to be done by the farmers on soil enrichment before competitive farming was achieved. This led to the employment of land management skills through conservation farming practices (Moyo, Mutuma & Magonya, 1989). Emphasis was to conserve the environment so that the natives remain satisfied with the space that they had. In terms of income from farming, the Shonas in 1903 could afford paying taxes through the sale of foodstuffs and cattle rather than by becoming migrant labourers on mines (Palmer and Parsons, 1977). Palmer and Parsons (1977, p. 230) thus quoted Lawrence Vambe (1972, p. 176) who said:

Now that my people were under foreign rule, they believed even more firmly than they had before that self-sufficiency in their own food supplies was essential to their limited freedom. As long as they grew enough food for themselves they were spared the humiliation of working for White men. (Palmer, 1977, p. 230)

In terms of farmer support, after 1908 the European agriculture in Zimbabwe (then Rhodesia) was "heavily subsidised while that of Africans was utterly neglected, potential White farmers received training upon arrival on the farms and they also received bank loans and many other extension services were at their disposal" (Palmer, 1977, p. 243). In the financial year of 1940-1941 a total of £14,107 (6.8% of total Vote) was for the development of agriculture in the Native reserves as compared with £208,217 provided in the Vote for European agriculture (Palmer and Parsons, 1977, p. 243). Thus by the end of the 1930s the agricultural economy of the Shona and the Ndebele had been disabled by the then political structure, a social conversion factor. This was viewed by Phimister (1977) as structural underdevelopment of the colonies. Arrighi (1931) in Palmer and Parsons (1977) further reiterated that in 1903 some 70% of African cash-earnings had come from the sale of agricultural produce and by

1932 (after Africans were pushed into reserves and were exposed to various taxes) the proportion had slumped to below 20% (Palmer and Parsons, 1977, p. 143). Palmer and Parsons, quoting Carbutt (1931), noted that:

From the Natives' personal point of view, the situation is very harassing; he cannot sell cattle; he cannot get cash for his maize....and he has great difficulty in obtaining employment, and when he does get it, it is at a reduced rate of pay. (1977, p. 243)

Thus the reserves were no escape, even though one did not have to pay rent or grazing fees, the Blacks could not market their products. Alvord, in Palmer and Parsons (1977, p. 243), explained it as follows:

...the greatest handicap to our efforts to introduce better methods of tillage among reserve Natives is the lack of marketing facilities. In many areas it is impossible for Natives to sell for cash, and they are forced to take salt or cloth for their grain, or they cannot sell it at all...(this) imposes a hand to mouth existence upon him under which he cannot progress.

Kramer (1997) noted that the indigenous Black farmers sold a good deal of meal to those working on the mines in the year 1903. Learning about markets was mainly by observing the demands and taste of the neighbourhood. Kramer (1997) noted that the coming up of peasant farmers into the maize market equation was a direct threat to the settler farmers who wanted to enjoy the monopoly of that market. Because of this foreseeable threat, the peasant producers were later driven out of market agriculture through the reserve policy which required that more land, especially near the rail transport system, had to be allocated to the White settlers (Kramer, 1997). This meant that the majority Black farmers were pushed to reserves that were too remote from markets and away from the railway, making it expensive and impossible to bring products to the markets. Consequently, maize crop production declined due to costs involved in attempting to market the produce in the 1920s. Quoting the Report of the Native Commissioner of Umtali (Mutare) for the month of November in 1907, Phimister spoke on market constraints:

A native is handicapped to a considerable extent in the sale of his produce; not having as yet adopted any other means of transport than the old fashioned 'pakamisa' (i.e. carrying on human head or shoulder), they are obliged to sell their grain to traders who make a double profit, viz. on the goods and on the grain, and have also to pay transport to the place of consumption. (Phimister, 1977, p. 261)

The opening up of railway transport in 1902 and 1903 that bypassed the Native reserves was a major element that affected the ultimate underdevelopment of the peasant sector in the

Victoria (now Masvingo) district (Phimister, 1977, pp. 262-263). In this thesis a move that deprived the peasants of markets, is viewed as a social conversion factor (political structure) that still (2018) constrains the community-based farmers' practice. Thus the political structure, for over hundred years, designed a subsistence farmer in the community-based farmer. From the literature I interrogated, the issue of a structurally designed (Cruickshank, 2003) deprivation of the Black farmer from lucrative markets was a product of policies of the 1900s (socio-political conversion factors). This continuous repressive policy seems to have been accepted by Black farmers as the norm for over a century since they have remained subsistent even today (2018). Thus Sen (1993) understood poverty as a deprivation of one's freedom and capabilities to a good life while he views development as capability expansion. It can further be argued from this literature that the introduction of cash crops (Rukuni & Eicher, 2001) during the colonial era, with the emphasis continuing 38 years after independence (1980), somehow might have exacerbated people's poverty and threatened food security and nutrition as most people ventured into cash crops and not food crops, especially tobacco and cotton. The cash crops were also subjected to changing market forces (Harvey, 2005).

Whilst pre-colonial and colonial agriculture in Zimbabwe was marred by structures that often disabled the communal farmer from practicing her farming capabilities, the situation did not change much in post-colonial Zimbabwe. The newly resettled farmer under the fast track land reform of the year 2000 has failed to get enough government support in trainings and bank loans as was the case during the colonial era (Scoones; Marongwe; Mavedzenge; Mahenehene; Murimbarimba; & Sukume, 2010). Apart from the land reform being blamed for parcelling land to cronies of government officials (Ibid, 2010) the incapacitation in terms of farming knowledge, irrigation and marketing, of the newly resettled farmer under the fast track land reform programme, led to poor yields (Scoones; Marongwe; Mavedzenge; Mahenehene; Murimbarimba; & Sukume, 2010). Climate change also exacerbated the poor equipping of the newly resettled farmers and the situation led to poor harvests and underutilisation of land for two decades now. Some newly resettled farmers were found to be doing well in small business ventures like running butcheries, bottle stores, hammer milling, and being involved in the manufacturing of door- and window frames (Ibid, 2010). Such small scale business ventures offered services to the farmers but could not directly be attributed to increased yield-outputs in crop and animal husbandry. The technical farming

knowledge offered by the post-colonial government extension service as well the technical service from NGOs, has not all been congruent to farmer needs and demands (Moyo et al, 1989). The technical advice that the newly resettled farmers indicated as received from extension workers was mainly on land management and high yields while absent were solutions to address contemporary challenges that the new farmer faced, that of climate change, water harvesting mechanisation for irrigation as well as marketing (Moyo et al, 1989). This shows that the small scale farmer has always been deprived during the pre-colonial era, the colonial era as well as during the post-colonial era.

2.5 NON-CROP FARMING ACTIVITIES AS CLIMATE CHANGE ADAPTATION

On page 1 of the first chapter of this thesis, I introduced community-based farming as agricultural activities [cropping and non-cropping including husbandry and horticulture] within the communal areas or communal lands. By non-cropping I refer mainly to non-maize cropping. I further categorised the community-based farming activities in this thesis as crop and non-crop farming in the last paragraph of the research site section **1.7**. This section provides an immanent critique of the literature on the non-crop farming as part of the environmental and social conversion factors as noted in section **1.7.4** and also in sections **2.4.4** and **2.4.6**. Non-crop farming is alternative to maize crop farming and so is part of climate change adaptation practices (Dirwai et al., 2018).

2.5.1 Farmers' Knowledge of Aquaculture as a Social Conversion Factor

By definition, aquaculture is the farming of aquatic organisms, including fish, mollusks, crustaceans and aquatic plants (WRC Report, 2010). Knowledge of aquaculture, apart from it being a social conversion factor, gives the community-based farmer an alternative to maize crop farming and so I classified it under climate change adaptation. In 1999, for example, the contribution of aquaculture in sub-Saharan Africa to the total world aquaculture production was less than 1% in terms of tonnage produced (ibid., 2010). In areas such as the Philippines and Indonesia, China, Vietnam and Israel (mainly desert), aquaculture now produces fish consumed locally and for export. The fish sector is a source of income and livelihood for millions of people around the world and in 2007, fish accounted for 15.7% of the global population's intake of animal protein and 6.1% of all protein consumed (FAO, 2010). But the poor from the less developed countries seem to be lagging behind in recognising fisheries as

an income generating capability. Thus, Britz (2015), writing on the history of inland fisheries in South Africa, noted that:

the small-scale fishers were poor, but their livelihood strategies were diverse, ranging from a primary livelihood of last resort, to being part of a commercial accumulation strategy and in certain localities, a significant daily income was generated covering family living costs, but, value chains were short with no evidence observed of post-harvest value addition. These are constraints associated with small-scale fish farming.

There are many forms of aquaculture that produce a marketable commodity that is not eaten; pet ornamental fish kept in home aquariums, for example, the money from which could be used to purchase food. Apart from ornamental fish, marketing of fish goes beyond the selling of mature fish to fingerlings that are sold to fish farmers as ‘seed’. Thus fish can be a good source of income provided the farmer is trained in market capabilities inclusive of the knowledge of marketing itself. Knowledge as social conversion factors also extends to include understanding the environmental conversion factors (Sen, 1993) that could be considered for the achieved function of aquaculture. These are water and water temperatures and food availability. Zimbabwe’s regions are generally warm throughout the year, and such environmental conversion factors are good for tilapia production, tilapia thrive in warm temperatures of middle to upper twenties (WRS Report, 2010). The feeding of fish has to be timed and closely monitored. It is also believed that fish normally recognise the faces of their owners especially those who feed them (FAO, 2009) and so it is good to have familiar faces to consistently do the feeding in order to forge a good relationship with the fish. Therefore the knowledge of aquaculture is one social conversion factor needed by farmers to convert to the new functioning and adaptation to climate variability and as an alternative to maize crop farming [aquaculture as a possible income generating activity and livelihood]; thus I studied it in this thesis.

2.5.2 Farmers’ Knowledge of Apiary (Bee-Keeping)

An apiary is a place where small groups of beehives are kept (Gregory, 2011). This is a climate change adaptation option, and an alternative to maize crop farming, that small-scale farmers can engage in (Dirwai et al., 2018). Knowledge of apiary, like aquaculture, is shared socially within the communities and such knowledge is also referred to as a social conversion factor in this thesis. As a social conversion factor, knowledge of apiary can enable or disable the farmers’ shift from climate change affected rainfed crop agriculture to alternative

functionings (Dirwai et al., 2018). It is also accepted that social learning about beekeeping can offer people in rural villages an alternative way of generating additional income (Gregory, 2011) and when taken as serious business, beekeeping can be a multi-billion pound global industry (Cramp, 2008): “In 2017, the world traded over 700 000 tonnes of natural honey valued at over US\$2.3billion. The USA alone imported around 200 000 tonnes of honey, while Germany imported 80,500 tonnes” (Vinga, 2019, p.2). Moreover, bees help improve farmers’ crop yield when the bees pollinate their crops and fruits (Cramp, 2008) and in areas adjacent wildlife reserves, ‘bee-hive fences’ are used to deter elephants from damaging farmers’ crops (King, 2009). “Organic honey standards in beekeeping states that the siting of apiaries, should be within a radius of 3km away from sources of contamination as guided by the European Regulations” (Cramp, 2008, p. 265). Apiary is one of the three non-crop farming practices that has been looked at under social conversion factors (Sen, 1993) in this thesis.

2.5.3 Knowledge of Dendrology [tree and shrub nurseries, a branch of botany]

Tree nurseries are another climate change adaptation (alternative to maize crop farming) and social conversion factor in addition to aquaculture and apiary previously discussed in this thesis. Trees and shrub nurseries (dendrology – a branch of botany) play an important role in agroforestry and in the socio-economic development of communities (Mbora, Lillesø & Jamnadass, 2008; Dumroese, Landis & Wenny, 1998). In Zimbabwe Statutory Instrument 116 of 2012 requires that tobacco farmers, for instance, grow woodlots of fast growing trees, for example eucalyptus, for use in curing their tobacco crop instead of using the slow growing indigenous trees. The environmental conversion factors to consider for a community-based tree nursery establishment include: a microsite [planting areas where conditions favour seedling survival and growth] (Dumroese, Landis & Wenny, 1998, p. 47) with a reliable supply of water. Tree nurseries are one of the three non-crop farming activities that have been studied in this thesis under social conversion factors (Sen, 1993). As a climate change mitigation, trees have been removed as a mitigation mechanism (IPCC, 2014). The colonial history of tree production in this country was marred by deprivation as the then White settlers did not allow the Blacks to plant or transfer exotic trees such as the eucalyptus family (Moyo, O’Keefe & Sill, 1993). Thus exotic tree plantations were a privilege of the minority White Settlers then and such post-colonial socio-political conversion factors could still constrain the communal farmers’ new capabilities in dealing with exotic trees.

2.6 KNOWLEDGE OF SMALL SCALE INNOVATIONS: SOCIAL CONVERSION

The concept of small-scale innovations has been introduced in Chapter One under ecologies of knowledges. Hoppers (2017, p. 3) on innovations argued that:

once we begin to see innovations differently, innovations would then go beyond the formal systems of innovation done in universities and industrial research and development laboratories, to innovations from below by which is meant, taking into account the full participation of all producers of knowledge including those in informal settings of rural areas.

This begins to sound like home as the knowledges that are generated from the community-based farmers in this study would also be recognised as ‘global knowledge.’ But to have community-based farmers’ innovations regarded as real knowledge, Freire (1970) recognised this as the challenge of who names the world. To this, Freire had a response:

Dialogue cannot occur between those who want to name the world and those who do not want this naming, between those who deny other people the right to speak their word, and those whose right to speak has been denied to them. Those who have been denied their primordial right to speak must first reclaim this right and prevent the continuation of this dehumanising aggression. (1970/1996, p. 62)

:

The problem with the knowledges of the south including the community-based farmers’ knowledges and unheralded innovations in this thesis, is how to make them be recognised by others and by themselves. Literature argues that the higher the physical, technological, market, or socio-economic stress, the greater the probability that disadvantaged communities and individuals generate innovative and creative alternatives for resource use (Gupta, 1988; 1991). In this section I therefore looked at small-scale innovations as other knowledges from the south that the north might want to embrace as part of ‘real’ knowledge on climate change adaptation and mitigation.

2.6.1 Innovations in Water Harvesting Techniques for Community-Based Farmers

Collins (2001) defined rain water harvesting as the collection and/or concentration of runoff water for productive purposes. Denison, Smulders, Kruger, Ndingi and Botha (2011) noted that more than 16 water harvesting techniques can be adapted by small-scale farmers such as the community-based farmers studied in this thesis. Two main types of water harvesting techniques are in-field and ex-field. In-field is where water harvesting is done in the crop field while ex-field is where water is harvested elsewhere and then channelled into the field. Diversion furrows are one ex-field water harvesting technique where rain water ‘surface

runoff' is diverted into water reservoirs where it is later used for farming purposes (ibid.). Fertility trenches of one metre depth filled with bio-degradables such as grass, maize stalks, tree leaves and many others, are another source of moisture conservation (Denison et al., 2011). Deep contours that conserve water and irrigate crops through capillary moisture are yet another water harvesting technique used by farmers (ibid., 2011). The use of 'anaerobic' (liquid manure) methods is another innovation recommended for soil environmentally friendly enhancement by Scott and Brutsch (2008). Based on observations from this literature I also looked at the types of innovations the community farmers socially learnt in a community of practice, liquid manure included.

2.7 CONCLUSION

This chapter looked at the immanent critique of the two theories and the social learning pedagogy and process used in this thesis. These are dialectical critical realism and capabilities theories as well as the social learning process. Dialectical critical realism or absencing absences is a transformative theory and a necessary underlabourer to community-based farmers' social learning process and transformative practices involving the translation of their resources into functionings and new capabilities. Critical realism in turn explains the need for differentiating ontology and epistemology, being and becoming, while capabilities theory helps one to see how learning is related to agency via the transformation of resources into functionings in the context of what the farmers, value being and doing. I argue for a combination of two theories and a pedagogic process given the complexities being faced by Zimbabwean farmers economically and politically, but also in the context of climate change challenges which are emerging rapidly. From the literature reviewed, climate change is found to be evolving and the transitive and intransitive dimensions of that concept have been critiqued. The different learning practices by farmers have been reviewed from the pre-colonial, colonial and post-colonial phases, showing deeply rooted structures that could enable and disable farmers' capabilities and functionings. Moreover, not all that the extension officers taught the community-based farmers was congruent with the farmers' needs. The next chapter looks into how the conceptual and theoretical frameworks presented in this chapter were worked with to guide the methodological and analytical framing of the study.

CHAPTER THREE

THEORETICAL AND ANALYTICAL FRAMEWORKS

3.1 INTRODUCTION

This chapter further considers the two theories, critical realism and capabilities as well as considering the social learning process. The three guided the study, from a methodological and analytical point of view. Dialectical critical realism is the general meta-theory while capabilities theory and the social learning process are the specific theory and the learning domain, respectively. Figure 3.1 summarises the theoretical framework.

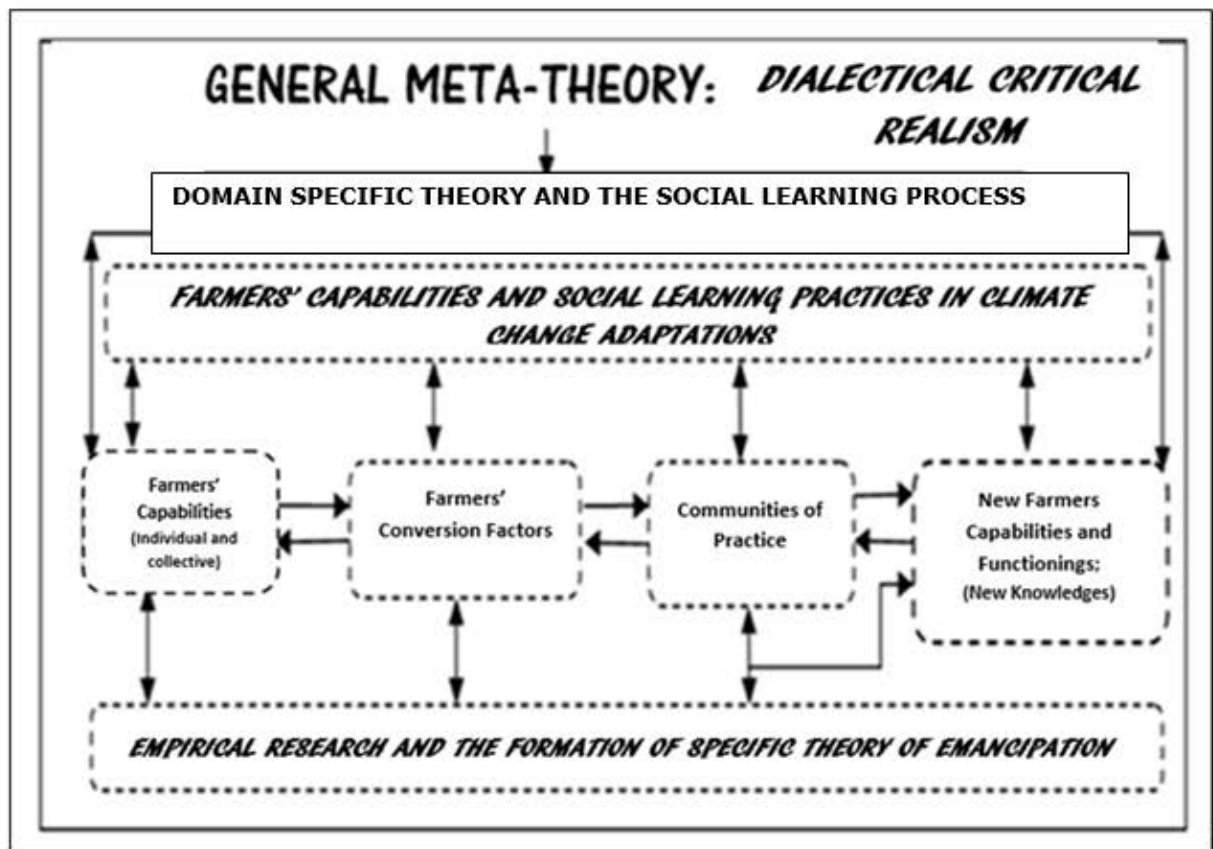


Figure 3.1: Levels of realist theorising: A theoretical framework

Source: Dirwai (2017) after Cruickshank (2003)

My theoretical framework as shown in Figure 3.1 comprises two theories which are dialectical critical realism and capabilities as well as the social learning process as introduced

in Chapter One (sections **1.7.3**, **1.7.4** and **1.7.5**) and described in detail in Chapter Two (sections **2.2**, **2.3** and **2.4**). In this theoretical framework shown in Figure 3.1, dialectical critical realism underlabours the domain-specific learning theory which is capabilities as well as the farmers' social learning pedagogy (Wals, 1987; Wenger, 1998). Farmers' capabilities (Sen, 1990) is studied in view of climate change/variability risks and vulnerability. In this thesis climate change is viewed as an environmental conversion factor as well as a social conversion factor in the capabilities theory as described in Chapter Two's subsections **2.4.5** and **2.4.6**. Climate change is an environmental factor or characteristic that modifies the biophysical environment including flora and fauna and it is also a social factor since it affects humanity's social environment as human beings grapple with adapting to and mitigating against climate change challenges. As shown in Figure 3.1 the two theories (critical realism and capabilities) as well as the social learning process in order to interrogate empirical evidence at the base of the framework, that is the community-based farmers' activities, in order to develop new knowledges (a specific theory) on a farmer's social learning trajectory, farmer's agency and to explore farmers' new capabilities and functionings (section **1.7.5**) and new knowledge capabilities on sustainable environmental education practices for extension service and related educational institutions.

From Figure 3.1 the limitations of social learning when interrogating absences and absencing the absences in divergence, dissonance and conflicts, are examples that can best be explained by a MELD schema, the transformation process in dialectical critical realism. The same can be said of the three main capabilities' conversion factors of Sen (1993) which are personal (individual), environmental and social. I therefore coined a '4C approach' as there are four main concepts in my theoretical framework, which are intricately bound and these are Critical Realism [Dialectical Critical Realism-DCR as C1]; Capabilities (C2); Communities of Practice (Social Learning Model as C3) and Climate Change [Capability Theory's Environmental and Social Conversion Factors as C4].¹⁰

¹⁰ Social conversion factors are concepts in a theory. The theory is capabilities (Sen, 1993; Robeyns, 2011).

3.2 DIALECTICAL CRITICAL REALISM EXPLAINING THE SOCIAL LEARNING PROCESS IN THE FRAMEWORK

In Chapter One section **1.7.3**, I introduced the term critical realism (CR), also well known for its role as ‘underlabourer’ for the natural and social sciences, posing and answering transcendental questions about what the world and human beings must be like for science to be possible. In Chapter Two section **2.2**, I provided an immanent critique of dialectical critical realism theory. I also introduced Wals’ (2007) social learning process (SL) as a critical pedagogy for community-based farmers’ learning in Chapter One’s section **1.7.4** and its immanent critique in Chapter Two’s section **2.3.1**. Learning is envisaged to take place at multiple levels i.e. at the level of individual, at the level of a group, at the level of the organisation or at the level of networks of actors and stakeholders (Parson & Clark, 1995).

In this section of my theoretical framework [cf. Figure **3.1**], I have tried to look at how dialectical critical realism’s [general meta-theory] MELD schema or the Four Moments or Levels of dialectical critical realism [absenting absences] (Bhaskar, 2016: 112-143), absent the limitations in the six ‘sequential moments’ [cf. subsection **2.3.1**] of the community-based farmers’ social learning [domain specific learning process]. Social learning in this thesis is the pedagogy trajectory of the community-based farmers. According to critical realism, the focus of the research process is the relationship between the real world and the concepts we form out of it (Danermark et al., 2005). Thus, the model of critical realism used in this study is dialectical critical realism (DCR) for its power of identifying ills or absences and absenting the absences and transformation (Bhaskar, 2016).

In section **2.3.2** on the communities of practice, I explained the process of social learning drawing on Wals and Heymann (2004), who noted six ‘sequential moments’ (cf. subsection **2.3.1**) or activities that might help when trying to design and monitor a social learning pedagogy trajectory. The six moments were explained in section **2.3.1** and in this section I explain the six moments in relation to critical realism and as investigation and analytical tool as applied in this thesis:

Orientation and exploration denotes identifying key actors and, with them [cf. subsection **2.3.1**], key issues of concern or key challenges to address in a way that connects with their own prior experiences and background, thereby increasing their motivation and sense of purpose, also 1M in dialectical critical realism. The pedagogical process and first sequential

moment seems not to be very clear on who and how the key actors are to be identified and which key issues or challenges to be addressed. The issue of how to come up with the sequence in orientation and exploration can be explained in **1M** of the MELD schema. As explained in subsection **2.2.3**, according to Bhaskar (2016), in the MELD schema, **1M** denotes non-identity or non-being or absence or alterity. **1M** is integral to the understanding of ‘what is’ as well as ‘what is not’ or absence and this includes, key issues of concern or key challenges to address in a way that connects with their own prior experiences and background, thereby increasing their motivation and sense of purpose. This might include conditions conducive or not conducive to growing food; policies and programmes that do and do not support the meeting of basic needs; and statistics and experiences of those that do and do not have their basic needs met. This could help in identifying the orientation and exploration process in social learning. **1M** is the sphere under which one thinks ontology or being as such, in particular, as non-identity (Bhaskar, 2016) or a moment of calling and preparations can begin for the learning to unfold.

Self-awareness raising or eliciting denotes one’s own frames as relevant to the issues or challenges identified during the learning process [cf. subsection **2.3.1**]. To explain this sequential process better, I engage with the second edge (**2E**) of DCR, the process of absencing absences in Bhaskar’s (2016) MELD schema as read with section **2.3.1** on the six moments of social learning. Thus the second moment of the MELD schema, **2E** (Bhaskar, 2016) can help explain the self-awareness process in my social learning pedagogy, as farmers become more conscious of absences and ills.

Deframing or deconstructing is articulating and challenging one’s own and each other’s frames through a process of clarification and exposure to conflicting or alternative frames [cf. subsection **2.3.1**]. The tool to explain better this pedagogical process is an overlapping of absencing absences (**2E**) and considering possibility and values in **3L** Totality. This is the third level in the MELD schema which denotes being (reality) together or as a whole i.e. ‘Totality plus’ as for **2E** plus **1M** (Bhaskar, 2016). **3L** Totality (alienation) from section **2.2.3**, is a process in product that is generally understood as maximised by praxis which absents incompleteness. At **3L** an absence or omission, say an incompleteness in a scientific theory, generates a contradiction, split or alienation, which can only be remedied by a resort to a greater totality such as a fuller, deeper, wider or more complete scientific theory (Bhaskar, 2016). **3L** can help to explain the deframing or deconstruction process in a social

learning pedagogy trajectory. Farmers can become aware of absences or ills (**2E**) through deframing and deconstructing existing practice or being, and they become aware of this because **3L** totality or possibility also comes into view.

Co-creating or joint (re)constructing of ideas is prompted by the discomfort with one's own deconstruction frames and so is inspired by alternative ideas provided by others [cf. subsection **2.3.1**] and available at **3L**. This too, can be explained by the **3L** Totality as noted in the sequential process above but now overlapping with **4D** transformation or agency. In explaining co-creating of ideas for completeness, **3L** totality, also referred to as the axiological or the role of values, is where values can be co-engaged and shaped from the interpretation of the researcher and that of the research participants towards improved or valued beings and doings that are good for people and planet (Creswell, 1998). Creswell (1998) also talked of multiple realities that exist, such as the realities of the researcher, individuals investigated, and those of the reader or audience interpreting a study, and so multiple realities exist thereby affecting the role of values and reconstruction, and in capabilities theory, Sen (2009) argued that it is important to take time to fully understand what people value being and doing which was important for the empirical part of the research, and for conceptualising alternatives with farmers. **3L** Totality is a cycle of formation, the process of binding the new knowledge. At **3L** therefore is totality which involves taking two or more things together or as a whole such as internal relations (Bhaskar, 2016: 129) and this explains the moment of co-creation well.

Applying or experimenting or translating emergent ideas into collaborative actions, is based on the newly co-created frames, and testing them in an attempt to meet the challenges identified [cf. subsection **2.3.1**]. This process can be explained by an overlap of **3L** and at **4D** within the MELD schema. As for **3L**, Schudel (2016, p. 12) further argued that “3L is where, despite all the possible absenting options, it becomes necessary to engage the affective domain of human reason, which Hartwig (2007, 19) has described as “the seat of the moral imagination and optation (e.g. hope), issuing in values and sentiment”, as mentioned above. This means that if the people value something then they are more likely to act or to put it into practice at **4D**.

Reviewing or assessing [cf. subsection **2.3.1**] the degree to which the self-determined issues or challenges have been addressed, is also important. This could have been through a

reflective and evaluative process. As long as the participants are still reviewing or assessing then this can be explained at **3L**, a process in product that is generally understood as maximised by praxis which absences incompleteness (Bhaskar, 2016). As noted, **3L**, an absence or omission, say an incompleteness in a scientific theory, generates a contradiction, split or alienation, which can only be remedied by a resort to a greater totality e.g. a fuller, deeper, wider or more complete scientific theory (Bhaskar, 2016). The reflexive and evaluative process thus overlaps into **4D**. In section 2.2.3, I noted that **4D** offers further knowledge and insight into ‘reasonableness’ as it encompasses “the capacity for practical human agency to change the world” (Norrie 2010, 12). **4D** is the moment of context-sensitive transformative agency where proposed change is specific to a particular individual and context (Hartwig, 2007), and involves reflexivity (Price, 2016).

This discussion above shows the close link between critical realism and the social learning pedagogy trajectory in this thesis. Here critical realism offers an onto-epistemic and axiological theoretical underlabouring to the process descriptions of Wals’ (2007) social learning process. Therefore the MELD schema of the critical realism theory was chosen as an appropriate schema to explain pedagogic practices in the six moments of the social learning process and pedagogic trajectory in this thesis as illustrated in Figure 3.1. To move from one moment to another is thus more fully understood when viewed from a critical realism perspective.

3.3 DIALECTICAL CRITICAL REALISM EXPLAINING CAPABILITIES THEORY IN THE FRAMEWORK

In the previous section, 3.2, I introduced how critical realism (general meta-theory) is applied in this thesis in explaining the six ‘sequential moments’ of the communal farmers’ social learning (domain specific pedagogic process) as a pedagogic trajectory. In this section of my theoretical framework from Figure 3.1, I look at how dialectical critical realism’s MELD schema or the “Four Moments or the causal axiological chain levels of dialectical critical realism {absenting absences and transformation} or the causal ontological axiological chain” (Bhaskar, 2016: 112-143), could help to explain the enabling and constraining factors in the capabilities theory’s conversion factors (domain specific theory). In his book, *Enlightened Common Sense: The philosophy of Critical Realism*, Bhaskar (2016, p. 66) wrote about the

link between the capability approach (Sen, 2011 and Nussbaum, 2011) to critical realism. Bhaskar (2016, p. 66) noted links with his critical realism theory as follows:

- (a) The beings and doings that agents value, which they call their functionings;
- (b) Their opportunities of substantive freedoms to achieve them, which they call their capabilities, together with,
- (c) The enabling or constraining personal, social and environmental conversion factors that account for differences between people in converting their capabilities into functionings (achievements)

Bhaskar (2016, p. 66) then argued that the agent's reasons (for action or a course of action) are regarded as a causal mechanism (**1M to 4D** of the MELD schema) that triggers a particular course of action. Such a course of action may be regarded as a tendency, subject to the play of enabling and constraining conversion factors (including counter-tendencies) in the context of four-planar social being. The result is an expanded or constrained capability on the part of the agent to achieve valued functionings. The valued functionings as noted by Bhaskar (2016, p. 67) include the development of a set of desired capabilities.

One may choose a set of desired capabilities for oneself (individual capabilities and agency - my emphasis) or for society (collectivity) overall. The development of such a set will involve a balance of negative and positive freedoms or opportunities for valued functionings, forms of solidarity that the capabilities entail, the universalisability of the capabilities, the degrees of empathy and co-presence encouraged and their potential contribution to the goals of well-being and flourishing for specific concretely singularised agents, with an in principle unique identity, sense of self and *adharna* (vocation and calling). (Bhaskar, 2016, p. 67)

In this theoretical framework, based on the insights given by Bhaskar in 2016 as shown in (c) above, I have made an attempt to further link dialectical critical realism with the capabilities' conversion factors as I did with social learning's six sequential moments in section 3.2. I introduced the capabilities' conversion factors (the relation between a good and the achievement of certain beings and doings) in Chapter One's section 1.8.5, and in Chapter Two's section 2.4 as an important idea underlying the capabilities approach (Robeyns, 2003; 2011).

Personal conversion factors as explained in Chapter Two's subsection **2.4.1**, are the personal characteristics of a human being that enable or constrain one's capabilities (Sen, 1993). In looking at the MELD schema of dialectical critical realism to explain the personal conversion factors, **1M** non-being or non-identity or absence shows the person's characteristics before the absencing of absences through the six sequential social learning processes discussed in section 3.2. **1M**, which is the first level also encompasses the layered ontology that is the domain of the empirical, the personal characteristics that are observable like disability (taking from Sen's example of the bicycle and how the disabled person can be constrained from using such a capability commodity to a full functioning of mobility) (Sen, 1993; 2006); one's level of education or quality or level of education, personal skills and understanding of policies and standards in the case of the community-based organic farmers. The domain of the actual denotes the events rising out of generative mechanisms and absencing of absences also at **2E** such as the personal trainings the individual farmer undergoes to empower her/him to function better in the crop and non-crop farming activities. The domain of the real encompasses all three (empirical, actual and real) and focusses more on the generative mechanisms that enable and constrain the individual farmer's conversion to realised functionings. Poverty (social and personal conversion factors) can be such a generative mechanism and so is climate change (environmental conversion factor), political structures, and cultural factors (social conversion factors) and so on as discussed in Chapter Two.

At **2E**, absencing absences, explains the interventions that take place to enable the person to absent the constraints noted at **1M**. At **3L** Totality the individual reflects on his/her personal characteristics and his or her valued beings and doings and the absencing of absences that he or she may wish to engage at **2E** under personal and collective agency. If the individual values all that, then s/he takes it a level up at **4D** which is transformation and agency or praxis. Roche (2009) also identified latent conversion factors as the synergy of living in a specific geographical location and belonging to a particular social class, age group and gender among other social groupings, has a combined effect on people's well-being, as discussed in section **2.4.4**.

Latent conversion factors embrace the type of social life an individual currently leads as explained by some deeply rooted historical structures that cannot currently be observed today but are now latent as they can be felt by their inherent actions as a disabler of people's

capabilities and this can also be read with DCR's **1M**, non-being. The level of poverty too, as explained by the historical repressive structures that were responsible for poverty creation in the Black farmer after being deprived of markets way back from 1903 (section **2.4.6**) and the after-effects can currently be felt as latent conversion factors, and so, poverty can be found at **1M**. Socially, the extended family concept can be latent as it can affect personal characteristics and collective agency in a way that has not been described in the original capability theory (Sen, 1993; Nussbaum, 2011; Robeyns, 2011). As such the influence of the extended family concept are latent to the individual and to the community, for example, the number of dependents can disable one from practising certain capabilities. One's eating and drinking habits can be latent conversion factors too as these are more than the personal characteristics such as being disabled or being wheelchair bound as noted by Sen (1993) and so are found at **1M**.

The social conversion factors have been introduced in Chapter Two's section **2.4.6**. Social conversion factors are those factors from the society in which one lives, such as public policies, social protection policies (community-based adaptations), social norms, practices that unfairly discriminate, societal hierarchies, or power relations related to class (structures), gender, race, or caste (Stanford Encyclopedia of Philosophy, 2011) and also in Chapter Two section **2.4.6**. The MELD schema and social conversion factors in this theoretical framework: **1M** as the understanding of 'what is' as well as 'what is not' or absence denotes the current socio-political and cultural policies that are present. The noted absences within these policies and structures including learning structures and content are supposed to be absented at **2E**. The community-based farmers in crop and non-crop farming, would also reflect during the trainings on the new practices at **3L** Totality and valuing. At **3L** the community-based farmers would further deal with omissions on policies and including key issues of concern or key challenges to address in a way that connects with their own prior experiences and background, thereby increasing their motivation and sense of purpose (Bhaskar, 2016). Upon evaluation, as shown in the sixth sequential process of Wals and Heymann's (2004) communities of practice, farmers then exercise their agency at **4D** transformation-praxis.

Environmental conversion factors have been explained Chapter Two's section **2.4.5** as the physical conversion factors that emerge from the physical or built environment in which a person lives. Among these are one's geographical location, climate, and pollution, the proneness to earthquakes, cyclones or floods or tsunamis, and the presence or absence of

seas, rivers and oceans (Sen, 1993; Stanford Encyclopedia of Philosophy, 2011). I included gradient or steepness or gentleness of the landscape, water availability, frost, floods, and droughts and so on as environmental conversion factors since these constrain and enable the community-based crop and non-crop farmers' capabilities also. **1M** non-being what is and what is not, describes the physical environment that the community-based crop and non-crop farmers are found or thrown into (Bhaskar, 1993) including uncertainty and climate variability and the absences are identified and absented at **2E** while at **3L** totality, the community-based farmers reflect and revisit any omissions and if they value the interventions (absenting absences at **2E**) they transform at **4D**. This shows the intricate link between critical realism, social learning and the capabilities theory as illustrated in Figure 3.1, my theoretical and conceptual framework.

3.3.1 The Strengths of the Capabilities Approach in my Theoretical Framework

The capabilities theory adds historicity and value to policies as identified at **1M**, so we do not view them as value free policies. Capabilities when read together with dialectical critical realism's absenting absences and transformation, make it possible to identify constraints or ills in policies and practices that can be potentially absented at **2E**. The capabilities approach energises people who feel demotivated by other theories since the capabilities approach is emancipatory especially when linked with the MELD schema of dialectical critical realism (Bhaskar, 2016). The capabilities approach uses interdisciplinary language which unites people from different disciplines like education, farming, social studies, geography and thus it fits well into my framework as illustrated in Figure 3.1 with the other two theories, critical realism and social learning.

3.3.2 Capabilities Approach in Education and its limitations in my Theoretical Framework

In evaluating vocational education and training (VET) using the capabilities theory, Powell and Mcgrath (2014) argues that contrary to 'productivist' approaches, which emphasise economic growth and income generation as key development objectives with employability and the creation of human capital conceived as a means to that end, the capability approach emphasises human flourishing, with economic growth seen as a necessary but not sufficient means to achieve development. Thus employability can be understood as more than the ability to access work: it is about "the real freedom to choose the job one has reason to

value,” (Ibid, 2014). The use of the capability approach as a tool for the evaluation of social policy is still in its infancy (Alkire, 2008). The capability approach provides a promising alternative that will need to be tested in practice (Powell and Mcgrath, 2014). More, the capabilities is critiqued for an individualised approach to agency, and under-developed theory of agency from a dialectical perspective.

In my theoretical framework, the capabilities approach provided me with tools to evaluate valued functionings and capabilities but did not give me explanations or tell me why the people were poor for instance (generative mechanisms) and this is what dialectical critical realism does (Bhaskar, 2016). Capabilities theory lacks the causal mechanisms regarding why people fail to exercise their agency and this is the strength of critical realism in this theoretical framework – to bring out these generative mechanisms. Critical realism goes further into looking at absences and the generative mechanisms which the capability theory cannot do (Bhaskar, 2016) and yet critical realism cannot describe the personal, environmental and social characteristics needed for agency, which the capabilities theory does well; thus, I needed a framework with the two theories and the social learning process since they could complement each other.

Sen (2006) pointed to the heterogeneity (variability) in people’s abilities to convert the same bundle of resources into valuable functionings. Thus, even if it happened that everyone had the same conception of the good, and the same bundle of resources, the issue of heterogeneity would mean that people would have differential real capabilities to pursue the life they had reason to value. I have called this hidden characteristic that brings about heterogeneity in farmers, latent, since it has some deeply rooted historical structures of deprivation in some of the farmers. Gore (1997) argued that Sen’s approach only considers states of affairs and social arrangements in terms of how good or bad they are for an individual’s well-being and freedom, but this excludes consideration of certain other goods which individuals may have reason to value which are ‘irreducibly social’ because they cannot be reduced to properties of individuals, such as a shared language, set of moral norms, family relations, or political structure (Gore, 1997; Alexander, 2008).

Another limitation to consider is that it is not only important that one can achieve certain functionings, such as mobility, but whether one’s achievement of these are conditional on the goodwill of other people or are independently guaranteed by one’s own rights and powers

(Alexander, 2008). Capability is understood as mapping one's range of choices over valuable functionings regardless of their content. Domination is regarded as capability deprivation and so is poverty. It is no coincidence that the people who are most capability deprived are often the poorest and weakest in society, and as a result also vulnerable to yet further exploitation (Alexander, 2008). Sen (1999) raised the concern that individuals can differ greatly in their abilities to convert the same resources into valuable functionings, valued beings and doings. He gives the example of disabled people who need specific goods to achieve mobility. This means that an evaluation that focuses only on means without considering what particular people can do with the means, is insufficient (Sen, 1999). Because of this, I also bring in the issue of a big family (extended family concept) (introduced in section 1.1 and defined in 1.7) as a personal and social conversion factor (section 3.3).

Sen (1999) was also concerned that people can internalise the harshness of their circumstances so that they do not desire what they can never expect to achieve, a case of 'adaptive preferences'. Sen gave the example of people who are objectively very sick but may still declare themselves healthy. In such cases Sen argued that evaluation should match what a neutral observer would perceive as their objective circumstances (self-perceived morbidity, Sen, 2002b). Another of Sen's (1999) concerns was that whether or not people take up the options available, the fact they do have valuable options is significant. Evaluation must be sensitive to both actual achievements or functionings and effective freedom or capabilities. The other concern of Sen (1999) was that reality is complicated and evaluation should reflect that complexity rather than take a short-cut by excluding all sorts of information from consideration in advance. In this case Sen implicitly acknowledged Bhaskar's domain of the real and generative mechanisms.

Sen argued that when evaluating well-being, the most important thing is to consider what people are actually able to be and to do. This relates to Bhaskar's dialectical theory of agency and transformative praxis, which is essentially also a situated theory of absence and emergence (cf. De Sousa Santos, 2007). Sen's famous example is of a standard bicycle which has characteristics of 'transportation' but whether it will actually provide transportation will depend on the characteristics of those who try to use it. It might be considered a generally useful tool for most people to extend their mobility, but it obviously will not do that for a person without legs. To the farmers, intensive rains and floods will not help them once there

are sporadic secessions and droughts when farmers do not have the knowledge (personal and social conversion factors) to harness the water for irrigation purposes.

3.3.3 Linking Critical Realism, Capabilities and the Social Learning process

The capabilities approach to social justice (Sen, 1999; Wals & Heymann, 2004) views transformative and transgressive learning as one of several intrinsic values to human well-being (Kronlid & Lotz-Sisitka, 2011). “The capabilities approach reminds people that transformative and transgressive learning, including the beings and doings that such learners enact, may function as one dimension of human flourishing (speaking with Nussbaum) or freedom (speaking with Sen) and as such is an end in itself” (Lotz-Sisitka, Wals, Kronlid & McGarry, 2015, p. 76). The conversion factors will lead to social learning as people break the barriers of capability deprivation (ibid.).

....transgressive learningmight actually lead to radical system change or at least a disrupting of hegemonic moral, epistemological, among others, norms that actually works in the favour of the same authorities or institutions...(Lotz-Sisitka et al., 2015, p. 76)

Therefore the two sections **3.2** and **3.3** explained the link between the general meta-theory (dialectical critical realism) and the two main domain specific theories, social learning and capabilities and the conversion factors. The domain specific theories and concepts interrogates the empirical evidence or data from the field in order to come up with a theory of community-based farmers’ social learning pedagogy theory or model as illustrated in Figure **3.1**. Each theory has to be supplemented by the other in order to overcome limitations. Social learning process and pedagogy trajectory needs critical realism in order to explain better the transformative process in pedagogy especially the shift from one sequential moment of learning to the other while the capabilities’ conversion factors needs critical realism to explain (provides the lens) the generative mechanisms that bring about the conversion factors. In subsection **2.2.11** I noted the limitations of critical realism as accepted by Bhaskar (1979, p. 6) himself, when he said that, “Knowledge is temporally relative and will change”. Bhaskar also accepted that critical realism itself is only “the best explanation so far” and that the “transcendental consideration is not deployed in a philosophical vacuum: it is designed to situate, or replace, an existing theory; and may of course come, in time, to suffer a similar fate.” From the literature reviewed on the theoretical and conceptual framework, I have summarised the framework into a model to identify the zone of transformative social learning in Figure **3.2**, the T-infinite model [T^{00}] meaning social learning, could happen at the

intersection of dialectical critical realism, social learning and capabilities theories and such a type of could be infinite and transformative. Learning is envisaged to be infinite and multi-layered. This research applied this proposed model to come up with a possible model for farmers' social learning pedagogy. Figure 3.2 identifies the zone of transformative social learning which is infinite [T-infinite- T^{00}].¹¹

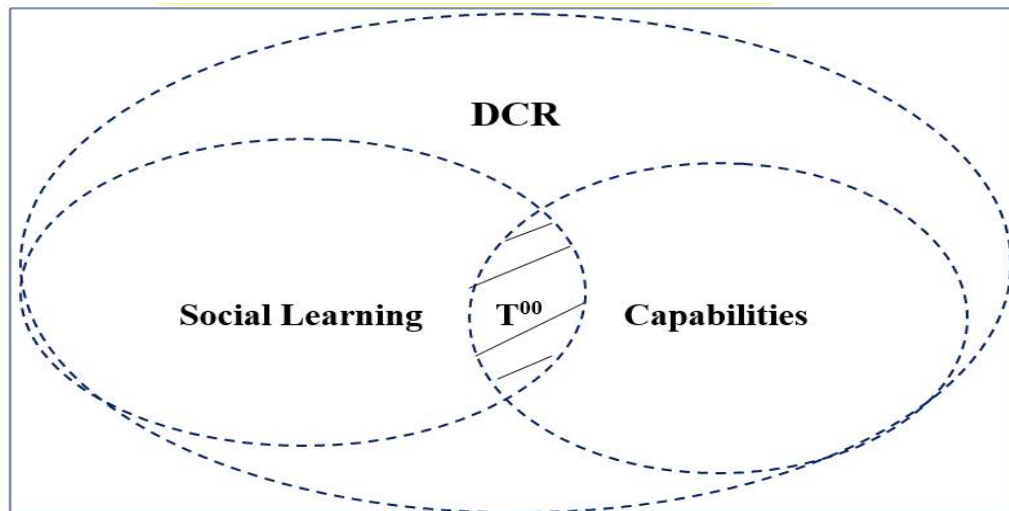


Figure 3.2: Identifying the zone of ‘Transformative’ social learning

In Figure 3.2 critical realism is the philosophical underlabourer for social learning and capabilities. Social learning and capabilities intersect at T^{00} as the three conversion factors are used to explain the enablers and constrainers of learning in the six sequential moments or processes of social learning trajectory and this I assume happens at many levels. Critical realism though a philosophical underlabourer, intersects with social learning and capabilities at T^{00} . From the above discussion, critical realism adds ontological depth to social learning engagements and interpretations, offering depth explanation of the shifts that can occur across the six sequential moments of the social learning process pedagogy using the MELD schema. The emancipatory dynamic is also offered by critical realism, with its emphasis on absences and absenting of ills, that is farmers and others co-engaging to identify absences and absent them (2E) including considering the community-based farmers’ reflections on

¹¹ The concept of 'transformative trajectory' indicates that this does not indicate a smooth or linear approach to the transformative trajectory, but rather seeks to capture it at a broader level over time. The narrative explanations of the trajectories indicate the many complexities and difficulties experienced by farmers within the broader transformative trajectory.

omissions noted at **2E** and valuing (**3L**) laminated totality or alienation, and transformation and agency (**4D**), hence they intersect at T. Critical realism also intersects at T with the capabilities conversion factors through identifying the generative mechanism to explain the three conversion factors for one's valued beings and doings. The central zone T is where the three intersect and I called this the zone of 'transformative' social learning, which is a potentially emancipatory product of the two theories (dialectical critical realism and capabilities) as well as the social learning pedagogic process.

As a product, this zone cannot be reduced to any one area, but is more of a compound (hybrid). Critical realism on its own cannot fully explain the pedagogic transformation process of the community-based farmers' learning of practices while capabilities on its own has its own weaknesses in trying to do this and so does the social learning process framework. $T (T^{\infty})$ is laminated or infinite, as it is multi-layered or laminated (at various levels, micro-macro scales). The transformation level or layer one is the basic level and has to be achieved before layer two to layer infinite. Once transformation starts at layer two or layer four or any other number before achieving layer one, then it would not be a sustainable learning trajectory and practice. This is similar to having **2E** or **3L** without **1M**. For example, learning of food security through handouts, without learning how to absent food insecurity, would be layer two. But, learning about food security, with mechanisms in place to sustain it, such as water harvesting (to absent droughts), marketing (to absent the economic aspects and poverty), storage (to absent losses through pests), and registration (to absent lack of accessing bank loans as the activity will be legally recognised) and so on, is layer one. This is what I am calling a sustainable social learning platform for further transformation and learning to take place as potentially emancipatory 'pulses of freedom' (Bhaskar, 1993) for farmers, academics and other actors who are collaborating. These levels of social learning that I am proposing for the social learning pedagogic trajectories in this thesis are infinite, hence, T infinite (T^{∞}) but have to start at layer one T^1 or with exploration as in the sequential moments or **1M** as in Bhaskar's dialectical critical realism language.

3.4 THE ANALYTICAL FRAMEWORKS FOR THE RESEARCH QUESTIONS

From the previous sections **3.2** and **3.3** I explained my proposed theoretically informed analytical framework based on a 4C model from Figure 3.1 and the T infinite (T^{∞}) model in Figure 3.2. I noted that critical realism is the general meta-theory, social learning in

communities of practice (six sequential moments of social learning) (section **2.3.1** and **3.2**), capabilities conversion factors as the premises for the community-based crop and non-crop farmers' conversion factors to valued beings and doings and climate change as a major environmental and social conversion factor that evokes the community-based farmers' agency. This section looks at the data analysis tools as explained by the theoretical framework in Figure 3.1. The data analysis tools and frameworks are guided by the main and sub-research questions as shown in section **1.6** of Chapter One. Data analysis is grouped by research questions and by theory used for analysis. The main research question is: 'How can and does social learning facilitate or constrain the conversion of resources into functionings and new adaptation capabilities of communal farmers in Muchena village in the face of increasing climate change and associated climate variability related socio-ecological risks and vulnerabilities?' This is addressed in the final analysis by bringing together the findings from all the sub-questions.

3.4.1 Capabilities and Conversion Factors as the Analytical Tool

For sub-research question **1.6.1**, sub-questions 1 and 3 are analysed using the capabilities frameworks that identify achieved functionings which are a product of the conversion factors studied. **1.6.1** The sub-questions are as follows:

- 1) What are the current farming practices and resources used by communal farmers? What does the communal farmers currently value being and doing? How are they currently learning their farming practices?' is analysed under social learning analysis shown in the next section **3.4.2**.
- 3) Do, and how do, the learning processes and practices in the community of practice promote or constrain conversion factors (personal, social, environmental) for turning resources into new functionings and capabilities that respond to socio-ecological climate variability and longer term climate change induced risks amongst farmers?

Figure 3.3 shows the five building blocks of the capability theory as an analytical tool.

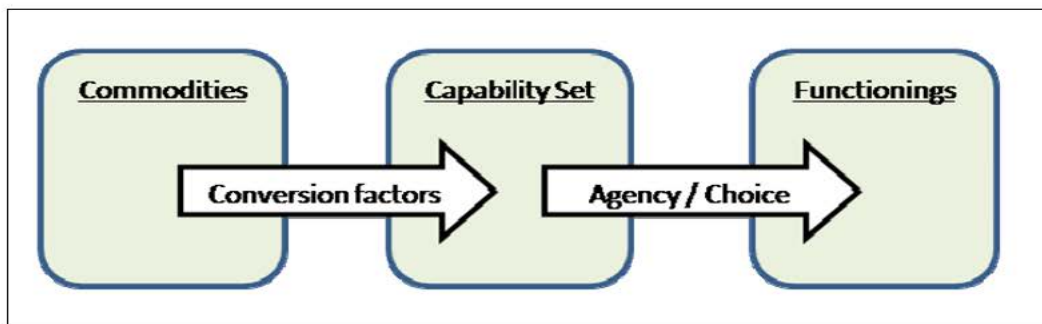


Figure 3.3: The five building blocks of the Capability Approach

Source: Goerne (2010, p. 7)

From question 1, the current farming practices and resources are identified under the commodities block in Figure 3.3. The capabilities commodities are also identified under **1M** in dialectical critical realism's MELD schema. To address the second question on achieved functionings, the three conversion factors are identified under the conversion factors block and arrow which evokes the community-based farmers' agency and achieved functionings. The conversion factors are also guided by critical realism' generative mechanism and **2E** and **3L** moments. The third part of question 1, 'How are they currently learning their farming practices?' is analysed under social learning analysis subsection **3.4.2**. From Figure 3.3 the five building blocks of capabilities approach as the analytical tool for part of the first question is made up of five conceptual building blocks as detailed below: Commodities, Conversion Factors, Capabilities, Choices, and Functionings (Goerne, 2010).

➤ **Commodities**

From Figure 3.3 commodities are the resources the individuals can dispose of. Examples are money, or other material goods, a bicycle, a television, water, land, slope etc. Goods and services (means) should not only be thought to be exchangeable for income or money; goods have certain characteristics which make it important to people as reflected in this commodities block. For example a bicycle apart from it being a form of goods with a particular shape and colour, can take us to places in a faster way than walking; it can also manoeuvre in certain rugged terrains where it is difficult to drive a car. A bicycle is a form of goods or means to achieve the function of mobility which in turn helps achieve beings and doings (Sen, 2002). Less material goods such as skills or habitual behaviour could also be conceived of as commodities. Measuring possession and non-possession of commodities is

the standard procedure for producing measurements of monetary poverty or of multiple deprivation (e.g. Townsend, 1993; Pantazis et al., 2006). In this framework commodities are taken as what is and what is not **(1M)** which then will evoke the process of absencing the absences through the conversion factors a process that involves reflection **(3E)** and agency at **4D** which is the achieved functionings or valued beings and doings. Instead of commodities, Robeyns (2013) noted different modes of production like the non-market production mode, the market production mode, net income and transfers in kind modes. These modes of production interact with the means to achieve or the commodities or inputs such as the land, soils, seeds, water, streams, climate, topography and goods and services such as education and training. The commodities or inputs (means to achieve) too, interact with the individuals' conversion factors in order to realise the achieved functionings. These include the personal, physical and social conversion factors. Thus in my analytical framework for the capabilities questions both commodities and production modes are viewed as Bhaskar's **1M**.

➤ **Capability set**

From Figure 3.3 a capability set contains an individual's capabilities. They are the materialised options or life chances of an individual. This conceptual distinction is based on the assumption that certain functionings are mutually exclusive, and that individuals (have to) exert choice. The potential transformation of commodities into functionings is mediated by the social, environmental and personal structures (characteristics) in place. Within the capability theory and approach, these structures are dealt with under the heading of conversion factors, and, occasionally, in discussions of choice/agency. Whereas functionings refer to what people really "do and are", capabilities denote what people really "can do and can be". Functionings, then, are a subset of the capability set (Goerne, 2010, p. 8).

➤ **Conversion factors**

Closer to the field of the community-based farmers' social learning, one could interpret certain acquired skills as a capability commodity, which are useful only if accompanied by respective labour market structures which help turn these skills into outcomes. Goerne (2010) liked to argue that "being qualified as a typesetter was useful in 1960, but not any more in 2018 when computers have replaced the traditional way of typesetting. A nursing degree acquired in India may have been recognised by British authorities between 2001 and 2003, but not in 2010" (Goerne, 2010, p. 8). How other personal characteristics such as intelligence

or disability can be converted into functionings is also dependent on a set of institutional arrangements. Conversion factors (Figure 3.3) are the place within the capabilities approach to take into account all these structural effects (characteristics: personal, environmental and social) which “determine what and how commodities can be turned into functionings” (Goerne, 2010, p. 8).

➤ **Agency**

Whereas the analysis of conversion factors usually refers either to external structures of the social world in general, or, sometimes, to the relevant policies that shape the conditions under which, individuals can (not) capitalise on their commodities, the question of choice refers more to internal limitations and the question of agency (Pelence et-al., 2015). Sen himself noted that capabilities are both “the person's ability to do the things in question taking everything into account (including external constraints as well as internal limitations)” (Sen 2002, p. 586). Where agency has been conceptualised within the framework of the capability theory and approach, this has often led to (and ended with) rather abstract discussions of internal constraints, such as the lack of desire to attain certain functionings. This problem is referred to as “adaptive preference formation” (Nussbaum, 2001; Teschl & Comim, 2005) and “basically means that individuals living in situations of deprivation or oppression often adjust their expectations and aspirations downwards” (Goerne, 2010, p. 8). I also added the latent conversion factors which are personal and social and create situations of deprivation and so the people adjust functionings downward. The framework (Figure 3.3) helped me to explore the issues of agency in the farmers, both personal and collective, in order to ascertain transformation and new functionings in the community-based farmers.

➤ **Functionings**

For question 3, the functionings are what people really “do and are” and are considered a concept superior to commodities and here I looked at the constraining and enabling factors through the conversion factors. This perspective is based on the view that individuals are fundamentally diverse, and that there are personal, environmental and social conditions (characteristics) which are the reasons for this fundamental diversity. In other words: because humans are not all the same, they require different (in terms of quantity as well as quality) commodities to achieve the same functionings. “Measuring whether an individual is below 60% of median income, or whether an individual possesses a specific number of material

items, does not necessarily allow one to reach conclusions about the individual's well-being state" (Goerne, 2010, p. 7).

Thus, based on Figure 3.3, the relation between a good and the functionings to achieve certain beings and doings is influenced by three groups of conversion factors, personal, physical and social. The personal conversion factors (such as metabolism, physical condition, gender, reading skills, intelligence) can influence how a person can convert the characteristics of the commodity into a functioning. Thus, if a person has never learnt to ride a bicycle then the bicycle will be of a limited help to enable the functioning of mobility (Sen, 1993; 2002) or if one has never been to school then reading instructions and information on farming can be a challenge.

Second, are the social conversion factors such as public policies, social norms, discriminating practices, gender roles, societal hierarchies and power relations. These too can enable or disable the community-based farmers' ability to achieve functionings. Cultural beliefs that do not favour certain crops, animals or even fishes, can restrict people's realised capabilities and these can be identified through the social conversion factors in this chosen framework in Figure 3.3.

Third are the environmental or physical conversion factors and these include physical barriers like mountains, slope, valleys, climate and climate change. The environmental-physical conversion factors play a role in the conversion from characteristics of the good to the individual's functionings. If there are poor roads and no bridges then cycling can be a challenge. If there are no books, no buildings then even when the teachers are qualified, it becomes difficult to get quality learning outcomes. Thus knowing the goods a person owns or can use is not sufficient for knowing which functionings one can achieve. Much more information is needed about the person and the circumstances in which s/he is living.

Goods and services are not the only means to achieve people's capabilities. The material and non-material circumstances that sets people's opportunity sets and the circumstances that influences the choices people make from the capability set, should receive a central set in capability evaluations. (Robeyns, 2005, p. 99)

The capability approach not only advocates an evaluation of people's capability sets, but insists also that one needs to scrutinise the context in which economic production and social interactions take place, and whether the circumstances in which people choose from their opportunity sets are enabling and just (ibid.).

Using my analytical framework in Figure 3.3 I could abstract whether or not the process was individually motivated and when it was collectively done, making my analysis more robust. This was because in this thesis there are also organisations that enabled and constrained the community-based farmers' activities and they too were accommodated in my framework under the conversion factors. In my analysis, based on the analytical framework in Figure 3.3, I then had to start by looking at the capabilities commodities also referred to as the means to achieve as in **1M** or exploration (Wals, 2007) and then look at the conversion factors at **2E** and how the farmers learnt of them. Conversion factors often overlap between personal and social (collective) and latent if they are not directly viewed under the three main classes by Sen (1993), personal, social and environmental. My analysis for the research questions on capabilities therefore was guided by the chosen framework in Figure 3.3.

3.4.2 Social Learning (Six Sequential Moments) as an Analytical Tool for Sub-Questions 1 and 2

Part of sub-research question 1 is analysed in this subsection as it pertains to issues of social learning: 'How are they currently learning their farming practices?' as well as sub-research question 2, 'How are the social learning interactions in a climate responsive community of practice (involving multiple stakeholders) currently supporting or constraining communal farmers to learn new adaptive farming practices?' Figure 3.4 shows an analytical framework for the six sequential moments of social learning.

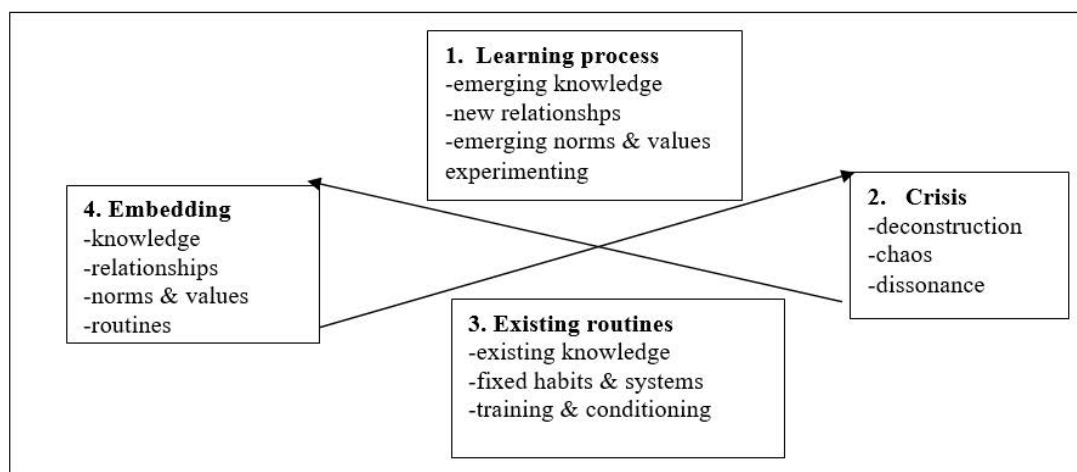


Figure 3.4: A learning system (based on Hurst, 1995, cited in Wals et al., 2009)

In Figure 3.4 the six sequential processes or moments are represented by Hurst (1995) in four

blocks: knowledge emerges at block 1 through crisis at 2 which looks at existing routines at 3 and embedding knowledge and relationships at 4. Block 4 encompasses the orientation and exploration process, applying, experimenting and valuing at 4 while (self) awareness raising, deframing or deconstructing and co-creating or joint (re)constructing are in block 2. To augment the framework in Figure 3.4 is the community of practice model which identifies the different participants (community), the domain and the practice and the outcome at the centre which is what is learnt, Block 1. While the communities of practice model explains who and what the participants do and for what purpose, Block 4, it does not show when the participants come in and the different skills they bring.¹² This is completed by Figure 3.5. communities of practice

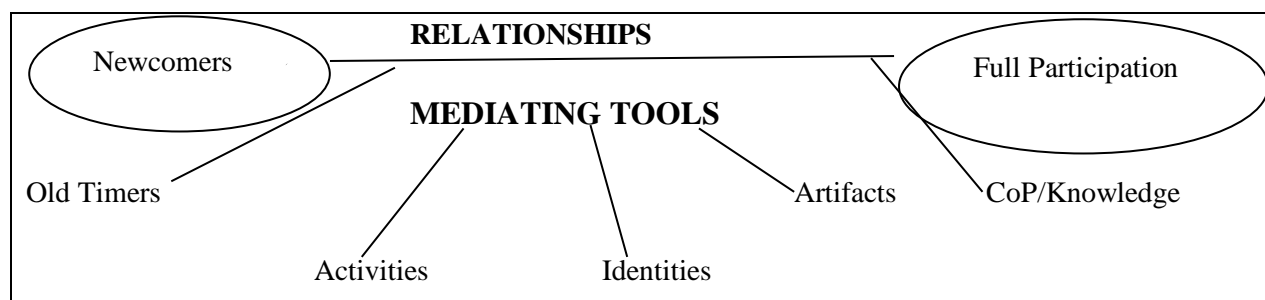


Figure 3.5: Communities of Practice Model (after Wals, 2007, p. 23, drawing on Wenger, 1998)

Apart from the six moments, the communities of practice model in Figure 3.5 was also used to analyse data in social learning (Wals, 2007; Wals et al., 2009) with the provision of a time frame for the participant's entry into the framework and a list of their skills. Figure 3.5 clears the way for Wals' (2007, p. 23) six steps of monitoring social learning processes namely: orientation and exploration, (self) awareness raising, de-framing or deconstruction (for newcomers mainly the local farmers new to the group), co-creating (relationship between newcomers and old timers), applying and reviewing (activities, identities, artifacts, CoP/knowledge and full participation as the end goal), as noted before. The framework in Figure 3.5 helped me to address the two research questions on how the community-based farmers learnt through a community of practice as well as through the six sequential process or moments of social learning. In the above framework the learning group of farmers can be divided into newcomers and old timers. This is also reflected in the purposeful sampling done

¹² Theories comprise multiple concepts. For example, "communities of practice" is a concept within social learning theory that would include concepts such as legitimate peripheral participation, novice, old timer, shared repertoire, and so on.

as briefly described in Chapter One's subsection **1.7** and in detail in Chapter Four's section **4.3**. The newcomers can be newcomers to the group but not necessarily novices to the concept under study, sustainable farming practices. Newcomers can actually bring in the much needed expertise to the group (Wals, 2007). My use of the communities of practice to analyse how learning took place in practices such as farming, is also on an upward trend in most institutions (Wals et al., 2009). It is envisaged that farmers' social learning in this analytical framework, based on the community of practice model (Figure 3.5) and within the context of their sites or communities, is likely to bring out the farmers' agency and capabilities to transformation since the ideas including those related to agro-industry markets are analysed. During field demonstration days (commonly known by communal farmers as field days), farmers learn from interested others, adapt to new practices learnt, copy and ask questions as they continuously learn from others through observations too (Figure 3.5). Thus two frameworks, Figure 3.4 and Figure 3.5, were used to analyse how the community-based farmers learnt their practices through the six sequential process or moments.

3.4.3 Dialectical Critical Realism As Analytical Tool For Sub-Research Question 4

The fourth sub-research question is:

- 4) What generative mechanisms shape the social learning and the conversion of resources into new functionings and capabilities associated with adaptive farming practices?

I introduced critical realism in Chapter One (section **1.7.3**) and an immanent critique of dialectical critical realism in Chapter Two's section **2.2**, where critical realism was viewed as an underlabourer to social learning and capabilities theories. In this chapter I discuss how the dialectical critical realism's MELD schema also referred to as the "Four Moments or Levels of dialectical critical realism (absenting absences and transformation)" (Bhaskar, 2016, pp. 112-143) or the causal ontological or simply the causal axiological chain, comprising four degrees stadia or a measure of length (stadium) **1M**; **2E**; **3L** and **4D** (section **2.2.3**) – in this chapter this is presented as an analytical tool for the last sub-research question 4. The concept of dialectic is key to this analysis of sub-research question 4 on mechanisms. Dialectical critical realism (DCR), also described in Chapter Two as an appropriate 'underlabourer' for this case study, has its strength in analysing generative mechanisms in causal explanation and in following up connections to situate the case within the wider context, thus illuminating

“part-whole relationships” (Sayer, 2010). In section 2.3, I noted the three main sources of knowing, the real, the actual and the empirical. The real refers to the structures and mechanisms or powers of the objects; the actual refers to what happens if and when those are activated; the empirical shows the experiences generated from the data. Critical realism thus helps in conceptualising abstraction, abduction, reflection and retroduction as the primary and secondary data analysis as well as the identification of the generative mechanisms from the two domain-specific meta-theories, social learning and capabilities and thus is useful to analyse sub-research question 4. Dialectical critical realism (DCR) is the model used and from it the MELD schema (Bhaskar, 2016; Lotz-Sisitka, 2016; Schudel, 2017) is applied as the analytical framework or lenses to interrogate and summarise results from the main theories; capabilities and social learning I address in the critical realist research question 4. Bhaskar (1993, p. 40) argued that “dialectic is at the heart of every learning process”. The dialectic explains emancipatory “real process of human flourishing’ allowing ‘the removal of obstacles that can affect and change the conditions of existence” (Scott & Bhaskar, 2015, p. 11). A useful general explanation of the term ‘dialectic’ is an “explanation of the movement and of the transformation of things” (Gadotti, 1996, p. 40). Bhaskar’s (1993) onto-axiological chain (or MELD schema) offers an extensive exploration of dialectical processes from a critical realist perspective (Schudel, 2016, p. 1). Figure 3.6 shows a critical realism analytical framework.

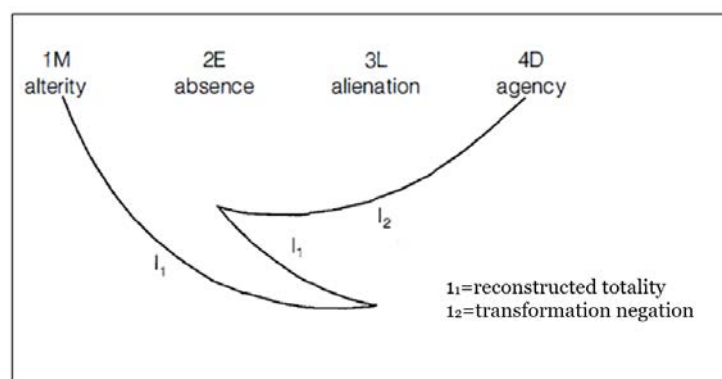


Figure 3.6: From 1M to 4D links of the MELD Schema

Source: Bhaskar, (1998, p. 593)

Bhaskar (1998, p. 593) argued that:

...**1M** non-identity or alterity (from the online merriam-webster dictionary alterity descends from the Latin word alter, meaning "other (of two)." ...

"Alterity" has been used in English as a fancy word for "otherness" ("the state of being other")...may generate a **2E** absence causing a **3L** alienating detotalisation or split-off resulting in a fragmented impotent self or to a transformed transformative totalising praxis absenting the split, or, let us suppose, a reconstituted unity-in-diversity.

From Figure 3.6, "alterity/change in **1M** and **2E** categories of the MELD schema respectively, are at once irreducible to or presupposing each other, interconnected dialectically as modes of absence or real negation and (within that) distancing" (Hartwig, 2007, p. 37). "Change is absence qua causality and process (paradigmatically substantial, but also non-substantial) structures and things considered under the aspect of their story in time. Alterity (non-identity/difference/otherness) is absence qua product-structures and things considered under the aspect of their differentiation in space" (Baskar, 1998, p. 593). At **1M** I identify non-being or Alterity (other of the two) or what exists in order to identify what is not or absences which are to be absented at **2E**. Space-time (from the Merriam Webster online dictionary spatio-temporal has both spatial and temporal qualities that relate to space-time) and causality as a 'tensed triunity' within which the identities of things are constituted relationally by their position within a system of "changing differentiations and differentiating changes" (Hartwig, 2007, p. 37). Totality **3L** presupposes the internal relationality of distinct elements of human praxis. **4D** presupposes both change and difference.

"Thus **1M** non-identity or alterity/otherness may generate a **2E** absence causing a **3L** alienating detotalisation or split-off resulting in a fragmented impotent self or to a transformed transformative totalising praxis absenting the split" as noted by Bhaskar (1998, p. 593) or let a "reconstructed unity-in-diversity (dissonance in **3L**) emerge". The framework by Bhaskar (1998) shows the **1M-4D** links, in which **2E** absence/absenting (positivisation) is the key mediation between **1M** non-identity (destratification), **3L** totality (detotalisation) and **4D** agency (de-agentification), which has its "prototype the absenting of absence manifest in the satisfaction of desire" (Bhaskar, 1998, p. 593). Dialectics in this analysis depends upon the positive identification and transformative elimination of absences, the process of absenting absences (Bhaskar, 1998, p. 593), as also discussed in the previous chapter. "An extreme case of absence is never anywhere in existence" (Bhaskar, 1998, p. 594). In Figure 3.6 on **3L** Bhaskar argued that "unless Sophia sees herself necessarily acting and so absenting, she cannot reflexively situate (and hence detotalises) herself" (Bhaskar, 1998, p. 593). That is to say, in practice she alienates and reifies and hence absents herself and/or her agency, in a way for which she cannot consistently account (ibid.). In my case study this

analysis looks at how and what farmers absent for an upward movement towards new functionings. More important to this analysis is to note the connection between causality and absence (Bhaskar, 1998). This brings about the analysis of what and how farmers learn and from where, in order to absent and to de-totalise and transform. In my analysis, the concept of spatio-temporal is important when looking at the different modes of farming and the knowledges farmers gained from other geographical spaces and at different times.

In my analytical framework for sub-question 4 on critical realism as shown in Figure 3.6, real negation is most simply first considered as the presence in some more or less determinate region of space-time (compromising, as a relational property of the system of material things, an objective referential grid) of an absence at entity, thing, power, event, aspect or relation, etc. Here, Bhaskar used the illustration of a stapler missing from a desk drawer, or a tool from a workbench: “The entity may be, if it is present, hidden and perhaps necessarily unobservable to creatures like us, whether prosthetically aided or not. The absence may be deep or superficial, real but not actual” (Collier, 1998, p. 590). This helps in my analysis to bring out the different types of absence that the farmers engage with as they try to absent and in some cases why they felt they failed to absent, where the absence may be deep. Thus a region may be totally empty, constitute a level-specific void or just not contain x. X may be never anywhere (as in simple non-existence), sometimes somewhere else (as in finite or limited existence) or just spatio-temporally distant (as in the ‘duality of absence’ and, we can add, ‘presence’ (Collier, 1998, p. 590). Bhaskar (1998) argued that absent includes, but is not exhausted by, the past and outside. Practical examples that help in explaining my theoretical framework of absenting absences are taken and/or adapted from Lotz-Sisitka (2016, pp. 318-339) who worked with waste management as a case example to illuminate dimensions of absences drawing on Bhaskar’s complex discussions on absences. Applications to my study’s focus and context are included in italics below. Lotz-Sisitka (2016) stated that absences can be, and are identified via

- Transformation (e.g. through creating new types of production e.g. zero waste production systems) (Lotz-Sisitka, 2016). In my study’s case, this could involve practices that are internally accepted by the farmers while when they feel they are imposed on them externally, they are alienated.

- Distanciation (e.g. through not putting lead in petrol (Lotz-Sisitka, 2016, pp. 318-339), or not packing children's food for school in disposable packaging (Schudel, 2017). In my study's case, this could involve not only absencing artificial fertilisers with compost and other organic manure, but also absencing pesticides with biological pest control like rotation of crops and other permaculture mechanisms.
- Referential detachment (i.e. through not associating our work with certain interpretations of sustainable development; or through not accepting modern science as the only epistemology to draw on in our educational work (Lotz-Sisitka, 2016, pp. 318-339). In my study, this could involve not accepting artificial fertilisers as the only means for plant fertility, but, rather using organic manure. Also absencing herbicides with manual weeding, and accepting the traditional ways of detecting organic parameters [self-perceived morbidity against the scientific, observed morbidity].
- Transfactual: the example here is absencing the ill of waste cannot be solved without recourse to changing global power relations and economic models (Lotz-Sisitka, 2016). In my study this could involve needing to absent contemporary dominance of ecologically destructive and exclusionary industrial agricultural models.
- Actual: absencing the ill of waste can be actual or empirical, and can involve constructing a recycling depot (Lotz-Sisitka, 2016). In my study's case this could involve establishing a viable market for organic produce or establishing a real canning industry at village or university level.
- In-process: absencing the ill of waste is always in process as it is a gigantic task and remains incomplete for as long as waste continues to be produced (Lotz-Sisitka, 2016). In my study's case, this could involve the gigantic task of resolving the impacts of poverty on community-based farmers' lives, praxis and histories as well as introducing organic practices in a country that distributes artificial fertilisers for free to all community-based farmers.
- Static: the absence of a dustbin in a schoolyard remains absent until the constraints surrounding the supply of dustbins can be absented (Lotz-Sisitka, 2016).
- Internally related in a totality: absences associated with waste problems are part of a wider constellation of socio-historical, cultural, material and economic practices that make up modern forms of living and ways of being and becoming (Lotz-Sisitka,

2016). In my study, community-based agricultural practices are part of such a wider constellation of political, cultural, socio-historical practices and the absences could therefore be similarly found to be constellationally related.

- Isolated: an absence of specialised or effective technology to address waste management problems may be isolated to a specific context or setting (Lotz-Sisitka, 2016).
- An inaction or not: the absence of more benign and sustainable/socially just economic paradigms are known about (at least to some extent) but these appear to be inactive (Lotz-Sisitka, 2016, pp. 318-339).

Lotz-Sisitka (2016) explained, drawing on Bhaskar's reference to Sophia and her waste management case example), with a similar possible distinction being possible in my research context,

If Sophia were in a school where waste management practices are poor, and where environmental educational activities are used for punishment (e.g. Silo, 2011), she may act to absent the litter in her school grounds in response to school punishment regimes, but may have no motive to do so other than to avoid further oppression, thus her act is an act of alienation, rather than transformation. If Sophia were, however, angry about the waste lying around her school and community, and together with her teachers and fellow learners chose to launch a waste management project in the school and community, she would be more reflexively engaged, her act would be an act of transformation (a power from and a power to), not alienation. (Lotz-Sisitka, 2016, p. 334)

Bhaskar (2008) thus proposes that absencing processes are crucial to dialectic as the logic of change – to the axiology of freedom; hence often more important than the concept of absence are the processes of absencing (Lotz-Sisitka, 2016), which Lotz-Sisitka further described as learning possibilities within zones of proximal development (i.e. the difference between existing knowledge and possible learning), where the absences and the movement from 1M-4D provide the zones of proximal development for such learning. To identify and analyse the generative mechanisms further see a thematic presentation as shown in Figure 3.7 which shows a critical realist view of causation.

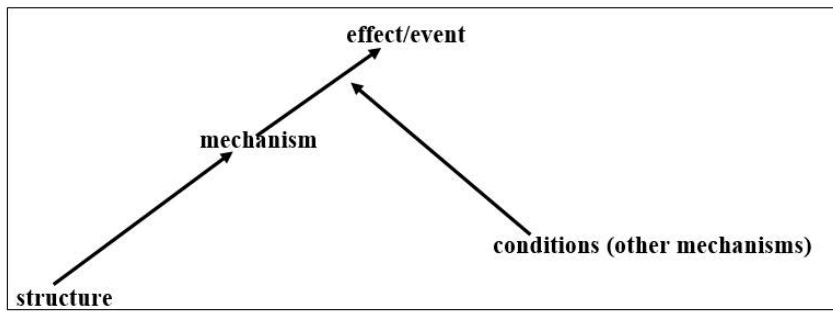


Figure 3.7: Critical realist view of causation

Source: (Bhaskar, 1975; Sayer, 1992)

Causality is thereby understood as operating transfactually, that is the ongoing operation of, and endurance of, these mechanisms apart from the experimentally closed conditions in which they are observed and identified (Bhaskar, 1975). Bhaskar also argued that the basis of causal law lay in the generative mechanisms of nature, of which we do not have direct (influence), only mediated, experience. These mechanisms can be understood as the way things act that is the structures, powers, and liabilities which frame an object's tendencies as they operate and interact. These mechanisms are said to operate in both open and closed systems (but are of course more identified in closed systems) and may also be exercised without being manifest (Bhaskar, 1975, p. 14). Bhaskar (1975) asked, 'What properties do societies possess that might make them possible objects of knowledge for us?' In the same way I ask, 'what properties do community-based farmers possess that might make them possible objects of their knowledge? The ontological question is of the properties that societies possess and the epistemological question is on how these properties make societies possible objects of knowledge for us.

Empirical data analysis (**Layer 1**) is done through the process of abstraction, abduction and induction. **In Layer 2** the process of identifying the generative mechanisms through RRREI(C) analysis complements the analytical frameworks in Figures 3.6 and 3.7. Here, the process of abduction is applied. Givón (1989) noted that the abduction process starts with consideration of facts, that is, particular observations. These observations then give rise to a hypothesis which relates them to some other fact or rule which will account for them. This involves correlating and integrating the facts into a more general description that is relating them to a wider context as noted before. In all stages of the data analysis reflexivity as an ongoing process is applied.

Through the processes of reflection, abstraction and abduction, retroduction, retrodiction, elimination and correction, I explain the generative mechanisms. The first stage is to read and annotate transcriptions making preliminary observations, abstraction. Here, I noted what the interviewee was referring to. Abduction is one other process in critical realism for **Layer 2** analysis. Abduction starts with consideration of facts, that is, particular observations. These observations then give rise to a hypothesis which relates them to some other fact or rule which will account for them. This involves correlating and integrating the facts into a more general description that is relating them to a wider context (Givón, 1989). **Layer 3** looks at the events and the real and this includes the dialectical aspects of critical realism as reflected in absence and emergence. Therefore in my analytical framework as depicted in Figures 3.6 and 3.7, the generative mechanisms are to be identified from the capabilities conversion factors and social learning's six sequential process (**Layer 1**). These are absented at **2E** and reflected and valued at **3L** and transformation is realised at **4D** of the MELD schema. Therefore, for my analysis of sub-question 4 on critical realism, I combined Figures 3.6 and 3.7 to come up with my analytical framework for the question and this final framework also features the three main domains shown in Figure 3.1 (theoretical framework).

However Scott (2010) noted some limitations to critical realism in education. Critical realism is critical because educational and social researchers accept the idea that their investigations are fallible, and also because the various ways that the world is ordered, and this includes the categorical distinctions that constitute the social order, are not self-justifying, but are determined by particular decisions made by individuals and groups of individuals stretching back in time, and are therefore always subject to critique and their possible replacement by a different set of categories and relationships (Scott, 2010). Fallibility cannot just equated with inadequacy or insufficiency, but also implies that no epistemic certainty can be guaranteed (Ibid).

3.5 EPISTEMOLOGY AND ONTOLOGY IN THIS STUDY

“Epistemology is the study, theory and justification of knowledge. It is an examination of how we make knowledge” (Dillon & Wals, 2006, p. 550). Danermark, Ekstrom, Jakobsen and Karlsson (2005) argued that concepts, notions and ideas that people represent may potentially contribute to knowledge production, especially when these are employed to describe objects and processes and causal mechanisms which generate them. Epistemology

includes ideas on knowledge, systems, thoughts, ideas, theories, language while ontology is concerned with being, things, ontics, existents, reality, objects of investigation (ibid.). This distinction between what critical realism calls the transitive (the changing knowledge of things) and the intransitive (the relatively unchanging things which we attempt to know) is a critical distinction which runs throughout critical realism and in this thesis. Epistemology is important as it influences the method of research (Carter & Little, 2007) by influencing the relationship between researcher and participant, whether participants are viewed as active contributors or subjects to be studied.

Secondly, epistemology influences the way in which the quality of methods is demonstrated. It is concerned with the types of action undertaken to ensure data collection and analysis is rigorous. Epistemology here influences the type of questions, the how, who type of questions. Thirdly, epistemology influences the manner in which researchers conceptualise, and communicate with, their audience, whether varied mechanism can be used to involve the participants as active interpreters to both produce and disseminate research findings, through multiple forms (e.g. poem, song and dance). How the communal farmers view reality and generate knowledge has also been covered in subsection **2.2.7** under the RRREI(C) model. Generative mechanisms generally operate in open systems; they are rarely, if ever, actualised as a regular sequence or constant-conjunction of events, which may or may not be empirically experienced by humans (Bhaskar, 1994). On epistemic fallacy, Bhaskar argued that the essential mistake is in reducing the ontological domain of existence to the epistemological domain of knowledge, statements about being (i.e. what exists) are translated into ones about our (human) knowledge or experience of being (ibid.). My epistemological stance, which is constructivist, as guided by my research methodology and design, generates data using unstructured and semi-structured questions through detailed interviews with key informants, focus group interviews and discussions and observation schedules. Knowledge, according to constructivism, does not therefore exist in a state awaiting discovery (Gordon, 2009) but is constructed by humans through proactive and purposive interaction with the world (Morcol, 2001). Thus, all truths are socially conditioned and value laden (Gordon, 2009). As Carr (2006, p. 429) succinctly noted, “human understanding is never simply ‘given’ in any perception or observation but is always ‘prejudiced’ by an interpretive element that determines how perceptions and observations are understood”. Ontology (onto from Greek ‘being’ and logia from Greek ‘science, study, theory’) can be defined as the study of

reality or things that comprise reality. Ontological positions describe what entities exist or can be said to exist and also what kind of relationships exists among basic categories of being (Guba & Lincoln, 1989; Blaikie, 2007). Ontology is thus concerned with the nature of social reality (Dillon & Wals, 2006; Ramey & Grubb, 2009) and the ontological theory that underpins this thesis is realist as explained in detail above via the discussions on critical realism.

3.6 CONCLUSION

This chapter related the theoretical frameworks to each other from a research design and analysis perspective. The role of critical realism underlabouring for the social learning pedagogy and trajectory and capabilities theories have been discussed, showing how critical realism deepens both frameworks offering a more ontologically grounded approach to working with these theoretical perspectives in a study of this nature. A total of five analytical frameworks have been discussed, each being a lens for a concept within the four sub-research questions. The analytical frameworks have been discussed, identifying the generative mechanisms in both capabilities (conversion factors) and six social learning processes or moments. Epistemology and ontological positions as found in critical realist research have been discussed as further defining the theoretical framework, the research tools and the analytical frameworks of the study. In the next chapter I share the practical aspects of the research methodology and study design.

CHAPTER FOUR

RESEARCH METHODOLOGY AND STUDY DESIGN

4.1 INTRODUCTION

This research methodology chapter presents the design, methods and procedures that I used in generating research evidence in this thesis, focussing on the Muchena community-based farmers' social learning, capabilities and transformative praxis. The Muchena case study is made up of an engagement with and across eleven case stories of individual farmers (and their social-ecological set up and capabilities) who were collectively engaged in the wider community of practice where the social learning took place over a period of six years. This was a nested and multiple case study design¹³. In a nested multiple-case studies design, there are no hard-and-fast rules about how many cases are required to satisfy the requirements of the replication strategy (Zach, 2006). In this case, the eleven cases were all happening and being studied concurrently (Stake, 2006) but each represented a phenomenon within the main case study area. Within the eleven cases one case (FCS3) represented a group of youths who are studied as individual participants. The chapter also presents the techniques that I employed to ensure credibility, trustworthiness and dependability of the research process. Details of the research participants in the study and the meetings that were involved during the data generation process are also presented.

The main data generating tools used in my case study were participatory observations, semi-structured interviews, and focus group discussions or interviews, detailed interviews with key informants and unstructured interviews during field tours and informal meetings with the participants. Questions were mainly open ended and were accompanied by photos and videos as documentary evidence. Angrosino and Rosenberg (2011) talked of naturalistic observation as a technique for the generation of data that is as unobtrusive as possible. Observations in my study were made as the community-based farmers interacted with other farmer agents during 'Before Harvest Field and Demonstration Days' also referred to in this thesis as Field Days. I also participated in the Field Days as I collected my data. Semi-structured interviews with individuals were done with purposively selected key informants practising two main

¹³ In multicase study research, the single case is of interest because it belongs to a particular collection of cases. The individual cases share a common characteristic or condition. The cases in the collection are somehow categorically bound together (Stake, 2006).

farming categories, crop and non-crop as noted in Chapter One Section 1.7 and I focused on non-crop farming as a social conversion factor and adaptation to climate change as explained in Chapter Two Section 2.4.5 [environmental conversion factors]. In one form or another virtually every household is practising some form of conservation farming in the study area and village [cf. section 1.7] but not all are doing organic farming. Only purposively selected crop and non-crop farmers were observed and interviewed in detail throughout this thesis journey. Different types of interview (semi-structured, unstructured {during field tours and informal meetings}, detailed interviews with key informants and focus group discussions) led to the relevant accounts from participants. Participants' accounts covered the old and new farming practices and the learning pedagogy used, as well as the scope and sequence used for the community-based farmers' transformation to new practices. Perakyla and Ruusuvuori (2011) argued that this kind of approach keeps the researcher in direct touch with the very object (participants) that he or she is investigating.

4.2 THE RESEARCH DESIGN

A case study is a research method that involves the documented history and comprehensive analysis of a situation concerning different subjects (Sammut-Bonnici and McGee, 2015). In this thesis the study design was a qualitative case study and so the data that I generated was naturalistic from the setting. In an environmental education study (as in this thesis), a case study can be defined as an intensive analysis of an individual unit as a person or community stressing developmental factors in relation to environment (Merriam-Webster's Dictionary, 2009). I considered each farmer as a single case story within this broader case study using a nested and multi-case study design, and together the group of eleven farmers under study, formed the overarching case for this study. Stake (2000) argued that a case study is not a methodological choice but a choice of what is to be studied, by whatever method one chooses to study the case. Understanding the critical phenomena in a case study, as done in this thesis, depends on how well the case stories were chosen. The case story is supposed to represent some population of cases (Stake, 2000). The 'sample' in a case study is usually too small to warrant random selection (ibid.) and so the preferred approach is to work with purposively selected participants that offer enough depth to warrant transferability. For the qualitative fieldwork in this study, I drew my participants from a purposive 'sample', building on a variety of adaptive farming activities and acknowledging opportunities for such an intensive study. The concept of 'sample' emerges from extensive research, and in this case

study, the research was intensive, hence I tended to use ‘selected participants’ rather than a sample. On representational grounds, the epistemological opportunity seems small, but one could be optimistic that one can learn some important things from almost each case story in this study (Stake, 2000). In the case of this study, I was not seeking extrinsic representivity, rather intrinsic depth (Sayer, 2002). In a critical realist case study, “one can learn about generalisability at the level of the mechanism analysis” (Danermark et al, 2005, p. 76), and in DCR, social learning and capabilities analysis, transferability is also possible at the level of process insights.

In terms of research evidence this critical realist and social learning case study was informed by focus group discussions, detailed semi-structured and unstructured interviews with key informants, focus group interviews and discussions and observations at the empirical and actual levels. Focus group discussions and interviews were important as collective conversations or group interviews (Kamberelis & Dimitriadis, 2011) and these were in small and large groups during the community-based farmers’ Field Days. All focus group discussions (FGDs) in this thesis were held during the Field Days, historically known as the ‘Before Harvesting Meetings’ (Kramer, 1997), except for two FGDs that were held at the agro-based industrial premises. Field Days differ in magnitude from Field Tours. In both cases unstructured questions were used depending on the challenges and skills observed on that particular day.

For multicas e research, the cases need to be similar in some ways (Stake, 2006). Each of the eleven cases studied was a complex entity located in its own situation (Sammut-Bonnici and McGee, 2015) such as the rain-fed maize crop farming, maize crop under flood irrigation, maize crop under diverted furrow and maize crop under fertility trenches, apiary, dendrology and aqua-culture. Multicas e do have special contexts or backgrounds. In my thesis each case story comprised important features, happenings, relationships, and situations that bring about rich experiences but all were similar in that they addressed issues on farmers’ social learning and agency. Knowledge in a critical realist case study is socially constructed as epistemological constructivism requires researchers to believe in their participants’ experiential and contextual accounts and also in ontological perspectives of intersecting generative mechanisms that emerge at the level of the real (section 3.5). The critical realist social learning case study researcher engages via interactions and also assists in the co-construction of knowledge about their realities, and the wider shared reality (Robinson, 1951;

Sayer, 2000). This approach gave me the possibility to investigate the social learning emerging among the community-based farmers. At an epistemological level, I therefore looked at the scope of what the farmers learnt, the mediating tools they used and how social learning took place within the communities of practice. By looking at the mediating tools, I got to understand better the farmers' capabilities and the transformation of resources into functionings in a detailed way (Widmer, Hirschi, Serdult & Vogeli, 2008). I was able to engage with the complexities of social interactions including the inherent dynamic aspects of social learning and action during Field Days where the community-based farmers and farmer agents met. All in all, from an epistemological point of view, what should be said about a wider case such as this study on Muchena community-based farmers and farmer agents studied in this thesis, is quite different from what should be said about all case stories in the same village and district or elsewhere in Zimbabwe or the world at large. Each case story in my study is epistemically unique by itself and the set of case stories from the two categories of farmers, crop and non-crop farming, brought about a better understanding of the diversity inherent in the epistemic and empirical dynamics of farmers' social learning. The critical realist analysis, which considers the ontological realities that shape the farmers' realities and experiences offers insights, however, that are more widely applicable at the level of generative mechanisms, and across the **1M** to **4D** processes of social learning and capabilities development.

4.3 THE RESEARCH PARTICIPANTS, THEIR FARMING PRACTICES AND THE RESEARCHER POSITIONALITY IN THE STUDY

In Chapter One section **1.7** I referred to the eleven case stories studied within my wider case study, through their achieved functionings and their social learning experiences. In this chapter and section, I look at the researcher position in the study as well as looking at the process of the purposive selection of the participants. The section also provided the initial individual units of study, the case stories, and the setting of their boundaries (Flyvbjerg, 2011) as well as the practices they are involved in. As a wider case study, the intention was to produce intensive, concrete context-dependent knowledge, with depth, high conceptual validity and an understanding of what causes a phenomenon by linking the critical realist analysis of causes related to agency-derived outcomes. Flyvbjerg (2011) argued that such conceptual validity is only possible if the case study (in this study these are articulated as case stories within a wider case study) is carefully bounded and participants are carefully selected.

As such, the eleven case stories constitute the wider case study of the thesis based in Muchena Village in the Mutasa district of Manicaland province of Zimbabwe as shown in Plate 1.1 of Chapter One section 1.7 and located in the Eastern Border Highlands of Zimbabwe. The majority of the research participants as described in Chapter One section 1.7 are community-based farmers. Labour in the two types of farming studied, was and is mainly family based [the big family also called extended]. The critical pedagogy in this thesis on farmers' social learning process, takes a form of non-formal and informal learning (subsection 1.7.1). From non-formal education farmers learnt practices through the various government and non-governmental organisations' trainings. Much of the learning of new practices by community-based farmers in this thesis emerged from the communal demonstration site (Case Story 3). The government agencies such as Agricultural Extension Services (Agritex), the Forestry Commission (CONNEX) and the Environmental Management Agency (EMA) were responsible for much of the learning process through non-formal education. Educational institutions such as schools (through theme based poems {sustainable farming practices} that the teachers wrote and were recited by the children), university (through community and extension service and research) and other environmental agencies and non-governmental agencies, such as Climate Smart, all provided non-formal education in the wider case study area. All were free to participate in training - there was no discrimination by gender, ethnicity, disability, creed or educational qualification. Thus, the participant selection for relevant case stories of potential social learning amongst community-based farmers was based on whether farmers had a practice or story worthy of showcasing (either crop or non-crop farming).

Apart from formal and non-formal education, learning in this wider case study and community also took place through informal learning from the older generations to the younger generations as intergenerational knowledge transfer. Informal learning on new farming practices (new functionings) and knowledge on climate change adaptation in this thesis and case study was also learnt through social media including WhatsApp and through SMS (short messaging system) and using different cell phone networks as the farmers shared knowledge with others using these platforms. SMS messages were also sent regularly by the Environmental Management Agency (EMA) regarding environmental hazards such as droughts, floods, frost and pests. The Civil Protection Unit also sent SMS messages to all network subscribers warning people about severity of droughts, floods, heatwaves, fire

hazards, and road and traffic accidents and so on. The EcoFarmer, a farming platform on Econet, a telecommunication service provider, sent SMS messages about the farming cycle - that is when to plant which crop and what cultivar to plant and where (agro-ecological regions), warning against pests at various stages of crop development including during storage, as well as information on markets and prices. Other farmers also learnt informally through continuously referring to textbooks acquired from training, as well as studying videos from the Internet and those from other villagers on different adaptive innovations as shared on WhatsApp and other social media.

As noted in this chapter, 11 community-based farmers, around which case stories were developed, were purposively selected from community based farmers who were observed to be championing different farming practices. Six were crop farmers and five, non-crop. A case story, as defined earlier in this chapter consists of a farmer, who is also socially connected to wider family members and who is also engaged within a wider social networked system involving one or more than one community-based farmers.

Zimbabwe's adult literacy level is way above 86% while the literacy level amongst the youth was noted to be 90.43% in 2014 (UNESCO, 2015). This means that the majority of Zimbabwean population, rural or urban, is literate. The 11 case story farmers were purposively selected from a literate group of community-based farmers. All the youths and young adult research participants confirmed they had completed schooling up to the country's ordinary level (Grade Eleven) with others completing advanced level (A Level) and various professional courses. All had a passion to improve their farming practices through learning with others as a community of practice. The high literacy level in the country and in the community studied (personal conversion factors) meant agriculture related training was easy to grasp.

On researcher positionality, in subsection **1.1.1** on my contextual profiling I provided in the last paragraph where I introduced myself as a teacher educator in a university. As a teacher educator my mandate under Education 3.0 (Hoppers, 2007) is community engagement. I co-engage and work with the community (cf. Mandikonza, 2016) and this too is part of my university new thrust under Education 5.0 (cf. section, **1.2**). Thus I share knowledge, source project funds and help the chosen community to sustain their activities thereby making the university visible in the community. As community engagement I helped the community under

study by securing and sharing videos so that the farmers could learn from other farmers elsewhere through watching the videos. I also helped to link the community under study with the university so that they accessed specialised laboratory tests for soils and products. I also made arrangements for the meetings between the community-based farmers and the agro-industry and that included funding for their travelling and subsistence to town. Thus as a researcher I reflected together with the community but I kept the research questions and objectives in mind. All observations out of the reflexive process were documented for the thesis purposes and for the transformation of the university curriculum (Mandikonza, 2016).

4.3.1 Farmer Case Story (FCS) Distribution By Farming Functionings

The case stories are classified as Farmer Case Stories (FCS) and Functionings 1 and 2. Functionings 1 comprised crop based farmers while Functionings 2 comprised non-crop farmers.

Farmer Case Stories and Functionings 1 (Crop Farming): These are the crop farmers comprising the following Farmer Case Stories (FCS) (the codes differentiate the participants and indicate the index codes used for referring to them across the study):

- Farmer Case Story 1, **VS** is a crop farmer practising rain-fed conservation farming
- FCS 2, **BC** practises rain-fed conservation farming blended with the use of artificial fertilisers
- FCS 3 involves youth led by **LN** who is a youth with ordinary level of education and a passion for organic farming
- FCS 4, **SM²** is a young teacher by profession who practises market based ‘irrigation’ farming
- FCS 5, **SS** is a young farmer who practises conservation farming under flood irrigation and the use of diversion furrows
- FCS 6, **JM²** is the only farmer in the study who practises conservation farming using solar power (also classified as climate change mitigation), with an irrigation capacity of 100 000 litres (10 x 10 000 litre water-tanks).

Farmer Case Stories and Functionings 2 (non-crop farmers):

- FCS) 7, **LM**², an apiary community-based farmer who is also practising conservation farming and moving towards organic production under a ‘local’ market model and is also a teacher by profession
- FCS 8, **LM**³ is another community-based apiarist
- FCS 9, **FN** is the only female apiarist and aquaculture farmer studied in this thesis
- FCS 10, **VC** a registered tree nursery producer
- FCS 11, **JC**, an exotic tree nursery producer who supplies a recognised market in the country, the tobacco companies.

Henceforth in this thesis, I index coded the Farmer Case Stories as FCS **1** to **11**. FCS comprised a group of youths who worked in one demonstration site. In this study, by youth I mean the research participants between the age of 18-35 (coded **y**); middle age meant between 36-49 (coded **ma**), and the elderly participants aged 50 years and above (coded **e**). Thus these are shown in Table 4.1 coded respectively as (**y**, **ma**, **e**). Table 4.1 shows the Farmer Case Story parameters defining their selection as participants in the wider thesis case study.

Table 4.1: Farmer Case Story Parameters

Farmer Case Story	Category	Farmers' main functionings	Links to media and other communications and training	Literacy level	Family set up / main group connections included in the FSC
FCS 1 VS (e) Adult female farmer	Seasonal-rain-fed crop farmer	Conservation farming, mulch, fertility trenches with humus and maize stalks	Attends Before Harvest Field and Demonstration Days, field tours and attended workshop with agro-industry	Standard Six	Extended family: two daughters and two grandchildren, feeds extended family in town
FCS 2 BC (e) Adult male farmer	Seasonal-rain-fed crop farmer, and village head ¹	Conservation farming: digging basins, compost and cowdung manure	Attends Before Harvest Field and Demonstration Days	Standard Six	Extended family: his wife and five grandchildren
FCS 3 LN (y)	Perennial youth crop	Conservation and organic	Attends Before Harvest Field and Demonstration	O Level, certificates	Nuclear family, wife and two

Male youth farmer	farmer and market gardener under flood irrigation	farming, crop rotation, market gardening, mulch, liquid manure, apiarist	Days, attends training on: farming business, apiary and tree seedling production (dendrology), networked on social media (WhatsApp), uses sms, listens to the radio	of participation in apiary and farming business	children
FCS 4 SM ¹ (y) Male middle-aged farmer	Perennial crop farmer and market gardener	Conservation crop farming under flood irrigation, use of cowdung manure, cash crop market gardening, teacher by profession	Attends Before Harvest Field and Demonstration Days, networked on social media (WhatsApp), uses sms and email, listens to the radio and watches television	O Level plus Diploma in Education	Extended family, his wife, two children and an elderly mother
FCS 5 SS (y) Youth crop farmer	Perennial crop farmer	Conservation farming under flood irrigation (uses diversion furrows), market gardening, winter wheat cropping.	Attends Before Harvest Field and Demonstration Days, networked on social media (WhatsApp), listens to the radio	O Level	Nuclear family, his wife and three children
FCS 6 JM ² (e) Adult male horticultural farmer	Perennial crop farming and horticulturalist	Conservation farming, flood irrigation, solar energy, cash-crop market gardening	Attends Field Tours and listens to the radio and watches television	Standard Six and Courses in Accounting	Stays with three male workers but gets support from extended family in the urban area
FCS 7 LM ² (e) Adult male non-crop and crop farmer	Perennial crop farmer, apiarist and teacher by profession	Conservation farming and moving towards organic, market mode	Yes, attends Before Harvest Field and Demonstration Days, networked on social media (WhatsApp), sms, listens to the radio and television.	O' Level, Diploma in Education, certificates of participation in apiary	Extended family, his wife, five children, an elderly mother and 3 orphaned children under his custody.
FCS 8 LM ³ (ma) Adult male non-crop and crop farmer	Seasonal crop farmer and apiarist	Conservation farming, market-based apiary farmer	Yes, attends Before Harvest Field and Demonstration Days, networked on social media (WhatsApp), sms and listens to radio	O' Level and certificates of participation in apiary	Extended family, his wife, four children and two orphaned children

FCS 9, FN (e) Adult female non-crop and crop farmer	Seasonal Crop Farmer, Apiarist and Aqua- culturalist.	Conservation farming (digging basins, compost manure), apiarist and aqua- culturalist	Yes, attends Before Harvest Field and Demonstration Days, networked on social media (WhatsApp), sms and listens to the radio from cell phone	Standard 6, certificate of participation in apiary and aquaculture	Extended family, son, daughter-in-law and two grandchildren
FCS 10 VC (ma) Adult male non-crop farmer and crop farmer	Full-time tree seedlings producer (dendrologist)	Supplements venture with seasonal conservation farming	Attends Before Harvest Field and Demonstration Days, networked on social media and with urban markets	O Level, certificate in tree, shrub and fruit tree production (dendrology)	Nuclear family, his wife and five children
FCS 11, JC (e) Adult male non-crop farmer	Exotic tree seedlings producer on contract.	Supplements venture with tobacco cash crop farming.	Attends Before Harvest Field and Demonstration Days, networked on social media and with tobacco companies	O Level, Accounting qualifications	Extended family, his wife and three grandchildren

From Table 4.1 and the description above, two main categories of farmers are evident: the crop and the non-crop farmers as well as categorised by age range into youths, middle-aged and the elderly. The crop farmers are categorised as seasonal and as perennial. The seasonal farmers rely on seasonal rainfall while the perennial farmers supplement their farming activities with some basic irrigation. All eleven farmers had completed basic education with 9 having attained O Levels, a basic entry qualification into training and into the world of work. The eleven case stories also looked after dependents as part of their big (extended) family settings. Their big families and households supported spouses (in some case stories), biological children, orphans, the elderly parents, grandchildren and other relatives and these formed part of their social and latent conversion factors.

4.3.2 Describing the Functionings of the Farmers Participating in the Study

This section and Table 4.2 that follows look at the functionings of the farmers participating in the study and why they were important to this thesis.

Table 4.2: The Farmers' Functionings and why they were Purposively Selected

Farmer Case Story	Farmers' main functioning and capabilities	Why the functioning was purposively chosen
FCS 1 VS Adult female farmer	Conservation farming, mulch, fertility trenches with humus and maize stalks, shared knowledge	Chosen as the only female farmer in the village of study who practised fertility trenches for water conservation and soil enhancement, also chosen as she was previously an urban dweller. Her story of transformation would be interesting to trace over the time of this study.
FCS 2 BC Adult male farmer	Conservation farming: digging basins, compost and cowdung manure, use of open pollinated seed variety (OPV), traditional maize crop	Selected for his age (stories through intergenerational knowledge on climate change), community leadership and a historical view of the village of study and use of OPVs. BC still farms part of the traditional maize seed variety inherited from his parents in the 1950s. BC is also literate and a retired professional.
FCS 3 LN Male youth farmer	Conservation and organic farming, crop rotation, market gardening, mulch, liquid manure, apiarist, irrigation as a capability	Selected to capture a youth story on climate change adaptation and social learning, marketing and the move towards organic farming and flood irrigation
FCS 4 SM ¹ Male middle-aged farmer	Conservation crop farming under flood irrigation, use of cowdung manure, cash crop market gardening, teacher by profession, and metal-worker by profession, capability of water reservoir and pump	Chosen for his enthusiasm as a newcomer and his story of learning through Field Days and his entry into market gardening could be of interest. His intrinsic motivation for farming and his learning through other farmers' practice was good to study.
FCS 5 SS Youth crop farmer	Conservation farming under flood irrigation (uses diversion furrows), market gardening, winter wheat cropping	Chosen as the only case story from a youth known for winter wheat farming in the village who also utilised diversion furrow as an innovation for flood irrigation. His perennial farming venture was of interest in the study.
FCS 6 JM ² Adult male horticultural farmer	Conservation farming, flood irrigation, solar energy, cash-crop market gardening	Chosen as the only case story from a newcomer who used solar energy for irrigation (climate change mitigation), his story was good for showcasing climate change mitigation in the study and another dimension of winter cropping. JM ² is well educated with professional qualifications.
FCS 7 LM ² Adult male non-crop and crop farmer	Conservation farming and moving towards organic, market mode of honey production, has 45 apiaries and many fruit trees	LM ² is a conservation farmer, an apiarist and a teacher by profession. Apiary here is chosen as an alternative to maize crop farming and LM ² case story towards marketing was of interest. His current apiaries are the Horizontal Kenyan bar, having moved from traditional hives made from bark and wooden boxes. The teacher also appreciates organic farming and links his apiary farming to organic fruit orchard

		production since bees need no chemicals.
FCS 8 LM ³ Adult male non-crop and crop farmer	Conservation farming, market apiary farmer, has 260 apiaries	LM ³ was chosen as one of the most successful apiarist stories (in this thesis journey) whose market was beyond the village of study. His case story as alternative to maize crop farming could have brought insights into climate change adaptation. LM ³ with 260 apiaries, provided stories on how such community-based farmers were constrained by the three different capability conversion factors (personal, environmental and social).
FCS 9 FN Adult female non- crop and crop farmer	Conservation farming (digging basins, compost manure), apiarist and aqua-culturalist, has six apiaries and two fish ponds, trained in aquaculture and apiary from reputable institutions in Zimbabwe	FN was chosen since she was the only female farmer practising apiary and aquaculture as non-cropping (alternative to maize crop farming) as well as conservation crop farming. Her stories were of interest in this thesis since FN was the only female farmer venturing into apiary, a male dominated venture in the village of study.
FCS 10 VC Adult male non-crop farmer and crop farmer	Supplements venture with seasonal conservation farming, certificate in producing and marketing medicinal tree seedlings, hedges, shrubs and fruit trees (dendrology)	VC was chosen for his long trajectory towards company registration in a non-crop (alternative to maize cropping), a story that emanated from social learning of other young farmers' practice in this project. VC was one of the two remaining tree seedlings producers together with FCS 11. VC is literate and has social contacts in the nearest town (Mutare) where he used to work and these contacts played an important role in his social learning trajectory.
FCS 11 JC Adult male non-crop farmer	Dendrology and supplements his dendrology venture with tobacco cash crop farming, capability of large earth water reservoirs, water pumps and knowledge of accounting and proposal writing and accessing bank loans	JC was chosen since he was one of the two remaining tree seedling-producers (dendrologists). The village had 52 tree producers before the thesis inception and ten in 2012 at the thesis inception, but only two remained and JC is one of the two. Why he remained resilient when others opted out, was of interest to the study particularly as an alternative to maize crop farming.

Each FCS in Table 4.2 was purposively chosen after having considered several functionings that could provide rich insight into the research question and sub-questions. Each of the 11 FCSs provided trajectories that could guide understanding of farmers' social learning and agency. Each FCS was purposively chosen for unique functionings such as crop farming: FCS 1, **VS** was chosen for her move towards fertility trenches; FCS 2, **BC** for his advanced age which helps in the dissemination of intergenerational knowledge in a changing climate over time in the village of study; FSC 3, **LN** (youths) for learning about the move towards

organic farming under irrigation; FSC 4, **SM**² for his perennial market gardening under flood irrigation; FCS 5, **SS** for irrigation under diversion furrows and winter wheat cropping.

For non-crop farming functionings or alternatives to maize crop farming, FCS 7, 8 and 9, **LM**²; **LM**³ and **FN** were selected for alternatives to maize crop farming and new functionings recorded in apiary and aquaculture and apiary in the case of **FN**. The other alternative to maize crop farming and new functioning was dendrology (a branch of botany) or tree seedling production, and FCS 10, **VC** and FCS 11, **JC** were chosen for this. Therefore each of the 11 farmer case stories was selected for its unique functionings as they contributed potentially rich insights towards addressing the research question.

4.3.3 Describing the Activities in Farmer Case Story (FCS) 3

In a nested multiple-case studies design, there are no hard-and-fast rules about how many cases are required to satisfy the requirements of the replication strategy (Cf 4.2; Zach, 2006). FCS 3 led by **LN**, was unique for this is a case of a group of youths who have been moving towards organic farming, a new functioning and a capability for health and nutrition and marketing. The different youths represented by FCS 3, **LN** had different competences that helped me to understand the social learning trajectory that the young farmers went through when moving towards their achieved new functionings of organic farming.

Each individual youth in FSC 3 brought different experiences and executed special tasks like marketing, training, irrigating crops, weeding and harvesting. As a group (FSC 3), they too reported on their general practice. The youths were also purposively selected based on their interest in organic farming. This new functioning was characterised by the absence of artificial fertilisers, purported absence of heavy chemicals and pesticides and characterised by the use of compost, mulch, weeding, terracing, crop rotation and use of liquid manure to enhance the health of the soil and improved crop yield. The group practises monoculture during winter when pests are few and when they need to maximise on economies of scale, by supplying one product in bulk to the nearest urban open market and to an agro-industry. Labour is shared and monitored at this demonstration site amongst the young farmers under the management of one of their own (**LN**). The youths take turns to look after the site with those coming on a part-time basis spending a maximum of ten days in a month on the project and the rest of the month-days they practise farming in their own fields.

The agricultural extension service constantly monitors and gives advice to the young farmers from planting to weeding and harvesting. Together, with the young farmers, the extension service organised the before harvest field and demonstration days and field tours where other communal farmers from the village are invited to share their practice with the young farmers. This meant that there have been opportunities for the community-based farmers' social learning spaces two or three times a year (following a two-three crop cycle) since the inception of the project. The youths moved from subsistence to a market mode of production. Table 4.3 shows the different achieved functionings.

Table 4.3: FCS 3 by Functionings by Literacy Level and by Period in Project

Youth case story (FCS 3)	Youth farmer's main functionings and capabilities in the group	Literacy Level	Period in the project
LM¹ Adult male	Landscaping and terracing (conservation farming)	Primary schooling	up to end 2012
NM Adult male	Landscaping and terracing (conservation farming)	O Level	up to end 2012
GC Adult female	Established the organic farming functionings and the introduction of liquid manure.	MSc Crop Science	up to end 2012
LN Youth male	Conservation and organic farming, Crop rotation, market gardening, mulch, liquid manure, apiarist, irrigation as a capability, marketing (to agro-industry in 2018)	O Level	2012-2018
SM¹ Youth female	Conservation and Organic farming and introduction to the open market (2013)	O Level	2012-2015
JM¹ Youth female	Cropping and mainly marketing at the open market (2015)	O Level	2012-2015
PG Youth male	Cropping mainly organic farming (signatory to the delivery note in 2017)	O Level	2012-2017
OD Female	Cropping and mainly marketing at the open market (Signatory to the delivery note in 2017)	BSc Tourism	2012-2017
BD Youth male	Conservation farming and traditional crops processing (2012)	O Level	2012-2013
MD Youth female	Cropping mainly organic functionings (signatory to the delivery note in 2017)	O Level	2012-2018
MM Youth female	Cropping mainly organic functionings	O Level	2012-2018
TD Youth female	Cropping and mainly organic functionings	O Level	2015-2018
CM⁴ Female student	Organic farming practice and a diploma student of agriculture on attachment [responsible for experimenting on sunflower production and processing into homemade cooking oil and poultry feeds]	A Level and studying towards a diploma in Agriculture	2019

4.3.4 Sampled Participants in addition to the Farmers' Case Stories Studied

On ethical grounds to ensure anonymity in the final thesis text [although participants did agree that I could use their details] I chose to use the initials of the research participants' first

names and surname. The participants around which the case stories were developed are listed in Tables 4.2 and 4.3.

Here I share details of the other respondents whom I interviewed and used in the study outside of the participants that made up the eleven FCS. These were as follows:

- Organic farmer **TM²** appreciated organic foods and the link between inorganic foods and non-communicable diseases during a Field Day.
- Organic farmer **VM** had comments on garlic and other traditional crops during a Field Day.
- Organic farmer **BM** was a champion of conservation farming and contributed during discussions at Agro Industry 1 and also was active during Field Days, Field Tours and in FGDs from 2012 to 2017.
- Village head 2, **EM** contributed to discussions and activities during the Field Days.

Also described here are the Farmer Agents from Agritex and Connex, climate change activists and agro-industry experts who I interviewed or engaged with in focus group interactions. They are as follows:

- **MNA** is the farmer agent who was responsible for the district and all extension activities in the district and in the village of study.
- **PN** is the farmer agent responsible for the village or branch of study. She was responsible for working with the FCSs in the study, organising all Field Days and Field Tours.
- **NN** is a farmer agent who specialised in husbandry. Together with PN and others NN was responsible for organising the Field Days and Field Tours in the 11 case stories in my study.
- **CM¹** is a farmer agent specialised in crop science and was responsible for all logistics during Field Days and doing most of the demonstrations during Field Days' social learning processes.
- **TM¹** (now late) was the forestry extension (Connex) officer responsible for training on agro-forestation (see Plate 5.5).
- **DM**, climate change activist, was responsible for marketing of the organic products.
- **WM**, climate change activist, was responsible for marketing of the organic products and featured in the study interviews especially on marketing.

- **TM³** is the agro-industry member¹ who actively contributed during the FGDs with the community-based farmers, demonstrating the quality and quantity of bean and tomato products required from contract farmers.
- **CM³** is a technical advisor at the agro-industry who advised the community-based farmers and extension officers on water content and other parameters of quality in products they purchase from farmers.
- **CC** is the second agro-industry member² who discussed contract farming of tomatoes. **CM²** is the donor agent responsible for training the community-based farmers in the village of study and who actively contributed to the 2015 Field Days and to the farmers' social learning trajectory.

Text messages took place mainly with FCS 3, OD in 2017. These were captured from the phone to the relevant transcript and section of the thesis, mainly concerning markets. Information on horticultural crops was also captured from SMSs.

4.4 DATA COLLECTION AND ANALYSIS METHODS

Stake (1995) argues that there is no particular moment when data gathering begins. It begins before there is commitment to do the study in the form of 'back-grounding', making acquaintance with other case stories, developing first impressions. A considerable proportion of all data is impressionistic, picked up informally as the researcher first becomes acquainted with the case story. Many of these early impressions will later be refined or replaced, but the pool of data includes the earliest of observations (ibid.). Thus, in this thesis preliminary data was collected earlier to inform Chapter One's contextual profiling which formed the foundation of working towards the generation of the primary and empirical evidence that centred around the FCSs' social learning and functionings as outlined above. In this section I show how empirical evidence was generated during the community-based farmers' social learning trajectory to develop the FSCs.

Different methods were used in data collection and each demanded multi-visits to the project site since there eleven cases to be visited. Only a small number of observations, interviews, and document reviews are possible for each case story (Stake, 2006). Data was collected during the Before Harvest Meetings (BHM) or Field Demonstration Days (FDD) in an interactive knowledge generation process. A Field Day is a long standing way of a sharing

farming knowledge in Zimbabwe (Krammer, 1997). Farmers and farmer agents meet at a field to learn from the farmer-holder regarding her or his practice. These Before Harvest Meetings, in my thesis, are slightly different from the Alvord's 1920's model that was restricted to the local farmers and agriculture extension (Krammer, 1997). In my case, these involved more stakeholders apart from the community-based farmers, who came to learn together as a communities of practice. It was during this practical and interactive process that focus group discussions, observations and interviews were also carried out as analytical knowledge generation processes. Observations, interviews and focus group discussions in particular provided the platform to extract tensions, contradictions (dissonance and absence), and areas of agreements during knowledge generation. Included in the learning process are Climate Smart as enviro-activists on Climate Change, the Forestry Commission (the arm of government for agro-forestry), agro-industries regarding markets and the need for raw materials from farmers, different agricultural donor agents, teachers and school children. All regularly came to learn together and share knowledge on adaptative practices and to share why these practices were important to them. The focus group discussions paved the way for data generation in this thesis. Detailed interviews and observations were part of the follow-ups with the farmers and are included in the case study.

Observations on the different practices were recorded during the Field Days at individual farmer plots and these were done in conjunction with detailed interviews with the farmers. Farmer interviews were either individual or the farmer would opt to co-opt his or her family and extended family members into the interview thereby enriching the discussion which became a small group interview. Each of the interviewees signed a consent form as per the university ethical requirements. All were given the option to withdraw from the study at any time, and all were given clear orientation as to what the study was intending to explore.

Data were also collected during organised Field Tours. An organised Field Tour in this thesis was less than a Field Day in terms of the population and in terms of intensity. During a Field Tour, farmers get the chance to see the product at an earlier stage than a Field Day which mainly took place during harvesting. Field Tours to other farming areas were also facilitated by different farmer agents including Agritex. These included the bee-keeping tours organised by Agritex where the community-based farmers from the village of study went to Harare (capital city of Zimbabwe) on two occasions for non-formal education and trainings on apiaries. During the tours, the other members of the community-based farmers benefitted

from feedback of those who had attended as they shared their learning experiences with those back home. Where funds for tours were not available, the farmers learnt from videos from other farmers in the country, for example the sampled farmers learnt from videos about fish farming from the Matabeleland South province drip irrigation from a school in Harare, and about organic farming in the Mashonaland Central province of Zimbabwe and compost making at Isdore farm in Durban which the researcher had visited in 2010 during the RHODES/SADC/REEP-WESSA Environmental Education Course (Madikonza, 2016). All these were shown to the community-based farmer participants in this thesis research process by the researcher as part of the participatory observation process. Data was therefore collected as stories from the farmers on how they learnt their different practices including what and how they learnt from other areas, regions and countries, through videos and training.

There was a category of farmers who neither attended Field Days nor did they watch videos or go for Field Tours or visits, but they still learnt indirectly from their children and others who attended these tours and thereby managed to change their practices too. Visits to industry (informal learning) were facilitated by the researcher so that the farmers could interact and learn together with the real industry in situ.

Each crop cycle (two cycles over the period 2012-2018) provided a learning curve for the community-based farmers. All challenges faced in the first crop were mirrored during the Field Day of the second crop and ills were absented as farmers reflected on problems identified in the second Field Day and so on. Knowledge had to be generated, similar to a change laboratory workshop model (Engeström, 2001) where challenges are mirrored and debated in subsequent Field Days. Thus each crop within the crop rotational cycle provided a learning curve. The same applied to the tree nurseries and apiaries, they too, were platforms for social learning moments.

I note at this point that the sampled participants are not a registered group of farmers but individuals selected from the village for the purpose of this thesis. These are community-based farmers who are independently involved in practices at their individual homesteads but are passionate about sharing their knowledge with interested others. They therefore invited their farmer counterparts, the farmer agents, agro-industry, the university, a school and climate change activists (a community of practice) to witness their practices during a Field

Day. The members of the community of practice were free to question and give suggestions, in a non-confrontational and co-engaged learning process. The farmer showcasing a practice during the Field Day continued to reflect on the questions and suggestions given by the other members of the community of practice who also reflected on their return to their own fields. Reflection thus became a reflexive, recursive and iterative laminated trajectory of social learning pedagogy processes that happened at individual and collective levels (subsection **3.3.3**).

As a loose and temporary group, this community of practice met only when a peer had something to share and show to others who came to learn, question and suggest. In such a scenario there seemed to be little reason for dissonance and conflicts and more of a focus on accommodating and convergence. This situation is slightly different from the descriptions of social learning in the literature, where the groups meet to deliberate on a problem or a challenge. Learning is done through reflections with the self (Layer 1) and with others (Layer 2 and 3 and Layer Infinite) (cf. Figure 3.2).

In case-study methodologies that deploy qualitative data, an inductive approach is required to link research results and theory (Sammut-Bonnici and McGee, 2015) while this critical realist data analysis, encompassed retrodictive, inductive and abductive reasoning. The abductive approach to analysis of the data (Danermark et-al, 2005), in this thesis, involved recontextualising data with theory and in context. For this reason I included explanations of the data in close association with the use of original quotes from the data. This approach differs from a purely inductive approach where one would use raw data and then interpret it into thematic areas at a later stage.

The strong point of case studies is the depth of analysis that they offer as well as the ability to examine the operation of causal mechanisms in individual cases (Sammut-Bonnici and McGee, 2015). The narratives in case studies offer detailed, rich descriptions of situations and their context (Ibid). Each case serves as a separate experiment that stands on its own as a discrete unit of analysis. Multiple cases can be viewed as distinct experiments, very much like a series of laboratory experiments, which meet the criteria of reliability and generalizability of emerging theory (Sammut-Bonnici and McGee, 2015).

4.5 THE RESEARCH TIMELINE AND INSTRUMENTS

The research timeline can be found in Chapter One (cf. Table 1.1: Thesis Gant Chart). The Gant Chart shows the activities covered by year. The period of six years allowed for observation of changing farming practices within a longer term social learning trajectory. The PhD study was conducted on a part-time basis. Engagement with the farmers took place as part of my university community engagement activities in the current framing of the Ministry of Higher Education's 5.0 thrust (iterative relations between teaching, research, community service, innovations and industrialisation), as described in Chapter One. All data were collected during the crop production process. All field observations on how the farmers learnt, socially, regarding their practices, were done from field preparations through harvesting and marketing. Detailed interviews and focus group discussions were carried out during the field and harvest demonstration days (Field Days). Interviews with the key stakeholders, the farmers' case stories (FCS) took place during Field Days and during Field Visits with a few farmers with special interest in the practice that was showcased. Two focus groups and demonstrations on the quality and standard of crop product accepted by industry, were offered by two agro-industries where the FCS, other villagers, extension and myself, participated in the learning process. Photos were taken during all field activities. In addition, interviews, demonstrations and practical skills were either video or audio recorded. Three main instruments were used: 1) observations using an observation sheet/schedule; 2) detailed interviews with FCSs, farmer agents and agro-industry partners; and 3) Focus Group Discussions (FGDs) and Focus Group Interviews (FGIs) with farmers, the FCS agents (and sometimes their extended families).

Observations: The observation schedule or sheet (see Appendix iii), guided the observations of the researcher when the farmers were doing their practices, when meeting with industry and when meeting with other farmer agents during Field Days. Laminated observations over the thesis journey have been accompanied by a group of photos (also called a plate) that helped in telling the story over time. Each plate thus shows the flow of events from 2012 to 2018. The observations used in this thesis have been detailed further in Table 4.4.

Table 4.4: Field Observations by Venue, Date and Use in the Study

Field observation	Venue	Date	No. of participants	Use in research
Workshop Training-Forestry Commission	Local Primary School	30-05-12	30+ participants but FCS 9 was of interest	Plate 5.5 photos (FCS, FN 9)
Field Demonstration and Field Visits	Demonstration site (youths)	05-10-12 10-03-13	20 participants and FCS 3 was of interest	Plate 5.3 (FCS 3, LN & the youths)
Field visits	VS homestead	06-10-12 07-10-14 14-07-15 15-10-17	6 participants and FCS 1, VS was of interest	Plate 5.1 (FCS 1, VS)
Field Preparation	Demonstration site (youths)	10-10-12 05-11-12 15-07-15 04-03-17	5+ participants on Field Visits, FCS 3 was of interest	Plate 5.2 (FCS 3, LN)
Field Day	Demonstration Site (youths)	2007-2012 2013- composts 2015 garlic 2016 peas 2018 canning	50+ including school children (FCS, 3, LN and youths were of interest)	Plate 5.9 (FCS 3, LN)
Field Tour	Fish ponds FCS, 9, FN)	20-06-16	5 (FCS, 9, FN)	Plate 5.5 (Photo 7) FN show-casing
Visit-Agritex 3	Demonstration site (youths): compost to liquid manure	21-06-16	4 (FCS, 3, LN and others)	Plate 5.11
Reflections FCS, 11, JC	Tree seedling production trajectory	2008-2017	20+ participants, FCS, 11 JC and others	Plate 5.11 (FCS, 11, JC reflections)
Field Tour	Diversion furrows, FCS, 5, SS	14-07-17	3 participants, SS and FCS,8, LM ³ and FCS, 3, LN	Plate 5.10, FCS, 5, SS
Reflections FCS, 10, VC	Trajectory towards company registration	2008-2017	2 Participants, FCS, 11, VC and FCS, 3, LN	Plate 5.6, FCS 11, JC with FCS, 3, LN
Field Tour	Trajectory towards market mode of production	07-07-16	3 participants, FCS, 6, JM ² , FCS, 3, LN and FCS, 4 SM ²	Plate 5.5, FCS, 6, JM ²

Interviews and focus group discussions: The interview and focus group questions were open ended (see Appendices) to allow for the collection of ‘whole stories’ to flow on the practices and how the practices had been learnt over time. Appendix iv indicates the broad areas of questioning, rather than specific questions used in individual interviews, as these were adapted to the specific settings and interview processes.

Ethics protocols: All the social research mediating tools were printed as hard copies for ease of informing participants, and informing the signing of the consent forms (see Appendix vii) by all the participants. The consent forms also stated that the participants were free to withdraw from the study at any time during the course of the thesis. On the consent forms, participants also agreed that the researcher could take photographs and videos during their practices as documentary evidence for the purpose of this thesis study.

Mobile Text Messages: Mobile text messages (SMS through cell phones) were also used as instruments to collect data especially when the farmers were at the market and the researcher was far away. Thus most market-based data and issues of organic products supplied and prices fetched were sent to the researcher by the research participants as text messages and these were recorded with the respective farmer's details. At times the data sheets were sent as pictures or scanned data through emails (see for example Muchena Organic Peas Project Delivery Form of 2017 in Appendix viii). All data sent by emails were downloaded and used as text in the thesis with the signed delivery note (sheet found in Appendix viii). SMS (a text messaging service) were mainly done with FCS 3, **OD**, the youth at the market. Four of these messages were captured and used as transcriptions in the thesis, mainly showing communications on the status of the market, the fluctuation of prices due to market forces (supply and demand). Table 4.5 outlines the field interviews: venue, date, number of participants and length of the transcription.

Table 4.5: Field interviews by Venue, Date, Length of Transcription and by Code

Field interviews	Venue	Date	No. of participants	Length and pages in the transcriptions
Field Day Demonstrations by CM ¹	Demonstration site (DS) (FCS, 3, youths)	6-10-12	Target 3 poems done by 10 children	Pages 1-3
Training-Agroforestry	Primary School	15-05-13	20 Main Focus TM ¹	Pages 4-6
FGD (FCS 3, youths)	Demonstration site	14-07-13	3 (FCS 3, LN +)	Pages 6-12
FGD (FCS 3, youths +)	Primary School	25-10-13	5 (4 youths, FCS 3+)	Pages 8-12
FCS 3 Interview	Demonstration Site	15-07-13	1, FCS 3, LN	Page 13
Field Day	Demonstration Site	17-07-14	50 demonstrations	Pages 14-18
Field Tour	FCS 1, VS homestead	17-07-14	5, FCS, 1 the focus	Pages 19-21
Field Day	FCS, 2, MNA	17-07-14	50 demonstrations	Pages 22-24
Field Day	Demonstration Site	17-07-14	50demonstrations	Pages 24-27

Interview	Climate Change Activists Office	01-10-14	1 interview, VM	Pages 28-30
Demonstrations	Agro-industry	01-10-14	20 farmers and agents	Pages 30-35
FGD	FCS 2, BC & family.	02-10-14	4 participants	Pages 43-48
Field Visit	FCS, 9, FN	20-06-16	5 participants	Pages 48-53
Field Visit by PN	Demonstration Site	21-06-16	2 participants	Pages 54-58
Field Visit	FCS 3, LN (DS)	22-06-16	4 participants	Pages 58-64
Field Visit	Demonstration Site LM ³	22/06/16	4	Pages 65-72
Field Visit	Demonstration Site	3-07-16	20 participants	Pages 72-75
Field Visit	FCS 4, SM ²	07/17	5 participants	Pages 75-80
Field Visit	FCS 8, JM ²	07/17	5 participants	Pages 80-84
Field Visit	FCS 10, VC	07/17	3 participants	Pages 85-95
Field Visit	FCS 5, SS	07/17	3 participants	Pages 95-100

4.6 CREDIBILITY, TRUSTWORTHINESS AND CONFIRMABILITY

Research generates knowledge which is aimed at a particular epistemological status, complying with a standard of credibility (Botes & Otto, 2003). Credibility can be referred to as the best account for the truth. On observations Lincoln and Guba (1985) noted that observations should occur at different times. In this thesis observations were mainly recorded during a crop production cycle that is either at the early, mature or at harvesting time by year. Table 4.4 shows the observations done and how they are depicted in the thesis as plates shown by date. In this thesis the trajectory that I followed was of multiple observations in either a two or three crop cycle. Member checking was one way of credibility assurance and this required me to enter critical discussions with the respondents to confirm the validity of my interpretations. New data to describe the phenomena better was obtained during member checking. This gave me an opportunity to clarify grey areas (obscurities and uncertainties) with the respondents (Lincoln & Guba, 1985; Botes & Otto, 2003). Plate 4.1 to the left shows a member checking a video clip she had participated in a year before while another member to the right, checks on what he said before as recorded in typed transcriptions.



Plate 4.1: Members checking video and text transcriptions

In my study I gave members the opportunity to verify what they had said as recorded on videos and also in text transcriptions. Members were given the chance to go through the videos and change their perceptions if they wished and to go over transcribed text to check if what I had captured still represented their views. Critical discussion took place with peer group members as the researcher engaged experts in argumentative discourse about methods of data collection, analysis, interpretation and selection of the population and sample (Lincoln & Guba, 1985). At every stage of this thesis development I made presentations during the Rhodes PhD week sessions. The instruments were also presented and I received comments on how best to make them more credible and worthwhile. The data was also presented to a board of academics during the PhD weeks and several conferences that I attended. Therefore as noted by Lincoln and Guba (1985), I engaged other experts in ESD in this thesis journey. Transferability in this case study refers to the applicability, or relevance, of the research to phenomena in the broader environment of practice (Lincoln & Guba, 1985; Mingers, 2004). To ensure transferability of this research, I had to document every stage so that it would be easy for other researchers to follow the data generation processes and apply findings in other environments [cf. Gant Chart or the Thesis Milestones in Chapter One Table 1.1.

4.7 RESEARCH ETHICS

The ethics of qualitative enquiry are concerned with the principles and responsibilities governing conduct in the field and writing up accounts of fieldwork (Schwandt, 1997). In this

regard I considered dialogue, consensus, confidentiality and security amongst different personalities as ethical considerations. Member consent and member checks were important for allowing research participants the freedom to move in-and-out of the research, ensuring both respect for persons and respect for democracy (Bassey, 1999). This study process included engaging with community elders, the village head and kraal heads in the case of any unnoticed cultural and ethical breaches. The Rhodes University Education Higher Degrees Committee, through my supervisor Distinguished Professor Lotz-Sisitka, endorsed and gave ethical clearance for use of the one-page ethical protocol document and various consent forms that had to be signed by different stakeholders (see Appendix vii). I sought clearance with the community leadership, the village head and the kraal head as gatekeepers of the community studied. I talked about my PhD project in the vernacular (Shona) explaining all the concepts in the study, the research process and methods. This was important as the project involved taking pictures and videos; they wanted to know why and what I would use the pictures and videos for, and I explained it would be for me to generate rich insights into the learning and farming practice development as viewed from their experience and practice, in order to assist others to learn how better to engage with sustainable farming practices in the face of increased droughts and climate variability (i.e. I used plain language to share the more complex theoretical aspects of my study). This was done despite the fact that I am a member of the same community under study and despite the fact that I had completed several other research projects with the same community who understood my role in the community and my role as a university teacher who had an interest in development and well-being of the community. Despite this history, my PhD study was different required a new mandate to do the research in this village. The village head signed the consent form on behalf of the village. The village stamp was used to authenticate his consent. Paul Oliver (2003) noted this informed consent process as one central feature of social science research ethics where the participants should be fully informed about the research project before they assent to taking part. Plate 4.2 shows some of the research participants signing the consent forms.



Plate 4.2: Participants signing the consent forms in the presence of the researcher

The kraal head also signed the informed consent by putting his name and signature and stamped the form using the kraal head stamp. This opened up the study space via the local institutional framework, and allowed me to engage in data collection processes in the village for the entire study period, with the individual farmers' and other participants' consent which I sought at the start of any engagements with them. All the research participants; the village leadership, the rural farmers, farmer agents, industry, NGOs, climate change activist and teachers voluntarily agreed to participate in the study and sign the relevant Consent Forms. As the study was long, I needed to regularly check if all were still happy to continue with the research process, which I did verbally as I interacted with them over time. At every stage of the research process, I had to repeat in vernacular language (Shona), what the research was about, simplifying all technical jargon on climate change, community-based farmers' agency and capabilities. The benefits to participants to this PhD study such as a database of a network of community-based farmers with a common interest who can possibly work towards supplying products to the agro-industries of the country, had to be made clear to the community-based farmer participants. This was meant to avoid confusing the community-based farmer participants who had in mind other projects that I had helped facilitate in the same community earlier, such as the nursery tree project. Moreover, I reiterated that the participants were free to move out of the project, but by the nature of the project, being a project based on the individual community-based farmer's crop or non-crop field, none except two who had migrated to urban areas opted to move out.

At every stage I tried to protect the research participants from injury, harm and food poisoning during Field Day gatherings and during organised focus group discussions by engaging fully the local community logistics structures. For all food logistics, I used the farmer agency (government representative) to provide the list of healthy foods to be consumed (this is always the norm for agriculture Field Days). Approved community ‘food sheriffs’, who are local community members approved by the community to cook for public gatherings, were engaged. They were responsible for food preparation and serving.

4.8 CONCLUSION

This chapter has described the research methodology and the generation of research evidence. Constituted as a critical realist case story study interested in intensive, depth ontological insights, yet recognising the constructivist nature of knowledge and experience, the main research instruments were interviews both with key informants and with groups of the community-based farmers as focused interviews. Observations were done throughout the thesis journey and these have been backed by videos and photos as documentary evidence. Ethical considerations were discussed and these involved the signing of consent forms by participants and member checking of the reports and videos and the freedom given to participants to opt out of the study at any time. The next chapter looks at the research findings.

CHAPTER FIVE

ANALYSIS OF FARMERS' CURRENT CAPABILITIES, ACHIEVED FUNCTIONINGS RELATED TO CLIMATE CHANGE ADAPTIVE AGRICULTURAL PRACTICES AND CONSTRAINTS TO THE PRACTICES

5.1 INTRODUCTION

The goal of qualitative data analysis is to uncover emerging themes, patterns, concepts, insights, and understandings (Patton, 2002). This chapter seeks to address the first sub-research questions as outlined in subsection 1.6.1 and as derived from the main research question in section 1.6 on the farmers' capabilities and adaptations to climate change risks and vulnerabilities. In line with the data collection methodology discussed in Chapter Four, the farmers' social learning trajectories were studied through observing and interacting with a practice and the observed practices were captured in hard and soft copies. The records included findings from interview guides, photos as hard evidence and videos and audio recordings as soft copy evidence. The audio and video evidence was transcribed and abstracted for the purpose of extracting the research findings for this and further chapters.

To bring out a transformative pedagogy trajectory in community-based farmers' achieved functionings, observations of the current farming practices, were made while detailed interviews and focus group discussions extracted the history of each climate change adaptive practice. Analysis in this chapter is viewed from identified capability functionings under two main farming categories, crop and non-crop. The crop farming category analysed in this chapter includes rain-fed farming [under a subsistence mode] and small scale irrigation farming [semi-subsistence, a mixture of market-based mode of production and adaptation to observed climate change]. The non-crop farming category analysed in this chapter includes apiculture (beekeeping), aquaculture (fresh water fishpond farming) and dendrology [tree seedling and shrub nurseries which is a branch of botany and a plant science that studies, identifies, and even names plants that have woody structural systems, typically woody plants, trees, shrubs and vines and so on] (cf. sections 1.7 and 4.3). The qualitative research findings analysed in this chapter have emerged under the context of a shift from severe droughts that characterised the period 1990s to 2012. During the period after the 1990s long dry spells and

at times meteorological, hydrological and agricultural drought-episodes with worse peaks recorded in 1992 and 2006 [cf. Figure 2.2]. The 2013 to 2018 agriculture seasons were relatively favourable for community-based rain-fed farming practices when compared to previous farming seasons. For each identified capability functioning studied, three segments are presented in this chapter: the rainfed conservation maize crop farming and small grains; small-scale irrigation and market based farming; and non-maize crop farming. These are presented under the following categories:

- a) the history (before and during the study) that is the old farming practices, as well as the new adaptive practices, are identified;
- b) the capabilities (valued beings and doings) such as food security and nutrition, education, health, shelter and markets for improved economy through alternatives to subsistence farming practices and so on; and
- c) the capabilities resource conversion factors such as personal, social and environmental as they bring about tensions (ills or constraints) and enabling conditions/factors.

The three segments [a to c] noted above, are a summary of the capability frameworks [cf. section 3.4]. I used the three capability frameworks to present and analyse information on the current farming practices and resources identified. The frameworks in section 3.4 were also used to identify and analyse the conversion factors using the five building blocks [cf. Figure 3.3] of the capability approach. The commodities [I also called these inputs or raw materials] are hereby classified also as products or outcomes under market or non-market modes of production. To extract the relevant information on capabilities from the transcriptions, I used data abstraction, a concept I introduced in Chapter One section 1.7.3 and in section 2.2.7 on a case story by case story basis. Each farmer's case story is also abbreviated in this thesis as FCS. Data abstraction in this chapter is taken as a process of removing unwanted details from transcription text so that one remains with the representative details that help to answer the research questions (cf. Danermark et al., 2002). '...to be adequate (knowledge) it must 'abstract' from particular conditions, excluding those which have no significant effect in order to focus on those which do' (Sayer, 1992, p. 86). The following sub-section abstracts data from each Farmer's case story.

5.1.1 Farmer's Case Story 1 (Profile)

FCS 1, **VS** is a community-based farmer who practises a subsistence non-market mode of crop farming under rainfed agricultural practice as the achieved functionings. For the period before 2012 **VS** has not been harvesting enough maize (a staple food crop) to sustain her big family (extended). She shifted towards conservation farming practices [new capability set, the valued being and doings] between 2012 and 2017 (thesis data collection period) which she learnt and reflected with and from another villager in 2012. Her new adapted practice involved the use of in-field water conservation (harvesting) techniques also referred in this thesis as the commodity or input needed to convert to the achieved functioning of conservation farming. **VS**'s fertility trenches are not the standard trenches in literature [cf. subsection 2.6.1] one metre deep; hers are only moderately deep and contain buried harvested maize stalks, grass and forest humus. Due to their spongy characteristics, the buried maize stalks retain moisture once it rains, and enhance soil fertility when they rot. Since FCS 1, **VS** embarked on the new functionings [fertility trenches and conservation farming practice], the maize yield or harvest from her crop field has increased steadily [from zero tonnes to four tonnes] over a period of five years, 2012 to 2017. Her practice was observed to be good for temporary agricultural droughts of three or so weeks but were not good for long meteorological and hydrological droughts. The rotting maize stalks and humus collected from the bush, also helped to change the soil structure from sandy gravel to a more dark loamy soil, a possible indication of an enhanced soil fertility over the 2012-2017 five year period. This is a new capability set (the materialised functionings) she attained through social learning from other community-based farmers [social learning and ecologies of knowledges, De Sousa Santos, 2007] through non-formal learning at a field and harvest demonstration day (Field Day) a platform for social learning pedagogic trajectory. She sometimes used artificial fertilisers when they were available [government free fertiliser distribution programme – once referred to as command agriculture and later to *pfumvudza* or conservation basins farming support - a social conversion factor]. FCS 1, **VS** also does manual hoe-weeding of crops and does not use herbicides even though they are readily available on the local markets and at affordable prices.

Tensions emanated from social conversion factors (Sen, 1993; Bhaskar, 2016) when the new knowledge practice on fertility trenches was not readily recognised and shared by the extension service and yet was readily accepted by other communal farmers (the case of

structure as a disabler). The extension officers agreed in 2016 on a Field Tour of FCS 1, **VS**' field after which they said they would recommend a Field Day.

The capability conversion factors that FCS 1, **VS** interacted with included social, which was a result of the type of education that she received including from extension services. Her comment, '*Takainonokera!* We left it (farming) until too late (old age), wasting time staying in towns!' might have shown that she had come to realise that as a human being, FCS 1, **VS** was not to blame for her failure to harvest maize sustainably, but she was disabled by her stay in town (Sen, 1993).

The other social conversion factors that disabled FCS 1, **VS** from enhancing her new functionings is the large family (extended). FCS 1, **VS** takes care of five dependents including three grandchildren (subsection 4.3.2; Table 4.1) and the cost to take care of the big family often diverts resources from enhancing production to meeting the demands and wants of the big family and such, I view them as personal and social (latent) conversion factors [cf. subsection 2.4.6]. In terms of physical or environmental conversion factors as a source of tension or a disabler of the farmer's capabilities, heavy rains that the community under study experienced in part of 2016-2017 season caused water logging. FCS 1, **VS** adapted through the raised ridges innovation so as to keep away water from logging and choking her maize crop. Plate 6.1 shows the adaptive social learning pedagogic trajectory that the community-based farmer FCS 1, **VS** took from 2012 to 2017.

she associated her new practice of water conservation with increased maize crop yields [subsections **2.2.3** and **3.3.3** on laminated totalities] and so she continued with the practice. Her achieved and new functionings thus involved digging fertility trenches (sub-section **2.6.1**), burying humus and harvested maize stalks [as commodities or inputs] for in-field water harvesting and for soil health (Photos **3** and **5**). Over a period of five years she transformed from a poor maize harvest (a few kilograms per year or zero tonnes before 2012) to a better harvest (four tonnes in the 2016-2017 season) from the same crop field space as shown from Photos **6-9** in Plate **5.1**. The maize crop yield of four tonnes after a shift towards sustainable farming practices [new capability set] might have reflected transformation (**4D**). Thus FCS 1, **VS**' success story can be viewed from the new capability of food security and good health, a move from **1M** to **2E** to **3L** and ultimately to **4D** when capabilities functions are read alongside dialectical critical realism's MELD schema. While FCS 1, **VS**'s conservation farming practice attempts to adapt to climate change, tension remained since she still use artificial fertilisers some of which have been blamed for contributing to global warming.

Today (2018) FCS 1, **VS** can afford exchanging (barter) her maize crop for other basic needs such as soaps, clothing, and she sells a few to fellow villagers. Barter has been an old practice in Zimbabwe [cf. Beach, 1977; Palmer and Parsons, 1977; sub-section **2.4.5**]. The little money she raised from selling part of her products is used to buy other groceries such as peanut butter and cooking oil and sending grand children to school. FCS 1, **VS** managed to build a double squatting-hole ventilated pit latrine and a semi-detached bathroom (shelter and health) and bought orchard trees from FCS 10, **VC** for her orchard garden (capability of nutrition). In a five-year period of collective capability and agency and emancipatory trajectory, FCS 1, **VS** learnt and practised to move from being a food handout receiver to a food sustenance community-based farmer, a move from non-being (**1M**) to being (**4D**). This marks the case story of FCS 1, **VS**'s social learning trajectory and practice and a move towards her new capabilities (freedoms) and valued functionings in conservation farming practice.

5.1.2 Farmer Case Story FCS 2, BC (Profile)

FCS 2, **BC** is a community-based farmer who practised subsistence non-market mode of crop farming under rainfed agriculture as a capability set. FCS 2, **BC** practised farming of

traditional maize crops (Hickory-King-*Hakiri-king* in local language) since the 1950s under cow dung manure and pit composts and with deep contours as a water harvesting technique (subsection 2.6.1). FCS 2, **BC** shifted to the green revolution's hybrid seeds and artificial fertilisers from the 1980s when the Zimbabwean government began to support the then disadvantaged Black community-based farmers with free seed and fertilisers [a social conversion factor]. But FCS 2, **BC** is slowly returning to his old green agriculture [environmentally friendly] through the use of cow dung and compost as well as the return to traditional maize crop, the open pollinated seed variety (OPV) and so reducing the use of hybrid seed after 2010. FCS 2, **BC** is currently practising the digging of basins [conservation basins] as an in-field water harvesting technique and also as the commodities or inputs [cf. subsection 2.6.1] as well as soil fertility enhancement since the basins are always filled with cow dung manure and compost. FCS 2, **BC** does hoe (manual) weeding of crops and does not use herbicides which are readily available in the local markets and at an affordable price, by this community's standard of assessing affordability. This section marks the history of social learning in FCS 2, **BC** and his current farming practices (capability et), the commodities or resources he used as well as his (**BC**) capability set which is non-market or subsistence.

This community-based farmer, FCS 2, **BC's** practice is still endowed in intergenerational knowledge transfer (traditional knowledge systems which also falls within the informal learning category) and a shift to traditional seed variety as his inputs (Robeyns, 2013). FCS 2, **BC's** new achieved functioning is seen through the digging of conservation basins technique, a skill achieved through non-formal education from extension services and the agro-based donor communities. FCS 2, **BC** also used OPV maize seed, seed he inherited from his parents and which he claimed, ensures food sustenance. The fact that FCS 2, **BC** still value practicing, OPV might suggest that he still exercise his capability set and exercised his freedom of choice [alternative to the government's hybrid seed distribution]. Conservation farming and OPV are FCS 2, **BC's** new capabilities and achieved functionings learnt socially from other villagers, his parents and from extension service.

Tensions rise from climate change that disables FCS 2, **BC** from practicing farming his long season maize variety - the OPV [needs more water than the short season varieties] since he is not practicing irrigation farming. FCS 2, **BC** also takes care of orphans and such a big family [cf. subsection 4.3.2; Table 4.1] often demands that the economic resources are diverted from enhancing his productive capacity in the crop field into social demands (latent personal and

social conversion factors). FCS 2, **BC** also practises barter trade of products and often shares OPV seed with fellow villagers for free. While FCS 2, **BC**'s conservation farming practices are good as climate change adaptation, his use of artificial fertilisers brought tensions to his new capabilities and functions of moving towards environmentally friendly farming.

5.1.3 Farmer's Case Story 3 (Profile of the group of youths at the demonstration site)

The group of youths under the code FCS 3 were represented by LN but comprised of more than nine youths who also provided information on the farming practice at the demonstration site in their individual capacities. The youths who provided information were as follows: OD; JM¹; PG; KS; SM¹; MM; BD and GC [GC an expert in agricultural crop science] **CM**⁴ [the first agriculture student to join the youths on attachment to this community based project as an experiment to work on the production and processing of organic sunflower and home-made cooking oil in 2019] form a group of youths and young adults from the community-based farmers' demonstration site.

FCS 3, **SM**¹ was responsible for breaking into the urban market between 2012 and 2013 and FCS 3, **JM**¹ was responsible for the entry into the urban markets as a new capability set of market based farming between 2015 and 2016 while FCS 3, **OD** was responsible for entry into the urban markets in 2017. FCS 3, **LN** apart from him being the youth leader, was responsible for the pathway towards the entry into the new capability set of industrial market in 2018. The youths took turns to send products to the urban markets, each bringing back rich experience and exercised responsibility, transparency and accountability especially where finances were concerned. This group of youths started the move towards organic farming and small-scale market oriented production model during the thesis study from 2012. The farming practice at the demonstration site shifted from non-productive rain-fed monoculture maize agriculture, 2007 and before to a semi-commercial practice where they supplied products to a nearby agro-industry in 2018. The youths moved towards organic production which was characterised by the absence of artificial fertilisers and perennial farming aided by the use of small-scale irrigation as from 2012.

At the thesis inception in 2012 the youths relied on a new capability set of environmentally friendly farming and so they absented artificial fertilisers by replacing them with humus from the forest, collecting humus and grass from the forests as well as using cow dung for composts. The youths FCS 3, also started crop rotation (two-three crop cycles) as an achieved

capability towards environmentally friendly farming after 2012 when permaculture (mixed cropping), mulching as an in-field water harvesting technique and irrigation were practiced.

By 2013 the youths reflected on the quality and quantity of harvests from compost manure and from the spreading of dung and humus collected from the forests. They observed that the products from compost farming were smaller in size than products that were conventionally produced under artificial fertilisers and so their produce was not appreciated by the competitive urban market. In 2015 the youths reflected back on how to prepare the anaerobic manure or liquid manure [subsection **2.6.1**] which they were taught by **GC** in 2012. They had applied liquid manure at a small-scale that is preparing it in small 20litre cans, then. The youths reflected on scaling up this revived innovation to a higher level where six drums of 210 litres each were used. A relative proportion of dung and water (33% dung to 67% water) was used for each 210litre drum container. This was the ‘miracle’ water that they had missed to enhance soil fertility and increased crop size, quality, appearance and yields per unit area. Liquid manure accounted for how the youths finally increased production quantity and size. But this did not account for all soil nutrient demands.

Apart from liquid manure, the youths (Farmer’s Case Story **3**) learnt of the use of biological pest control and they also broke beyond the local market into a competitive urban open market system [2012 to 2017 and finally into the industrial market in 2018] through a reflexive recursive and reflective process. The youths achieved the new capability set of mark-based gardening under perennial small-scale irrigation practice. Demands from the new markets enabled the functioning of specialised education for sustainable farming practices that is organic which added value to the already value added industrial crops. With income, the youths could now afford to attend some of the trainings and meetings with industries since they had the means for travel and the means to hire trucks to send their products to the urban markets. The youths also did hoe-weeding of crops and did not apply artificial herbicides even though they are readily available on the local markets and at an affordable price too. [Laboratory test results on the products that were produced by FCS 3, tested negative against pesticides and use of heavy metals (chemicals) and this showed that the youths were honest in their claims on environmentally friendly farming practices. The laboratory test results are found in Table **8.2**]. The information on the commodities or inputs and resources used by the youths and analysed in this chapter, have been abstracted from detailed interviews and FGDs’ transcripts.

Several capability sets or valued beings and doings were achieved by the youths such as food security and nutrition from organic farming practices, rotation of crops and biological pest control and soil enhancement and environmental protection through the reduction of heavy metals (chemicals) and pesticides and artificial fertilisers. The youths also achieved the functioning of marketing as absencing subsistence and this new capability set had several other functionings. The commodity or inputs for FCS 3 (raw materials or means of production) included shared knowledges, sloping terrain (irrigation under the force of gravity), improved soil health through organic practices, cement and brick built surface water reservoirs, a water pump (fossil fuel powered) and a sub-surface (buried in soils) hosepipe network system for syphoning and basin agriculture. The conversion factors included personal (latent) knowledge from formal education at school and shared knowledge of new farming practices and standards from non-formal education through sharing with extension service. The youths also shared knowledge with other community-based farmers (social conversion factors) during the Before Harvest Field and Demonstration Days (Field Days) and through informal learning by the use of cell phone network, videos from practices recorded in other provinces of Zimbabwe and through other social media platforms. Such social conversion factors enabled the youths' functionings. The youths engaged with physical or environmental conversion factors (Sen, 1993; Robeyns, 2005; Robeyns, 2013) which included droughts. These created the opportunity of the new capability set of water harvesting. The sloping terrain at the demonstration site enabled the conversion to the new capability set of diversion trenches. Knowledge on markets and marketing was learnt through interacting with other youths and through a reflective, reflexive and recursive process with the market itself [ills or challenges from the market were a source of learning too]. As their products got rejected by the market, the youths learnt socially from the market as they tried to make-up on quality and quantity from 2012 until 2018 when their peas product finally found its way into the agro-industrial market. Knowledge here was a social conversion factor (Harvey, 2005) that enabled the function of shifting towards organic farming, rotation of crops and perennial farming practices under a form of irrigation that is meant for the industry, a market mode of production and new capability. As personal and social conversion factors, the youths in FCS 3, took turns to take products to the market, for transparency and accountability. Accountability as a social conversion factor and 'ethics in business' created tensions amongst the youths and this led to the establishment of a delivery note system, where counter signatures were used for accountability and transparency. Tensions from social

conversion factors as observed through dendrology (tree nurseries, a branch of botany) produced by the youths, were multi-faceted. The availability and timing of transport for bulky products (tree nurseries) demanded bigger trucks (thirty-tonnage trucks) which were not easily available and accessible to the youths, FCS 3 when they were needed, thereby causing delays in deliveries to the market and creating losses to the youth and other community-based farmers in the process.

Environmental conversion factors such as the poor road network which were not accessible during the rain seasons when tree planting was in progress, caused delays on delivery and so the youths and other community dendrologists incurred losses. While the youths had now mastered the skill of producing healthy and marketable exotic tree nurseries (dendrology) since 2008 they were suddenly disempowered when they were advised by government and non-governmental agencies to produce indigenous tree nurseries in the year 2014. They had little experience in this new venture (social conversion factor as a disabler). At that time the pricing system of tree seedlings positively favoured more, the indigenous (USD \$1 to \$3 per plant depending on the variety) than the exotic (USD \$0.10 per plant or \$0.05 depending on the buyer) hence the youths were pushed out of business (Harvey, 2005). Apart from the pricing system that favoured indigenous tree nurseries, the delays in the payment system (from buyers that included arms of government) at times going into three to four months after the supply of the tree seedlings products, disabled the young farmers and the community. Such delays in payment of three to four months for a product that also needed close to six months in the nursery pots, meant that the producer (youths) would not be able to remain in business in the following production season as they had to buy inputs in time. The price of the tree-seed varieties from government was also quite inhibitive too [USD 500-1000/kg depending on the variety].

Tensions, the market, also failed to peg a higher price for organic products as compared to those conventionally produced. At the local open urban market the communal youths faced competition as they faced an ever shifting downward pricing system each day they sent products to the market. Price was not static and each day had its own pricing depending on the supply and demand of the product (peas). The youths reflected on poultry in 2012 and 2013 to supplement horticulture but the project was a flop as they failed to meet the market demands on standards and transport while refrigeration was also a challenge in the absence of a reliable electricity supply, hence they shelved the project. For entering the lucrative hyper-

super markets in horticultural products such as tomatoes and peas, the low prices and the failure by such hyper-super-markets to recognise and distinguish the organic products through a favourable pricing system from those conventionally produced under artificial fertilisers, depressed the community-based youthful farmers' morale. Low prices were another form of illness and social-environmental conversion factor faced by the youths. While the donor agencies emphasised social learning on farming business, they did not open the market opportunities for the trained youths and other community-based farmers to complete the agriculture value chain. The community-based youthful farmers were often stranded with large quantities of a product (king onion, garlic and small grains) that they could not all consume while the so called markets as promised during trainings were nowhere to be found or were protected by different bottlenecks [cf. Harvey, 2005]. The failure by the urban market to recognise the health-value of organic products since the organic products were pegged at the same price as conventionally produced farm products, was one disabling social conversion factor faced by the youths in FCS 3. Also, the demand by hyper-supermarkets, hotels and government institutions to buy products from registered suppliers only, disabled the youths from accessing such lucrative organic markets after they had met the previous demands by the same markets such as following the basic organic standards [cf. subsection 2.3.4], right quality, right size of product and guaranteed consistency and specific quantities [cf. Harvey, 2005]. The downward trend in prices of products as supply increases (price elasticity) at the market confused the youthful farmers in FCS 3, who had to deal with a static and high transport cost from the village to the market. This led to unforeseeable losses in profits and that created tensions [social conversion factors]. More tensions were noted from the new functioning of insect pollination with an aim of increasing yields of their peas crop. The youths, on pollination of the peas crop by bees, placed apiaries inside the peas crop, but could not stand stings from bees from one fully swarmed apiary. Insect pollination was a new capability set that the youths learnt from books and from the local expert other, FCS 8, **LM³** during field tours at FCS 3 [cf. Table 4.5]. Thus, in the absence of bee extraction gear (suits) the youths could not work in the organic peas field crop because of stings from the bees and so they quickly returned the hives into the nearby tree bushes away from the peas crop. This was tension from the type of formal and informal learning that the youths received which was not complete as it failed to give precautionary measures against stings such as how to take note of the positioning of the 'doors' of the hives and the provision of extraction gears and where to place the hives which was supposed to be at the edge of the field

[subsection 2.5.2]. Upon further reflection the youths positioned the swarmed bee hives at the edge of the crop field and the results in 2018 were pleasing since the youths finally managed to send a good-quality and quantity crop to the industry (753kg).

Other tensions emanated from a disabling pricing in the dendrology venture (tree nurseries) included the shift in policy towards the production of indigenous tree nurseries which the youthful farmers FCS 3 then produced at the same space they produced exotic tree nurseries, created other physical conversion tensions. The youths blamed such a move for the transfer of diseases from the indigenous tree seedlings to the exotic tree seedlings thereby forcing them out of business as all their exotic tree nurseries were diseased and condemned. This was after a leaf disease that was similar to galls or bumps was observed on the leaves of some of the deciduous such as Zebrawood's [*Brachystegia spiciformis*, *Msasa* in Shona or *Igonde* in isiNdebele] tree leaves, also destroyed their exotic tree nurseries.

With big contracts to produce tree seedlings in millions, the donor agencies, suddenly changed the type of packaging from the usual polyethylene [black polybags, which the community had stocked in hundreds of thousands since 2008], to a new packaging system which demanded imported material [the recycled floating trays]. The floating trays needed a specialised housing (such as greenhouses) and a special manure and watering mechanism. This meant that the youths had to finally fold the project and business [social {structural} conversion factors] for good. While the dendrology project was faced with tensions as observed above, the trees that the youths FCS 3 planted in 2008-2009 in the village of study, later provided food and shelter for bees and this created a new capability set in beekeeping nine years later in 2018. This could be viewed as one social conversion factor on a positive note.

The youths from the demonstration site FCS 3 liked to go organic but the advice that they received from extension service on the control of pests was often conventional with emphasis on the use of heavy chemicals. Thus the type of non-formal education knowledge shared between the extension service [conventional farming practices with the use of heavy chemicals to fight pests] and youths who are moving towards organic farming practices, was one tension, a disabling social conversion factor. The programmes of the agricultural extension service were not always in congruence with the programmes of the youths. The youths, after doing their two and three crop cycles outside the extension service programmes,

often failed to attract extension officers to grace some of their Field Days social learning activities. The frequent call for field days by the youths was not readily accepted by extension service, who preferred to be leading the youths by way of advice on when to plant which crop and not vice versa where the youths were leading extension in new practices. This created tensions as extension services would refuse to attend to some of the field day functions for crops they said they were not involved in from inception [social conversion factors].

While extension is a formal government employment, some of the officers could not easily accept the idea that the community-based farmers would supply agro-industries with large quantities of products while extension service was not remunerated in the process. This also reflected an issue of the power gradient when the non-being is finally emancipated (De Sousa Santos, 2010, Freire, 2005). Plate 5.2 shows the social learning pedagogy trajectory the youths took from subsistence into a small-scale market mode of production and valued beings and doings (functionings).

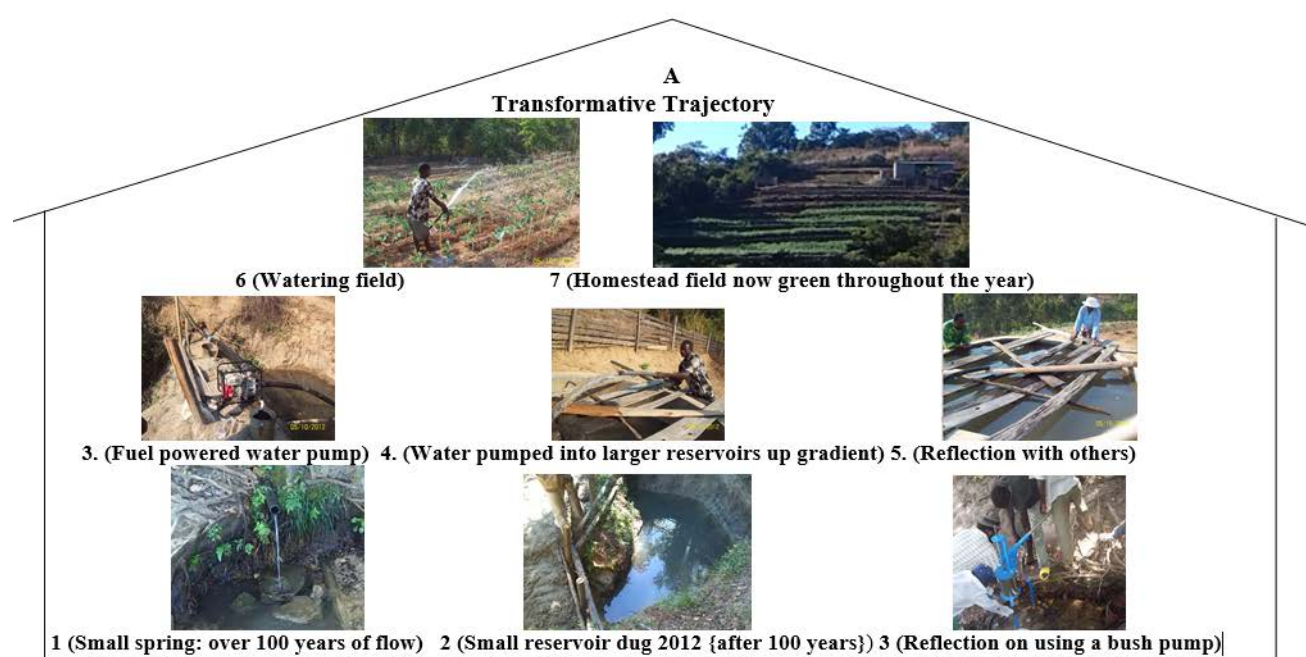


Plate 5.2: Social learning pedagogy trajectory from subsistence to semi-commercial

The collective capability and collective agency and the social learning trajectory taken by the youths in FCS 3 from subsistence rain-fed farming to irrigation and market mode of farming, was non-linear, long, and winding and one of recursive laminated cyclic reflections.¹⁴ The

¹⁴ From Plate 5.2 photos 1-7, water has been harvested from a small fountain into a small pond. The youths reflected on pumping water using a bush pump but it did not work and so a

collective capability and agency involved an iterative and recursive reflexivity process at personal (**layer 1**), household (**layer 2**) and community levels (**layer 3**), (**multi-layered**), experiments and further reflections with community elders until finally the idea of using a water pump was accepted. To date (2018) the fuel powered water pump draws water from an earth constructed water pond/reservoir that harvests water from the existing spring into two brick-walled built surface water reservoirs. From these two water reservoirs, water is drained into a network of hose-pipes that irrigate the field under the force of gravity as flooding. This has managed to change the community-based crop field from rain-fed subsistence mode of farming to small-scale irrigation and a market mode of farming or semi-commercial. The small stream (Photo **1**) is a commodity or input and commodity, an environmental conversion factor that was converted, upon laminated reflections at different levels (personal and family and community {social conversion factors}) into the functioning of irrigation (Photos **2** to **4**) and water harvesting (Photos **4a** and **4b**) and sustainable food production (Photo **7**). Thus the transitive view of springs as commodity or input and commodity in this study, shifts from water being a source for drinking and cooking only [for over a century as was the case story in this study area], to the stream as a source for irrigation (2012-2018 and beyond). This does not change the intransitive (Bhaskar, 1989) flow of this water source throughout the year as it has done for over a century now. Tension is noted on the use of a fuel powered water pump when the youths are moving towards organic farming as a climate change adaptation mechanism. A fuel powered water pump contributes to greenhouse gases and global warming. Plate **5.3** shows the other trajectory taken by the youths through intergenerational knowledge transfer on small grains (social conversion factors).

fuel powered pump was used to pump water into a reservoir in order to practice flood irrigation for perennial market gardening.

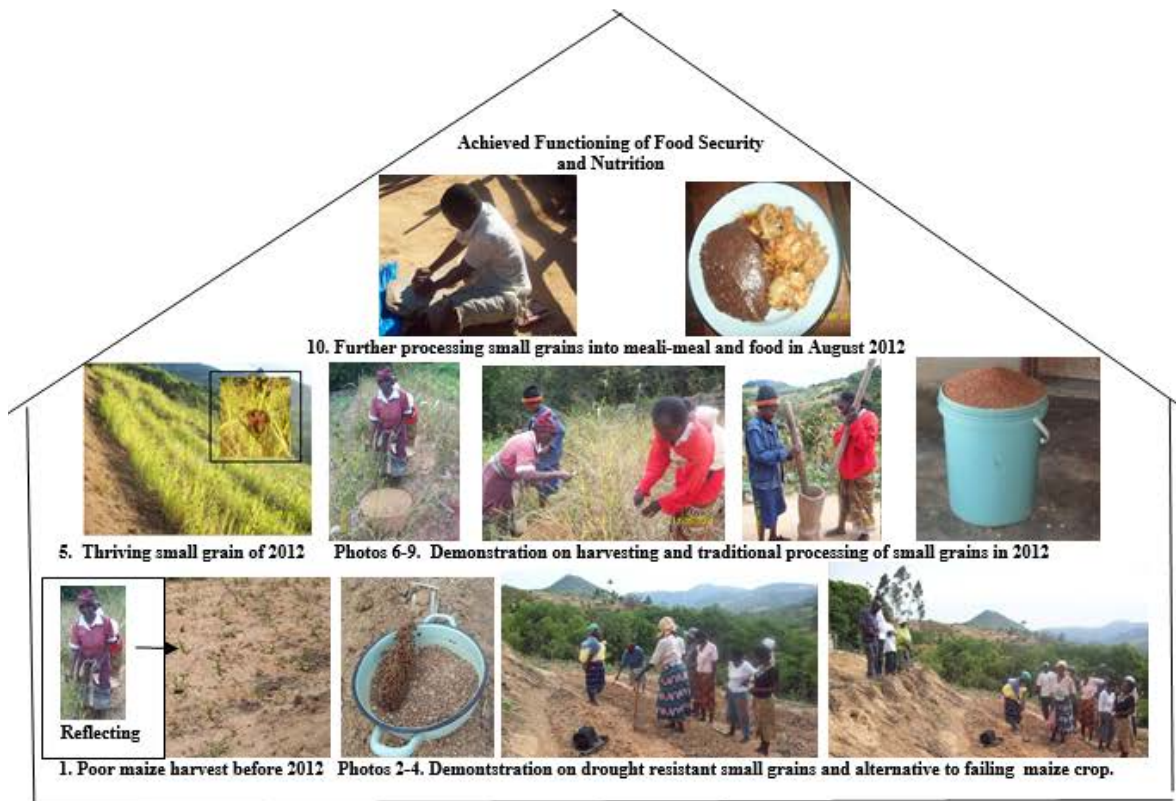


Plate 5.3: A social learning trajectory through intergenerational knowledge transfer

In Plate 5.3 the community elder **ED** reflected on poor maize production due to erratic rains and poor soil health (Photo 1 and Photos 2 to 4) and that is **1M** (non-being).¹⁵ They (as a team at the demonstration centre) decided on planting small grains as an alternative to maize and so demonstrations on the new method of sowing the small grain seed and not the traditional broadcasting, was showcased by the community elder **ED**. Methods of manual weeding of the crop were also demonstrated and so were the ways of harvesting (Photos 5 to 7), to the processing stage 1 of the small grains (Photo 8). The product output (Photo 9) and the final processing stage 2 (Photo 10) with the end product, or product outcome, a meal (Photo 11). Intergenerational knowledge transfer became one enabling social conversion factor.

¹⁵ From Plate 5.3 Photo 1 the granny reflects on poor soils and a poor maize crop, before 2012 (Thesis inception). She reflected together with other villagers during a CoP meeting on soil fertility enhancement in Photos 2-4 and in Photo 5 a thriving small gain crop rapoko was in place. Photos 6-9 shows the harvesting process in 2012. Photos 10 and 11 shows the processing and the food produced.

One other new climate change adaptation capability set and achieved functioning was the shift by the youths from claims about the quality of crops and soils (self-perceived or internal morbidity of crops and soils) to a more scientific laboratory testing of crops and soils (observed or external morbidity). Thus on self-perceived (internal) and observed (external) morbidity of soils and crops [subsection 2.4.4] the youths had part of their peas crop, that they had claimed since 2012 was free of chemicals and was said to be extra nutritious, canned and laboratory tested in July 2018 and also tested for heavy metals (chemicals) and for pesticides in 2019. The youths also learnt about laboratory soil testing (the observed morbidity of soils) and sent soils from the demonstration site, a field they claimed to be organic, for scientific testing for pH and other parameters, something that was congruent mainly to commercial farming.

More tensions were noted regarding the new capability sets of small grains as an alternative to maize crop farming and the shift towards scientific approach to farming that included laboratory tests of crops and soils. The small grains farming as climate change adaptation as knowledge learnt from informal learning (intergenerational knowledge transfer) was not popular with the local (village) buyers. Apart from being a healthy food, the thick porridge (*sadza*) from the small grains could not easily be eaten with traditional relish. This made small grains to remain unpopular with the community-based farmers and youths in FCS 3. Unlike the maize crop, which after shelling could easily be processed by harmer-millers, the shelling process of the small grains takes much longer. It involves much winnowing and pestle and mortar pounding which is seen by the youths FCS 3 as time consuming (social {culture} conversion factors). While the youths now like to go organic in all their field crop practices, they are still operating at a very small scale (0.5hectares) and most of their other crop fields are still under conventional farming practices. Like all citizens in Zimbabwe, they still receive and use free hybrid seed and artificial fertilisers from central government (a social conversion factor).

Another tension emanated from the new capability set of laboratory testing of crops and soils which was costly for rural farmers. More tensions emanated from engaging with CM⁴ [a diploma student on attachment who had to be supervised by youths who did not have qualifications in Agriculture as a subject]. Trying to monitor a student attached to a rural based project proved to be a mammoth task.

5.1.4 Case Story 4 (Profile)

Farmer Case Story (FCS) 4, **SM²** is a community-based male farmer who is also a teacher by profession. In terms of history FCS 4, **SM²** shifted from non-market production mode to small-scale irrigation and marketing at both local (village) and urban levels in 2015. Before, FCS 4, **SM²** practised subsistence rain-fed farming. FCS 4, **SM²**'s new capability set and achieved functionings and choice, was a market mode of production through small-scale irrigation using water harvesting techniques [subsection 2.6.1]. He diverted water (diversion furrow) from a nearby stream into an earth dug reservoir and from there he pumped the water using a petrol pump into a 5000 litre plastic tank on a raised platform. The water is released through the force of gravity from the plastic tank into a network of hosepipes and into his crop field and garden. The resources as commodity or inputs and commodities or means of production that FCS 4, **SM²** used include a 5000 litre plastic tank on a raised platform, a fuel powered water pump, conventional seeds, cow dung [he has a small herd of cattle] leading to enhanced soil health, personal and shared knowledge and slope [environmental conversion needed for the conversion into the function of irrigation through the force of gravity]. Tensions towards conservation farming and climate change adaptation was evident in the use of a fuel powered water pump which contributes to greenhouse gases and global warming. FCS 4, **SM²**'s individual conversion factors included personal knowledge on horticulture from formal education, social conversion factors from non-formal education through attending the Before Harvest Field and Demonstration Days (Field Days) at the community-based demonstration site of FCS 3 and informal learning on markets through social media and SMS. FCS 4, **SM²**, being a formally employed civil servant, was able to sustain field using a fuel powered water pump (personal conversion factor). The plastic water tank reservoir was bought by his brothers from the diaspora (social conversion factor) and enabled the functioning of market gardening through irrigation. The physical or environmental conversion factors were realised through the use of gradient to harvest water from a nearby stream through a diversion trench into a pond and then pumped into a water tank using a water pump then drained into the crop field down gradient as flood irrigation. FCS 4, **SM²** also practised permaculture with a mixture of onion and green vegetables in the same space. This acts as biological pest control. He also did physical weeding using hoes, a practice which is not artificially done using herbicides which are cheap and readily available on the local market (2017). FCS 4, **SM²**'s new capability of market based gardening was linked to

‘modern’ products like beetroot, lettuce and cauliflower that fetch better market prices from urban hypermarkets.

Here, intricate relationships can be noted: the social roles in the extended family set-up means sending remittances back home which are used to buy the means of production (water tanks and pumps). Individual agency and personal conversion factors (Sen, 1993; 2005) are evident in the individual knowledge of the use of the water reservoirs and a water pump to pull water from a small stream into a plastic tank through diversion furrows. Scientific knowledge is evident in the use of the force of gravity that the height provides to reduce energy in pulling water from the plastic tank on a raised platform and gradient into the crop field (part of latent conversion factor). There is learning from others in the community (social learning) on the issues of crop rotation and markets (Wals, 2007). These all work towards the trajectory of the emerging new farming practice and capability achieved functioning which perennial market is gardening.

Tensions also arise as FCS 4, **SM²** is constrained by transport costs to the urban market. Private transport per head from the village to the market is expensive and having small quantities of crops such as beetroot, cauliflower and lettuce which are not common on the village market, does not make large profits for FCS 4, **SM²**. While FCS 4, **SM²** wants to advance his functionings, he also takes care of a big family (extended) and so resources are often diverted from production to social needs and wants (latent and personal conversion factors).

5.1.5 Farmer’s Case Story 5 (Profile)

FCS 5, **SS** is a young community-based farmer who practises small-scale irrigation according to a local (village) market model as his new capability set. As historical background, FCS 5, **SS** shifted from rainfed subsistence farming to market gardening and winter wheat cropping after 2012 and after observing a series of droughts. FCS 5, **SS** is one of a few members of the community-based farmers in the entire village who practises winter wheat production at a small-scale. The commodities or inputs and commodities (raw material) that FCS 5, **SS** interacts with, include a steep slope that enables the environmental conversion factor of irrigation by gravitational force. A perennial stream that has been flowing and passing close to his homestead for centuries without being harvested for irrigation purposes and

decomposing dung for manure for soil enhancement as he has cattle, are all his commodity or inputs.

FCS 5, **SS** practices the new capability set of small-scale irrigation farming through water harvesting by channel diversion [cf. subsection **2.6.1**] from a nearby stream into an earth built pond or reservoir and then into the fields down a gradient through a network of hose pipes. This makes gradient another physical or environmental conversion factor that enables the function of perennial cropping and horticulture. No artificial pumping is needed and thus making FCS 5, **SS**'s functions cleaner / more-friendly to the environment in the absence of use of fossil fuels, which differs from case stories in FCS, **3** and **4**. With flood irrigation after furrow trenches there is the function of perennial agriculture and market based cropping though at a small-scale (local). FCS 5, **SS** learnt of this new type of farming (diversion trenches or furrows) through informal learning and intergenerational knowledge transfer from the family (social conversion factors) as an enabler of his new capability set. FCS 5, **SS** also does manual weeding using hoes which is not artificially done using herbicides which are cheap and readily available on the local market (2017). FCS 5, **SS** also learnt about wheat cropping and the relevant dates for planting wheat mainly in the first week into the month of May from the family, radio and television as informal learning systems. FCS 5, **SS** also learnt of wheat farming from visits and observations from surrounding commercial farms. All these social learning techniques augmented the formal education he learnt at secondary school agriculture up to O' Level (subsection **4.3.2**; Table **4.1**). Through non-formal education, FCS 5, **SS** attended Field Days from other communal farmers.

Tensions arise as FCS 5, **SS** fails to break beyond the local village market as well as the nearby mining settlements where he has personal social contacts and networks as markets for his products. Climate change and economic hardships are tensions that disable him from practising what he values being and doing. His small plot and lack of knowledge for markets (social conversion factors) constrain his functions. FCS 5, **SS** is a big family man and resources are often diverted to cater for social demands. FCS 5, **SS**' attempt to enter contract farming with the industrial market in 2018 hit a snag as the agro-industry failed to supply him with the needed horticultural seedlings citing small hectrage.

5.1.6 Farmer Case Story 6 JM² (Profile)

FCS 6, JM² is the only communal farmer in the entire village with massive water reservoirs of 100 000 litre capacity [ten plastic tanks of 10 000 litre capacity each]. He practises small-scale market oriented farming and he supplies the local (village) market with horticultural products. The history of FCS 6, JM²'s entry into this new functioning is short as he started this practice in 2015. Before, he practised rainfed subsistence farming and fallow. Fallow is noted by Kramer in 1997 as one practice that naturally replenishes the soil's nutrients. FCS 6, JM² commodities or inputs and means of production included ten plastic tanks, solar powered water pump and a favourable steep gradient for irrigation under gravitational force. His activities utilised clean energy (solar) and were good for climate change mitigation [cf. IPCC, 2014; Dirwai, Sibanda & Kakono, 2018]. FCS 6, JM² has a very short history into a market farming practice as he learnt the practice from formal education at school back in the 1970s but he did not practise it until 2015 upon a series of reflections at laminated levels. He also learnt of conservation farming from the community and through the field tours and today (2017) he is slowly moving towards organic farming practice. For organic practice, FCS 6, JM² uses decomposed cow dung and compost to enhance soil fertility and no heavy chemicals and artificial fertilisers. FCS 6, JM² used some traditional knowledge systems to suppress ground frost and as a result he produced tomatoes in winter (free of pests like aphids and his crop was not attacked by frost) in an open field. FCS 6, JM² also does manual weeding using hoes and not artificially using herbicides which are cheap and readily available in the local market (2017) and he also practised crop rotation. Unlike the other community-based farmers who were constrained by the extended family, FCS 6, JM² as is the case with FCS 4, SM², enjoys support from a big family (extended) set-up (latent). Like in the case story of FCS 4, SM², the big family enabled FCS 6, JM² to have the capability of a big water capacity (100 000 litres). The plastic tanks were a result of sponsorship from relatives working in towns.

On tensions, the big family was also a disabler. Tensions emanated from the need to break into the lucrative agro-industries but FCS 6, JM² lacked the drip irrigation facilities, a prerequisite for contract farming with one of the agro-industries that needed to contract him in tomato production. Although FCS 6, JM² has the capability to supply the quantities needed by the agro-industry, with his irrigation capacity of 100 000 litres of water powered by solar energy. The social conversion factor from the standard of irrigation demanded by the agro-

industry, disabled FCS 6, **JM²**. In 2018 after agro-industry number two [which did not demand drip irrigation conditions] had done everything to see FCS 4, **JM²** get a contract to supply tomatoes from his four ha plot, reflections which FCS 6, **JM²** did with family members (**Layer 2**) disabled FCS 4, **JM²** from accepting the offer. Some social constraints and misunderstandings on ownership of the contracted tomato project within the big (extended) family members affected the signing of the contract. Plate 5.4 shows the social learning transformative trajectory taken by FCS 6, **JM²**.¹⁶



Plate 5.4: The capability transformative trajectory taken by FCS, 6 JM²

The social learning trajectory and the conversion process undertaken by FCS 6, **JM²** are reflected in Photo 1 when FCS 6, **JM²** goes for a field tour at FCS 4, **SM²** who showcased his single plastic tank, a water pump and a stream that he used to convert the noted commodity or inputs to the functionings of irrigation, nutrition and market gardening which he did over a very short space of time (three years). FCS 6, **JM²** reflected together with FCS 4, **SM²** on his

¹⁶ 'Transformative trajectory' has been used to illustrate that it does not indicate a smooth or linear approach to farmers' transformation, but rather seeks to capture transformation at a broader level over time. The narrative explanations of the trajectories indicate the many complexities and difficulties experienced by farmers within the broader transformative trajectory.

new practice as shown in the series of photos in Plate 5.4. At photo series 2 within Plate 5.4, FCS 6, **JM²** adapted the concept of plastic tanks as a water harvesting mechanism but he went on to increase the number of tanks from one as learnt from FCS 4, **SM²** to ten with a water holding capacity of 100 000 litres. FCS 6, **JM²** moved away from the polluting fossil fuel powered water pumps to a much cleaner green energy, solar to harvest underground water, and so is mitigating climate change. The centre photo in Photo series 2, is a winter tomato crop where he used traditional heating mechanisms to suppress frost attack. These included the burning of saw dust and the use of cow dung. In winter cowdung when applied around a plant station, creates a micro-warm climate environment (Dirwai, Sibanda & Kakono, 2018) that suppresses frost from affecting each plant station. While FCS 6, **JM²** has managed to beat winter frost, his tomato production is not under drip irrigation hence he cannot supply this tomato crop to the first agro-industry (type of drip as a social conversion factor and a disabler of the farmer's new capability set). In 2018 a second industry actually engaged FCS 6, **JM²** to produce tomatoes but ownership conflicts within the social family setup constrained the event and so it never took place (socio-cultural ills).

5.1.7 Farmer Case Story 7 (Profile)

FCS 7, **LM²** is a teacher by profession, an apiarist and community-based farmer who was also practising conservation farming and moving towards organic production. FCS 7, **LM²**'s mode of production falls within semi-commercial small-scale market model. FCS 7, **LM²** was also a horticulturalist with a variety of fruit trees in his orchard garden near his apiaries. To FCS 7, **LM²** apiary is an alternative to food security and an adaptive practice to climate change and variability. FCS 7, **LM²** initially learnt of apiary from his own parents and later from extension service and the donor agents. By a way of history, apiary farming ran in his family and so it has been passed on to him through intergenerational knowledge transfer (social conversion factor). But at his current location, the study area, FCS 7, **LM²** started apiary farming in 2010.

The commodity or inputs that FCS 7, **LM²** interacted with were the horizontal key-bar (also called the Kenyan T-Bar or the horizontal Kenyan key bar), a type of bee-hive [Table 4.2] which is a new innovation that he recently learnt through trainings from extension service and the donor agents [social conversion factor]. FCS 7, **LM²** shifted from the traditional apiary which was just a hollow rectangular box and from those traditional hives that were made of

tree bark [intergenerational and traditional knowledge system. See also Table 4.2], that he learnt from informal family knowledge, through a reflexive reflective process, to the modern Kenyan key bar. FCS 7, **LM**² learnt of the new capability, use of the Kenyan key-bar bee-hives from non-formal education, training by the donor world and government agencies. FCS 7, **LM**²'s current capabilities (valued beings and doings) were food security, nutrition and improved economy through alternatives to subsistence maize crop farming practices, fruit production and apiary [he has 46 beehives]. In terms of physical or environmental conversion factors, FCS 7, **LM**²'s field has deep eroded landscapes that he successively covered with trees [Dirwai, 2012] which now provide shelter, flowers and nectar to the bees, for honey production. At his homestead is a big orchard garden with a variety of fruit trees that also supply pollen and nectar as inputs to the honey making process within a vicinity of fifty metres from the apiaries [organic honey since bees collect from non-polluted environment, see also subsection 2.5.2]. Near his 46 apiaries (bee-hives) he grew a variety of flowers and shrubs in order to supplement the inputs for the bees while reducing the distances bees travel to collect their inputs for honey processing. The degraded landscape now covered with trees is another environmental conversion factor that helped in converting the capability of apiary [an alternative to maize crop farming] as an achieved functioning.

In terms of social conversion factors FCS 7, **LM**² learnt a lot from intergenerational knowledge transfer as he grew up in a family of apiarists (informal learning as a social conversion factor). FCS 7, **LM**² also gained knowledge on apiary through formal education at school under the topic 'Benefits of trees to man' in Geography and Science. FCS 7, **LM**² learnt more from non-formal education through the various forms of apiary trainings that he attended from the village and from Harare, the capital city of Zimbabwe. These were facilitated by the government through the Forestry Commission Connex and by the various donor agencies. By default, FCS 7, **LM**² apiary has forced him into organic farming so as to reduce the use of pesticides and other heavy metals (chemicals), within the reach of his apiaries. Pesticides meant to kill insects on maize crops subsequently kill bees too. The commodities or inputs for FCS 7, **LM**² are: the rugged landscape covered with exotic and indigenous trees and fruit trees that provide flowers and nectar for his apiaries and forty-six apiaries. A nearby stream for water supply, a herd of cattle for manure, sloping gradient for irrigation under gravitational force (engages diversion furrows that he learnt from FCS 5,

SS), personal and collective knowledge on apiary, horticulture and organic farming all enabled his new functionings of market based apiary.

Tensions to the conversion factors rose in the pricing system of the honey. The market in the capital city (Harare) which was at times mediated by a middle-person (aggregators) who acquires the honey from the community-based farmers at a lower price in order for him/her to resell it in Harare at a profit, is a social conversion factor. Harvey (2005) noted this as part of the neo-liberal economy as the market puts bottlenecks that stifle the small-scale producers by creating middlepersons in the value chain. This makes the community-based farmer struggle to break even. FCS 7, LM² cannot directly access the urban (Harare) market as he lacks the know-how-to and the necessary legal documents needed in order to access such big markets. Such ignorance on markets by FCS 7, LM² can be viewed as non-being or 1M [cf. Hoppers, 2017; De Sousa Santos, 2007; Bhaskar, 2016]. FCS 7, LM² consistently supplied the community-based demonstration site FCS, 3 with cowdung manure from his kraal throughout this thesis journey.

More on tension, the ever changing honey prices from the Harare market, made planning by FCS 7, LM², often difficult (market forces) (Harvey, 2005). For over six years only six out of forty-six apiaries (hives) were fully swarmed with honey bees [swarming at a rate of one apiary per year] and FCS 7, LM² blames this on bees' swarming patterns which have been disturbed by veld fires. Absent in FCS 7, LM² is the knowledge on how to create queen mothers and how to split hives [subsection 2.5.2] so as to encourage swarming in and colonising forty of his empty apiaries. That is the transitive dimension of knowledge [cf. Bhaskar, 1989] as compared to the intransitive knowledge on bees. Like most of the community-based farmers in this study FCS 7, LM² is a head of a big (extended) family apart from his own nucleated family, hence the proceeds from the beekeeping and horticulture new capability sets and achieved functionings, are not usually ploughed back into production but are thinly distributed to cater for the socio-economic needs of the family (social and latent conversion factors).

5.1.8 Farmer's Case Story 8 (Profile)

FCS 8, LM³ is a locally well-known apiary farmer [*gogodera renyuchi* - apiary guru] by this community measurements. FCS 8, LM³ practises an apiary market based production model as a new capability set [though done at a small-scale] for the local and national markets. Like

FCS 7, **LM**², FCS 8, **LM**³ as an apiarist, is by default moving towards organic crop farming. Organic functions absence use of pesticides and heavy metals which hurt bees when they collect pollen and other honey inputs. In terms of history FCS 8, **LM**³ has inherited apiaries from his own family who practiced apiary as a hobby and **LM**³ has continued with this family venture since the early 1990s. FCS 8, **LM**³ shifted from the traditional hives made of bark to the Kenyan key bar (subsection 2.5.2) in 2010. In 2011 during my contextual profiling for this thesis, FCS 8, **LM**³ was the first apiary farmer I interviewed and recorded videos as he constructed the hives. In 2011 FCS 8 had 22 hives only.

FCS 8, **LM**³ continued participating in this thesis journey as I continued to observe his social learning trajectory towards his new functioning, apiary, to the end of this thesis journey. The environmental conversion factors that FCS 8, **LM**³ interacted with, like many in this part of the village, was a rugged terrain that he conserved for indigenous trees, making his honey organic since the bees collect nectar and pollen from organic sources and within a fifty metre radius of other crops [cf. subsection 2.5.2]. His commodities or inputs included over 120 horizontal key-bar beehives with 65 that are fully swarmed, an indigenous tree plot nearby and absence of pesticides from the field crop. On personal conversion factors, FCS 8, **LM**³ learnt apiary from intergenerational knowledge transfer (informal learning) and from non-formal education through workshops and trainings arranged by the donor agents and government. These were held locally (in the village) and in Harare. FCS 8, **LM**³ does apiary field tours to other apiary farmers locally and in Harare to enhance his knowledge on honey production and marketing. The donor agencies he interacted with also supplied him and other apiarists (beekeepers) with bee harvesting gear.

Tensions emanated from the type of non-formal education shared with the donor and government agencies and from the market. The market encouraged FCS 8, **LM**³ to produce for one industrial market from the capital city (Harare) and the new market buys in bulk but at suppressed prices much to the disappointment of FCS 8, **LM**³ who then claimed to be poorer than before when his market was simple and localised (social conversion factor). FCS 8, **LM**³ cannot determine the price hence cannot name the world [section, 2.6; Freire, 1970, p.62], ‘...Dialogue cannot occur between those who want to name the world and those who do not want this naming’.

FCS 8, **LM**³ has learnt a lot from other apiarists (bee-keepers) from other villages on hiring out apiaries (beehives) to commercial citrus tree producers. He has contemplated hiring out his apiaries to these citrus fruit commercial farmers but lacks the full knowledge on how to, and also lacks the specialised transport to ferry the apiaries to such a new type of market, the citrus tree plantations. Lack of education was one other tension and capability deprivation (Sen, 1993) that affected FCS 8, **LM**³ and his new capability set. FCS 8, **LM**³ also hosted apiary Field Days at his venture where the entire village and other stakeholders come and learn and reflex from his practices and new capability set. As another tension FCS 8, **LM**³ argued that, despite hosting other farmers and despite him having the highest number of apiaries in the village, the donor agents often distributed apiary and honey extraction gear and other extraction equipment such as smokers, to apiary ‘enthusiasts’ who did not even have a single beehive and had no experience in doing the business, leaving perennial apiarists without [corruption as a social conversion factor]. On personal and social conversion factors, FCS 8, **LM**³ also took care of a big family [extended, subsection 4.3.2; Table 4.1] hence the income from apiary was thinly distributed to cater for the socio-economic needs of the family and was not ploughed back into the apiary business (social and latent conversion factors).

5.1.9 Farmer’s Case Story 9 (Profile)

FCS 9, **FN** is the only female community-based farmer in this multiple case study who was known to have practised a combination of conservation horticulture farming, fish pond (aquaculture) farming and apiary as her new capability sets. FCS 9, **FN**’s mode of farming was non-market that is she was still operating at subsistence level with some exchanges or barter at village level. In terms of the history of fish pond farming and apiary FCS 9, **FN** started in 2015. Her commodities or inputs (Robeyns, 2013) were 22 horizontal key bar hives with four that were fully swarmed. The other input was the vast woodlot (one thousand *eucalyptus grandis* trees that are good for nectar extraction) she benefitted from the 2009 free tree nursery distribution [cf. Dirwai, 2009; 2012]. FCS 9, **FN**’s current water ponds were used for watering her garden crops and today (2017) they play a dual purpose as the ponds are used to farm some tilapia fish. FCS 9, **FN**’s personal conversion factors included non-formal education training from non-governmental agents. Apiary training that FCS 9, **FN** attended, were held in the capital city, Harare and some training events were held locally and ran by the district extension service (Agritex and Connex). FCS 9, **FN**’s individual agency helped to push her into bee-keeping and aquaculture, the why not a woman concept [cf.

transformation and not alienation {Lotz-Sisitka, 2016: 318-339; subsection **2.2.3**}. FCS 9, **FN**'s social conversion factors included the social learning knowledge gained at village level on apiary during the Before Harvest Field and Demonstration Days held at FCS 8, **LM**³.

Tensions from the conversion factors on beekeeping FCS 9, **FN**, were constrained by how to control pests such as ants and mice that were disturbing the bees and making the bees leave the hives and swarm elsewhere [social and environmental conversion factors on knowledge of pest control]. FCS 9, **FN** sought advice to solve the problems of pests from FCS 8, **LM**³. On the fish pond, FCS 9, **FN** had not reflected on selling the fish yet but she learnt through social learning trajectories, of marketing challenges faced by small-scale fish farmers in other rural areas in Zimbabwe through social networks and watching videos.



Plate 5.5: FCS 9, FN's trajectory towards new capabilities as alternatives to crop farming

From Plate 5.5, FCS 9, **FN** attended a training workshop on how to raise tree nurseries (Photo 1 and Photo 2) in 2012.¹⁷ In Photo 3 FCS 9, **FN** reflects together with other villagers

¹⁷ From Plate 5.5 Photo 1, FCS 9, **FN** reflected with other communal farmers on tree nurseries (Dendrology) in Photo 2 she attended a training workshop on Dendrology and in Photo 3 she reflected on the benefits she gained from the training workshop. In Photo 4 she reflected on apiary farming, an adaptive practice that is directly linked to trees and in Photo 6 she attends a training workshop on apiary farming. Photos 7 and 8 she reflects and showcased to other farmers on aqua-culture and apiary.

through a communities of practice workshop on other uses of trees which included housing of bees. Instead of opting for tree seedling nurseries, FCS 8, **FN** upon reflection, chose apiary farming which appealed better to her due to the stories she heard from other apiary farmers in the village. In Photo 4), FCS 9, **FN** attended an apiary workshop and Field Day held by FCS 8, **LM**³ and she reflected further on the option to start a beekeeping project. FCS 9, **FN** already had some basic commodity or input for apiary farming, one thousand flowering gum trees in her off the yard plot. In Photo 5, FCS 9, **FN** further reflected with some funders on possible training on apiary and in (Photo 6) FCS 9, **FN** finally got sponsorship to attend the apiary training in the capital city of Zimbabwe some 284km from the village, Harare. In Photos 7 and 8, FCS 9, **FN** showcased her fish pond and apiary gear and actually extracted the honey for me on the day of interview on 15 July 2017. FCS 9, **FN** through a reflective and reflexive and recursive process, managed to shift from non-being (2015) to being or existence (De Sousa Santos, 2007). That is from non-voice to voice (Freire, 2005) by 2017. **Tension**, FCS 9, **FN** like the other case stories in this multiple case study, takes care of grandchildren as part of her big family [subsection 4.3.2; Table 4.2]. Plate 5.5 shows the trajectory FCS 8, **FN** took from 2012 to 2017.

5.1.10 Farmer's Case Story 10 (Profile)

FCS 10, **VC** is a youthful dendrologist (fruit nursery, hedges and flower producer), practising a market model of farming as his new capability set. FCS 10, **VC** is the first of the communal farmers in this thesis journey to 'commercialise' and legalise his achieved functionings (there by naming the world, **section, 2.6**). His commodities or inputs include thousands of plastic pots that he was fully supported with from the communal demonstration site tree nursery project of 2008-2013 (Dirwai, 2011), a legal document, registered company (has a company logo, a date stamp and receipt books) and an existing orchard used for tree grafting. The other of FCS 10, **VC**'s commodity or input was a deep and protected well that he personally sponsored from realised sales in order to enhance his functionings. Personal conversion factors of FCS 10, **VC** included the formal knowledge that he gained from school on tree nursery production and non-formal education he gained from the Before Harvest Field and Demonstration Days on skills on tree nurseries in the village of study. Upon reflection, FCS 10, **VC** did not adopt the exotic tree nursery project after gaining knowledge from the communal demonstration site, but adapted the concept and mapped out his own niche of dendrology which included fruit, hedges and flower nursery production. In terms of social

conversion factors, FCS 10, **VC** managed to legalise his activities by registering a private company into his and wife's name (joint partnership) thereby contributing to the domestic national product of the country, at a small scale though. This was beyond what was learnt from the demonstration site, FCS 3, where the youths' activities were not registered into a company. The environmental or physical conversion factors in FCS 10, **VC**'s activities included a crop field on a flat terrain which makes it easy to stack his tree seedlings in the plastic pots.

FCS 10, **VC**'s nearness to the wide tarred road network makes it easy to transport his product to the urban market all year round unlike the youths FCS 3 who have to face the challenge of dirty roads which are inaccessible during the rainy season (physical conversion factors). The commodities or inputs for FCS 10, **VC** included a water source (protected well), nearness to a tarred road for ease of transportation of products, easily available empty plastic and empty plastic beer bottles, a fruit orchard where he got cuttings for grafting and black plastic, personal and collective knowledge on trees and horticulture (social and personal conversion factors), and a fenced-off yard.

Tensions that FCS 10, **VC** faced included the unfavourable market where middle-men (aggregators) often took advantage of him, hence he did not make much money (Harvey, 2005). The empty plastics and beer bottles were becoming scarce as other community-based farmers were also picking them up for other innovations, such as the inverted bottle drip irrigation and so FCS 10, **VC** had a challenge of packaging materials. Transport constraint disables **VC**'s new capability set of marketing. Plate 5.6 shows the trajectory FCS 10, **VC** took between 2012 and 2017.

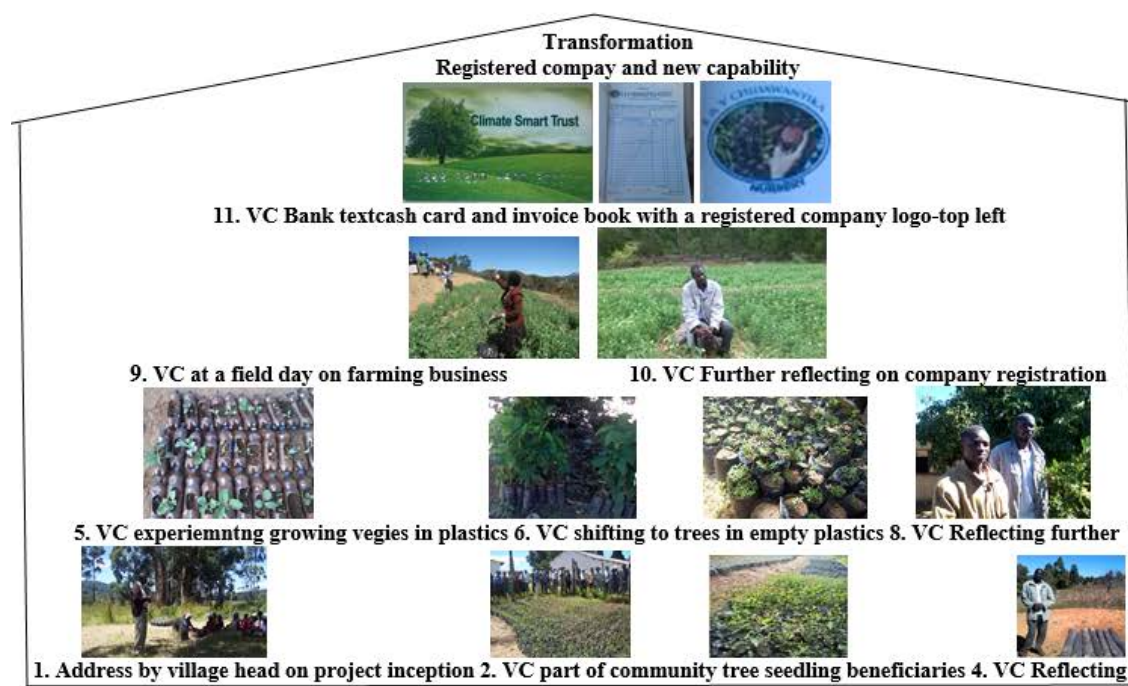


Plate 5.6: The social learning trajectory taken by VC towards transformation to a registered ‘company’

FCS 10, VC’s journey is depicted in Plate 5.6.¹⁸ The trajectory started way before 2012 when he attended a community-based tree nursery project inception address in 2008 where one of the village heads (in photo 1) worked on the acceptance of the donor funded project then, in the village (Dirwai, 2009). Upon reflection FCS 10, VC accepted the project concept and he was then one of the beneficiaries who received tree seedlings to plant trees at his homestead (Plate 5.6 Photo 2). Upon further reflection, FCS 10, VC visited the community-based project site to see how the trees were produced. In Photo 4, FCS 10, VC reflected further by laying out all possible options (Mezirow, 2000) that were related to tree seedlings and the commodities or inputs that were needed to establish a similar project. Upon a reflexive, recursive and reflective process with family and other community members, FCS 10, VC opted for establishing a project that could depend on his personal knowledge background and finances (transformation and not alienation-intrinsic and not extrinsic). FCS 10, VC thus opted to experiment with the use of empty plastic beer bottles which were readily available at village beer outlets (Photo 5) to plant vegetables. He reflected (individual and family layer

¹⁸ In Plate 5.6 FCS 10, VC was one of the attendees to the inception of a dendrology project. He reflected together with family and fellow villagers and he opted for registering in a small company in dendrology from Photos 9-11.

one and two reflexivity) again on formal employment which paid him USD110 per month in the early 2000, which he claimed was not going to be enough to feed his family and send his children to school. He reflected together with his family and big family (extended) on how to supplement this income (Layer 2 reflexivity).

Thus in Plate 5.6 Photo 5, FCS 10, **VC** started experimenting with the use of empty plastic beer bottles to grow vegetables by feeding soils in on an opened side and lay the plastics lengthwise, and continued reflecting. In Photo 6 he opened the empty plastic bottles by the neck and put soils and planted tree seedlings upright and it worked better. In Photo 8, FCS 10, **VC** further reflected and shared his reflections with the youth leader, FCS 3, **LN** (layer three reflexivity) who had faced challenges at the market before (learning of challenges from others). The need for registration of a venture came out. In Photo, 9 FCS 10, **VC** attended a Field Day where marketing issues and registration of farming ventures were talked about, amongst others. In (Photo 10) FCS 10, **VC** further reflected with the youth leader at the demonstration site FCS 3, **LN** for further inspiration to register his purported new capability set. This was a recursive process (Mezirow, 2000) and collective agency too. In (Photo 11) FCS 10, **VC** and the other ten community-based farmers, got registered for the bank text-cash cards for all monetary transactions within his business. Finally FCS 10, **VC** got through the process of registration after reflecting with knowledgeable others in town (reflexivity layer four) and they (together with wife, formed a joint company) got registered and had an invoice book in their company name. On each page of the receipt book is the company name, a logo (emblem) showing a human hand picking an apple from a tree and the motto (Hand in Hand with Mother Nature) and in addition, an official business stamp to further authenticate his business (Plate 5.6 Photo 11). Now he contributes to the income tax system of the nation and to the national gross income of Zimbabwe. Further, FCS 10, **VC** now talks of possible exporting of his non-fibrous mango tree seedlings (2017).

Tension, FCS 10, **VC** faced competition from other villagers who too wanted to pick the free empty plastic beer bottles to use in the inverted bottle ‘drip irrigation’ and so he opted for the black plastics.

5.1.11 Farmer’s Case Story 11 (Profile)

FCS 11, **JC** is the remaining dendrologist specialising in exotic tree nursery production out of as many as 50 who ventured into the project after 2008. FCS 11, **JC** has gone ‘commercial’

supplying both Black and White commercial tobacco farmers with exotic tree seedlings for their woodlots as per Statutory Instrument 116 of 2012. This statute encourages planting of fast growing woodlots for curing tobacco for a sustainable production of the flue cured tobacco. FCS 11, **JC**'s commodities or inputs in dendrology include over 50 000 tree nursery plastic pots that he acquired from the communal tree nursery project (Dirwai, 2009) and certified seed that he buys from the Forestry Commission of Zimbabwe. FCS 11, **JC** social learning trajectory towards dendrology, specialising in exotic tree seedling production started from the demonstration site in 2008 and moved to a backyard venture selling to a small urban market in 2009 until he was contracted by some tobacco companies to produce exotic tree seedlings at a large scale. As one of his commodities or inputs FCS 11, **JC** now has a 5-horsepower fuel powered water pump that he uses to draw water from a small water reservoir at his communal homestead and a one tonne delivery truck to ferry his products to the market. FCS 11, **JC** moved from **1M** to **4D** from non-being to a recognised tree seedling producer and farmer.

In terms of personal conversion factors, FCS 11, **JC** learnt through non-formal education about dendrology, specialising in exotic tree nursery production in the tree nursery project of 2008-2013 where he fully participated from the inception of the exotic tree nursery project through its maturity and folding stages (Dirwai, 2009). FCS 11, **JC** also learnt a lot from market demands (reflective, reflexive and recursive process). The physical conversion or environmental factors that FCS 11, **JC** interacted with, included the availability of a water reservoir (infield ponds) and water pumping devices and a small lorry for transportation. Unlike other communal farmers, FCS 11, **JC** has access to bank loans to fund his achieved functionings which is a kind of a social conversion factor not enjoyed by any of his community-based farmer-counterparts (2012-2017).

Tensions in his new capability set of 'commercial' exotic tree nursery production included the delayed payments by some of the indigenous tobacco farmers thereby affecting his honouring of bank loans. A leaf-disease that affected his dendrology venture of exotic tree nurseries in the 2016-2017 season accounted for the destruction of a third of his crop. No treatment was offered by experts and the best method to deal with the affected tree seedlings was to destroy (cull) them. FCS 11, **JC** reflected further on transport, water supply and how to improve payments (**layer 1 reflexivity**) and so he absented these concerns by buying a small lorry. FCS 11, **JC**'s tensions towards climate change adaptation was the use of fossil

fuel to power the watering devices. Figure 5.7 shows the trajectory that FCS 11, **JC** took between 2008 and 2017.

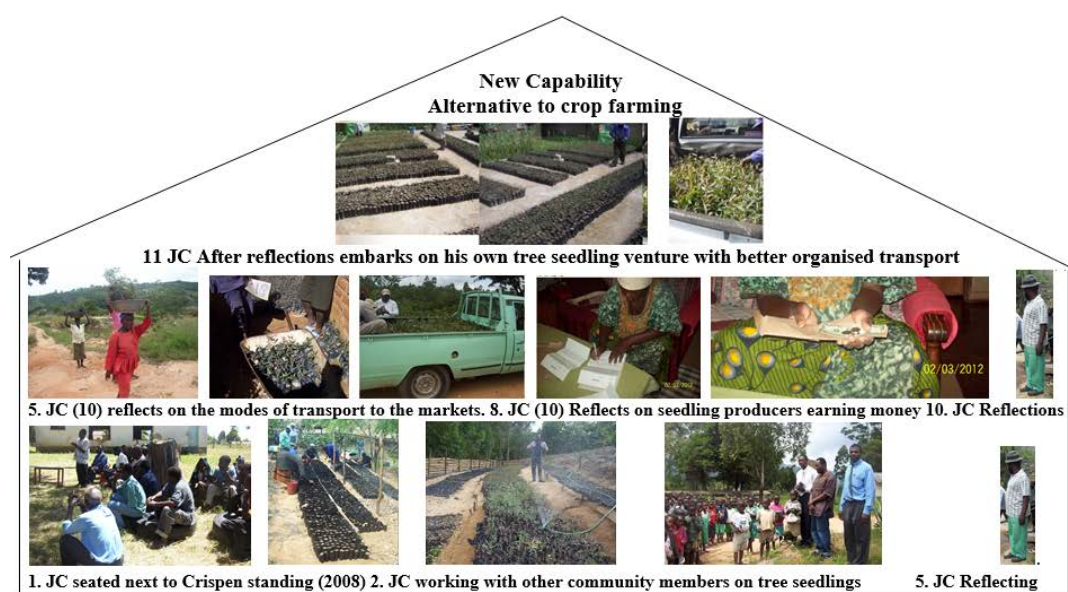


Plate 5.7: JC Trajectory reflection, individual and collective agency and transformation

FCS 11, **JC** in Plate 5.7 Photo 1, seated near CD, standing and introducing the tree nursery project to the community in 2008. FCS 11, **JC** reflected on the prospects of participating in such a venture.¹⁹ The reflexive process was recursive between the self, FCS 11, **JC** (reflexivity layer 1) and his family (collective reflexivity layer 2) and reflecting with others in the community [laminated reflexive process-collective layer 3]. In Plate 5.7 Photo 2 FCS 11, **JC** joined the project, learned with others in the community of practice (social learning) on how to grow tree nurseries. He reflected further in Photo 5 (with self (Layer 1), with family (Layer 2) and with the community {Layer3}), on the commodity or inputs that were needed for him to embark on a similar venture elsewhere.

In Photo 10 FCS 11, **JC** further reflects (Layer 1 and Layer 3) on the modes of transport that the villagers were using to carry the seedlings to their various market destinations. These included the human head, wheelbarrows and small trucks. FCS 11, **JC** further reflected on the amounts (cash) the villagers were cashing from selling gum seedlings. By 2010 FCS 11,

¹⁹ From Plate 5.7 FCS 11, **JC** in Photo 1, reflected on dendrology during an inception of a dendrology before 2012. He reflected with his family and with the other villagers until he transformed to recognised dendrologist who supplied reputable commercial farmers.

JC started his own dendrology venture in gum seedling production targeting Black and White tobacco growers in the Mashonaland Central province. FCS 11, **JC** had the capacity to access bank loans. He was credit worthy and by so doing he could now name the world (Freire, 1970; section 2.6).

5.1.12 Summative Perspective

Section 5.1 and sub-sections 5.1.1 to 5.1.11, presented a synthesis of data abstracted from the transcripts (text) and observations which reflect relevant knowledge based on the community-based farmers' capabilities sets (valued doings and beings) and functionings (achievable doings and beings) in relation to their emerging farming practices. The high level analysis of each case was based on evidence extracted from observations and detailed interviews on each of the 11 case stories. This section addresses sub-research question 1: "What are the current farming practices and resources used by communal farmers? What do the communal farmers currently value being and doing (functionings)?"

The results from this overview analysis, show that the crop farmers' old practices were all changing towards more organic approaches, but these were at times tension laden, due mainly to circumstances, but also to knowledge histories, family experiences and resource flows. The high level analysis of all 11 case stories presented above, also shows that the practices varied by farmer capabilities sets and time of entry into the practice for both crop and non-crop farming practices.

As indicated above, I have shared the collective capabilities and agency and social learning trajectories of each of the FCSs individually at a broad level, which gives an overview of each individual and collective capabilities as well as the social learning trajectory. In the next sections, I consider the **shared practices** to provide more detailed insight into the contextual dynamics of capabilities development **across the sites**. The shared practices that I discuss are:

- Rain-fed conservation crop farming and small grains under small-scale irrigation (section 5.2)
- Small scale irrigation (section 5.3)
- Apiculture (Section 5.4)

- Aquaculture (Section 5.5)
- Dendrology (Section 5.6)
- Marketing (Section 5.7)

For each practice, I draw on data to provide a ‘thick description’ of the practice as emergent around the following sub-themes:

1. the production mode also referred in this thesis as commodities or inputs to achieve, the history: dynamics of the older and more recent practice,
2. personal, environmental and social conversion factors influencing the agency-based transformations underway.
3. tensions and enabling factors

I share extracts from the data to offer a thick description, and annotate this with perspectives from the theory used in the study in square brackets, where I particularly indicate aspects of translation of functionings into capabilities, and **1M-4D** movement.

5.2 RESEARCH EVIDENCE: RAIN-FED CONSERVATION CROP FARMING AND SMALL GRAINS UNDER SMALL-SCALE IRRIGATION

The research evidence in this section is abstracted from three of the case stories practicing rain-fed farming, OPV and small grains. FCS 1, **VS** [rain-fed conservation farming], FCS 2, **BC** on (rain-fed OPV maize crop farming) and FCS 3, **LN** [OPV maize crop farming and small-grains production, both under small-scale irrigation].

5.2.1 The Production Mode and Inputs to Achieve and the History: Old and New Adaptive Practices under Rainfed Maize Crop Farming and Small Grains [FCS, 1, 2 and 3]

This sub-section reviews evidence from the commodities or inputs as the means to achieve in the three farmer’s case stories 1, 2 and 3, under rain-fed crop farming and small grains under small scale irrigation by the youths, Farmer’s Case Story 3. The sub-section also looks at the history of the old capabilities sets and the new achieved functionings. The small grains are produced under small-scale flood irrigation as adaptation to climate change, as shown by the discourse of the farmers below:

FCS 2, **BC**: (October 2014). ... But we still practise our traditional maize crop (OPV) under rainfed agriculture and mainly in our gardens (wetlands) since they (OPV) need a longer time to mature and they also need to be away from the conventional seed varieties [away from the main crop field fearing cross-pollination and showing evidence of transfactuality].

CD: What about the seed varieties of those days and those of today? How did you and do you access it?

FCS 2, **BC**...We don't buy the seed but we have always exchanged with others in the village over generations.....FCS 10, **VC** (son to BC) ... Government policies such as the shift towards provision of free seed and fertilisers after independence [also referred to as command agriculture and a new production mode] meant that people had to practise farming using the same seed variety in the same region and the same village. Farming is still subsistence.

FCS 10, **VC** ... Researchers too have played a role in the shift to new practices [conventional farming practice as a collective capability and agency].... research came up with the new seed varieties that adapt to the short rain season and frequent droughts.... R201, R213 [types of seed] and so on. ...But as we have observed SR52 is not completely out of the market but we can see that researchers have reworked it and gave it a new name as 709 [*Nzou* a local name as another collective capability]This variety adapts well to conditions of both heavy and low rainfall and on harvest you won't find weevils [showing evidence of inductive reasoning and collective capability and agency; cf. subsection 2.2.9].Nowadays we do conservation farming [referring to conservation basin as a new production mode and a new capability] unlike the old methods where manure were left on top of soils near a crop.Today (2016) with water for irrigation [a new production mode and means to achieve new functionings] some of our people in this village [LN, SM, JM, SS, etc] now practise winter cropping and these, they plant and harvest the winter crops before the traditional summer crops (1M to 4D). they (farmers) have come to realise that it is unprofitable to waste a certain time of the year being idle when the soils and water are available [showing evidence of internal motive and agency i.e. transformation and not alienation as a result of collective capability and collective agency].

From a historical perspective FCS 2, **BC** practiced traditional maize crop farming under rain-fed agriculture. This farmer also indicated that he still values his old capability set of rain-fed farming of the open pollinated variety (OPV) maize crop, but this time practicing it in wetlands since it needs plenty water. Because of droughts, the wetlands was the best option for practicing OPV maize crop farming. Practicing OPV maize crop farming in wetlands was also a way to reduce cross-pollination with conventional maize seed varieties in the main crop field. Farming, though under rain-fed, is now done twice in a year with winter cropping due to the observed shift of the rain season into winters. Onset rains are now late but cession of rains sometimes extends into the winter season. From FCS 10, **VC**'s comment the

government played an important role in the new capability set of conservation farming. More, researchers contributed to the shift from the old capability sets to new, by improving on seed varieties as guided by research and also by the observed changes in climate. Diversification praxis has emerged from inductive and transfactual reasoning amongst the farmers as they consider the climate variations they need to adapt to. This is also a key feature of the new capability set and achieved functioning in conservation farming, as shown below:

FCS 3, **LN**... We don't just practise organic horticulture [a new capability set], we also plant maize crops (OPV) under organic conditions and under small-scale irrigation [a new mode of production]. We don't buy the seed but we use our traditional OPV- Hickory-King-[Hakiri-king in local language] that we acquired from our village head FCS 2, **BC** [as collective agency]. We learnt from elders like FCS 2, **BC**, [intergenerational knowledge transfer and also as collective agency] that this type of maize crop is similar to the then SR52 and requires a lot of water, long season variety [evidence of transfactuality]. In the absence of long rainy seasons such as the erratic rains and frequent droughts as a result of climate change we are experiencing today, people can't plant the traditional maize variety, a high rainfall seed variety..... Luckily in this demonstration site, we have 'irrigation' facility and liquid manure [evidence of T¹ Figure 3.2]. We plant our OPV during the dry period of September [under small scale irrigation] and we harvest by March after 5 months, ready for our peas winter crop [agency at 4D and a two crop cycle as an achieved functioning].

From the citation above, the youths [Farmer Case Story 3] managed to absent the impact of drought and now they value exercising their freedom to plant the long season maize variety using small-scale irrigation as a mechanism that is more resilient to droughts. As can be seen from the questioning below, I continued to probe modes of production and commodities or inputs throughout the study over time. In 2017, the community-based farmers responded as follows, confirming the importance of social learning and drawing on diversity of knowledges, including traditional knowledge, encountering new practices, and inter-generational knowledge transfer which allowed farmers to combine inductive, abductive and retroductive reasoning that was also related to observations amongst the farmers in the process of transforming resources into new conservation farming functionings as they moved from 1M to 4D:

CD: [13 July 2017]: What type of farming mode [referring to capability set] are you practising and what are your major inputs [referring to commodities or inputs or means of production]?

FCS 1, **VS**: ...In this new practice [referring to fertility trenches as a new capability set and mode of production], I learnt of digging trenches as you can see, and, to bury all the maize stalks. I also learnt of collecting humus and grass from the forests and to bury them in the trenches too, in order to supplement manure [referring to soil nutrients]. These rot, provide manure and retain moisture for my crops in the season [reflecting an in-field water harvesting technique, cf. subsection 2.6.1].

FCS 2, **BC**: [in 2014]. ...To prevent weevils we normally hang in the traditional kitchens the seed maize of our traditional crop, where there is soot [traditional knowledges to promote the new functioning of seed storage, a knowledge learnt from forefathers] and whenever we do that the seed is not attacked by weevils at all [induction-observations and abductive over a long time].

FCS 3, **MM**: [On small grains knowledge transfer]: ...Today [10 October 2017], we now know from the knowledge that we gained from grandmother, knowledge shared with other farmers and knowledge that we gained from the extension service through the field demonstrations, that small grains are good for our health [collective capability and agency]. We now have massive knowledge for every stage of production and processing of small grains like rapoko. Knowledge such as field preparation that is sowing, weeding, harvesting, pounding, grinding to knowledge on how to prepare a meal from small grains. We also learnt of the best types of relish that suits the small grain meal [referring to *sadza/pup/nzima* or thick porridge, cf. Plate 5.3].

Traditional knowledge systems and the transfer of knowledge through intergenerational knowledge transfer is regarded by Mignolo (1995) as good knowledge domiciled in the communal people which can help other societies appreciate them. The research evidence and insights from the data on the shift from old and more recent practices, to new adaptive practices and how these emerged, show a shift from conventional (hybrid) maize production that was rain fed to increased production outputs using conservation farming approaches and rain water harvesting. The farmers had this to say:

CD: [3June 2017]: What were your old farming practices and what are they like today and what are your inputs?

FCS 1, **VS**: ...ever since before the year 2012 my maize crop farming has always been conventional [hybrid seed and use of artificial fertilisers and chemicals whenever possible] and rain-fed.... My maize harvest could hardly fill up a small dish [*chibage chekukanga maputi*, loosely translated as a harvest that could produce a few small packets of pop-corns as she could hardly produce a 20kg mealie-meal bag of her staple food]. ... This year's harvest [2016-2017 season] as you can see from the maize on the roof top of my house and from other storage devices [Plate 5.1], I expect to have four tonnes after shelling.... The first year I shifted from my old farming practice to this new one [referring to fertility trenches as a new mode of production and capability set], that was 2012-2013 farming season, I harvested 20x50 kg bags of maize [1000kg=1 tonne per yield] in 2013-2014 the yield increased to 35x50kg bags [1750kg=1.75 tonnes per yield] and in the 2014-2015 it was 65 of such bags

[65x50kg=3250=3.25 tonnes], and now [2016-2017 season] as you can see [Plate 5.1], I am expecting [80x50kg=4000=4tonnes]. If God is willing [a common statement amongst locals that only God has the ultimate plan for people's survival, or it can mean 'if I am still alive by then', or that God gives us the blessings of life and good rains], I will continue experiencing better harvests with time.

The case story of **VS** shared above reflects that the communal farmers might not need high input and expensive centre-pivot-technologies but knowledge on very simple and effective small-scale innovations can substantively facilitate transformations to sustainable food production. This reflects T¹ as **VS** increases maize yield through enhanced soil fertility and absencing temporary drought through fertility trenches and not T² when she had to rely on food handouts from government and donors. This is a concept developed in the T⁰⁰ framework in Figure 3.2 as Case Story 1, **VS** reflected and came to conclude that she was her own liberator. FCS 2, **BC** also offered interesting insights related to changes in production that were driven by observed climate change/variability:

FCS 2, **BC**: [in 2014]: ... In the early 1950s, in this village, we used to receive first rains [not meant for planting crops] around the 13th to the 18th of September and this was called *gukurahundi* [local name]. Whenever we received this, it was an indicator that the rain season was about to start [showing inductive and abductive reasoning. cf subsections 2.2.9 and 5.2.1].....onset rains [meant for planting crops] were around the 15th of October [induction], and that was the date most of our farmers planted maize seeds [OPV- Hickory-King-Hakiri-king in local language] into the soils...Today onset rains have shifted, creating a shorter season which can longer support our traditional maize crop which needed more time to mature.....In the 1950s, no artificial fertilisers were applied in those days in this entire village. It was manure from cow dung.

CD: Now can you explain the difference between the old farming methods and the new?

FCS 2, **BC**: (in 2014).*Rapoko* yes, traditional rice yes, sweet potatoes, yes, we used to have all those here but never *mhunga*, a millet variety. That one is prohibited in this village and district as it is believed to be a wish for droughts [evidence of social conversion factor and tension since millet is also good for organic chicken stock feeds, Pesanayi, 2007]. You can be surprised, we used to make composts in those early days [1950-70s] by then, were different from the ones we prepare today [cf. also Palmer, and Parsons, 1977, referring to deep trenches of 1900]. [showing evidence of transfactuality, and recovery of traditional knowledge]....Once the compost matured into good manure, we would spread it in the field. We did not concentrate the manure in a single basin as we now do in conservation farming....[Evidence of such ancient compost pits can still be observed at BC's current fields].

Tensions have risen from climate change [cf. subsection **5.1.2**] that disables FCS 2, **BC** from practising farming from his old capability set of long season maize variety – the OPV [needs a longer rainy season than the short season varieties that are currently provided by government and seed companies] since he is not practising irrigation farming. FCS 2, **BC** also takes care of orphans and a big family [subsection **4.3.2**; Table **4.1** and subsection **5.1.2**] often demands that the economic resources are diverted from enhancing his productive capacity in the crop field into social demands [latent personal and social conversion factors]. While FCS 2, **BC**'s conservation farming practices are good forms of climate change adaptation, his use of artificial fertilisers brings tensions to his new capabilities set and achieved functions of moving towards environmentally friendly farming. However, making the transformations that were observed, was a combination of social and physical conversion factors that included the introduction by extension services of different adaptive maize varieties [new physical and social conversion factors] that were under experimentation for drought resilience. As outlined below, farmers were not only evaluating the adaptive seed varieties that were introduced, but also their own traditional seed varieties and their efficacy under new climatic conditions, showing the importance of inductive, retrodictive and transfactual reasoning coupled with co-engaged experimentation [social conversion factors] in the collective capability and co-creation social learning process:

FCS 10, **VC**....From the early 1980s we saw the introduction of different maize varieties, SR52, R200, R201, R213 and R214. Around 1984 we were introduced to R215 maize variety....[The said varieties were introduced by the government through the extension service].

CD: What were the reasons behind the introduction of all these maize seed varieties in this village? [I was hoping to see if there was a relationship between climate change and adaptive seed varieties in asking this question.]

FCS 10, **VC**....You heard of the shift from SR52 to these 200s. In this village as noted [by FCS 2, **BC**] at the beginning of this conversation, rains used to come early and the rains would continue for a much longer time [season] than they do today when they come late and still sometimes extend into winters [climate change as observed through shifting seasons]. SR52 was a variety that needed a lot of rainfall and a longer agriculture season and so cannot thrive in today's erratic rain patterns [evidence of inductive reasoning]. ...Seed houses in the country [Zimbabwe] therefore introduced short season varieties to cater for the reduced rainfall season... [evidence of inductive reasoning]....The traditional maize crop variety [Hakiri king-Hickory King], also a long season variety, could no longer survive under the changing weather patterns and so the majority....abandoned it as a major field crop [showing a shift in practice as a result of observed changing seasons or climate variability].... More, before 1980 short season variety crops could not survive also in this village as

these would mature in the mid-rain season thereby giving farmers harvesting and storage challenges [evidence of inductive reasoning]. Seasons are changing and country policies also change and all these make the farmer to change so as to move with time and seasons [evidence of changes as a result of social conversion factors].

Climate change played an important role in changing the communal farmers' practices. Climate change also impacted on research as new seed varieties were introduced as shown from the evidence above. There was also deliberation on soil quality, and how to become more productive in response to poor soils, as outlined below:

FCS 3, **MM** ...Before 2007, this field was basically 'light-sandy' and basically infertile [self-perceived morbidity of soils²⁰, subsection 2.4.4]...Today this demonstration site is now used for our new venture, the organic farming production. Granny advised us that we could start with small grain rapoko for it enriches the soils and does not need artificial fertilisers and was drought resistant [2000 to 2010 were observed drought periods in the village and country]... So between 2010 and 2012 we worked on further landscaping, terracing and collecting humus [conservation farming] from the bushes to enrich the soils [cf. Photos 5, 6 & 7 in Plate 5.8]...rain-fed maize was ruled out at that time since it was prone to droughts and the soils were 'light' sandy (cf. Plate 4.10) and prone to leaching such that even the artificial fertilisers given by government [under command agriculture], could not help much where the soils are too loose like that....But with time, and the introduction of organic farming techniques, and irrigation, the soils improved and we reverted back to maize, this time, the traditional long season variety [Hickory-King-Hakiri king also locally known as *Chimanyika*], a long season variety that thrives well under irrigation.

The social learning trajectory from the old capability set of conventional farming model under sandy soils to a new capability set of organic farming model and also the valued self-perceived change of soils from sandy to loam, was long (2008-2018). The soils too improved in quality as measured by physical appearance, texture and health status through laboratory tests. The social learning trajectory in this case was recursive and reflective at different levels and stages (T¹ in my T⁰⁰ framework in Figure 3.2).

The history and shift from old to new farming practices varied in the three case stories. FCS 1, **VS** shifted from ordinary rain-fed with artificial soil fertility to fertility trenches [burying of humus and maize stalks] through learning from expert others in the village. In the second case story [FCS 2, **BC**], the farmer shifted from old to new practice that is from the OPV to conventional seed varieties where he used artificial fertilisers as distributed freely by

²⁰ Soil enrichment is here measured by the human eye (self-perceived) and not externally observed through scientific methods such as testing soil for pH, organic matter, nitrogen %, potassium mg/kg, zinc mg/kg, manganese mg/kg, copper mg/kg, nickel mg/kg, iron mg/kg and phosphorus mg/kg. See also Table 8.2.

government, in response to the shift in climatic conditions. Government policy on free seed and fertiliser distribution, structurally determined what crop and when it could be planted and for which region, a social conversion factor. In the third case story, FCS 3, [LN, MM and the other youths at the demonstration site], reflected amongst themselves [layer 1 reflection] on poor harvest in 2007 and reflected with a grandmother, drawing on intergenerational knowledge transfer (2010) [layer 2 reflection, co-creation or collective agency] and via interactions with community and market from 2012 to 2018, they shifted from old rain-fed to new practices, irrigation, organic and market mode of production [laminated reflections]. This shows that a diversity of conversion factors [physical, social and environmental], as well as multi-layered reflections are involved in the transformation of resources into valued functionings and capabilities.

5.2.2 Research Evidence on the Resource Conversion Factors: Personal, Social and Environmental

The section gives more detail on the personal, social and environmental conversion factors [climate change related] at play. FCS 1, VS reflects on social conversion factors i.e. the social influences on people's choice of converting a functioning towards a desired capability (Robeyns, 2013).

FCS 1, VS:....After struggling with poor harvests due to climate change for some time, I heard of a Field Day [Before Harvest Field and Demonstration Day] that was being held at Gogo Hildah's place where the use of fertility trenches was being showcased. There, I learnt of the new practice, digging trenches.

To convert to the new capability set of fertility trenches, FCS 1, VS learnt through non-formal education [social conversion factor] within a community of practice and learning network of farmers and farmer agents [Field Day]. VS's conversion factors were also personal as she reflected by herself [Layer 1] which evoked individual agency [Layer 1] that propelled her to move forward and choose a new farming practice (cf. Robeyns, 2013). It is when FCS 1, VS reflected again with her daughter back home [Layer 2] that she practically embarked on the new capability set and practice which she finally had accepted but with modifications through the use of humus from forests and maize stalks, in the absence of cow dung which Gogo Hildah had taught her (cf. Mezirow, 2000; Freire, 2005; Flew, 2007 on reflexive reflectivity). This was collective agency as the decision to shift to a the new capability set and practice was not solely an individual effort.

FCS 2, **BC** had this to say on social conversion factors: “We have been taken by the winds of change, we left our old practice...But, we know our old maize seed variety (OPV) gives better mealie-meal and is resistant to diseases...” This reflects a feeling of alienation and not transformation as given the freedom to resort back to his old maize variety, FCS 2, **BC** would do so since he is forced to accept the new capability set in short season maize variety farming due to circumstances. The government distributes free seed and fertilisers [command agriculture and later under conservation farming or *pfumvudza*] to all communal farmers in the country [section 1.7]. This is a structural conversion factor (Sen, 1993) where the political structure enables the functioning of farming mainly in short season maize seed variety [hybrid seed,subsection 5.2.1]....Absent are the knowledges on water harvesting [T^1 in my proposed T^0 framework in Figure 4.2] which would allow them to resort back to their traditional long season maize variety OPV which is similar to SR52 of the 1950s if they still wanted to, thus allowing the freedom to choose which crop to plant and when. FCS 3, **MM**, youth had this to offer on social conversion factors and small grains with a trajectory as summarised in Plate 5.2.

CD [13 July 2017]: How did you learn about the production, harvesting and processing of small grains such as rapoko? (pedagogic trajectory)

FCS 3, **MM** [on 13 July 2017 and also in sub-section 5.2.1].....We learnt from grandmother.... small grains are drought resistant....are good for their nutritional (capability sets of of health and nutrition) values especially for the terminally sick....FCS 3, **MM**, [subsection 5.2.3]....Grandmother taught us that of the old methods of sowing small grains.....the new method is about putting the grains in lines along the contour as this ensured a uniform spacing between the lines and it has an aesthetic value too [Plate 5.2]...

From this, it can be seen that the pedagogic practice was social and based on intergenerational knowledge transfer. Intergenerational knowledge transfer was one social conversion factor that influenced the choice of production mode and achieved functioning of small grain farming as adaptation to climate change. Variability in the youths in FCS 3, **MM** was empowered at T^1 in my T^0 framework in Figure 4.2, **MM** could reflect on the entire process and not T^2 where she could have easily received rapoko as food handouts from government and non-governmental organisations.

FCS 3, **BD**...As a grandson...I also learnt a lot from my grandmother...how to grind the small grains into a mealie-meal [as shown in Plate 5.2]. Today (2017) my family cannot experience starvation....I am now empowered with the skill to [process

rapoko into mealie-meal without processing it through the hammer miller] sustain my own family when there is no money for hammer milling [a social conversion factor].

FCS 3, **BD** processed the small grains on his own thereby absented the impact of drought [by engaging in drought resilient and adaptive practices] and subsequently famine and addressing the absence of money for hammer milling. This reflects on the importance of intergenerational knowledge transfer as a social conversion factor. FCS 3, **BD** had personal agency [individual conversion factor] which supported by collective agency into the achieved functioning of food security and nutrition provisioning. FCS 3, **BD** learnt from his grandmother but he too valued that knowledge [individual agency and internal and not external ‘transformation,, **3L** Totality for transformation to take place.] FCS 3, **LN**: [youth leader], offered the following explanation on social conversion factors:

FCS 3, **LN**...We are committed to the local organic standards which bar us from using artificial fertilisers, chemicals and where possible, we avoid hybred seed. So, since 2010 [c.f Plate **5.9** photos **5-6-7**]..... subsection **5.2.3**: ...We also learnt from elders [intergenerational] how to prepare seed maize from this traditional maize crop (OPV).. we learnt that from FCS 2, **BC** who gave us the seed...) ... We are now our own monitors we don’t need someone to keep checking on us whether or not we are still practicing organic farming year in year out...

This reflects an act of emancipation and also the issue of transformation at **4D** (not alienation), since the youths internally value following organic standards without being coerced to do so. Literature used by FCS 3, on the organic standards as policy documents to guide farmers’ practice is one social conversion factor that helped the young farmers to convert to the new functionings of organic farming. This relates to the issue of observed soil morbidity [sub-section **2.2.4**] that was related to the shift from conventional farming to organic [cf. Sen, 1993 and also sub-section **4.2.3**]. Here, the ability to reflect on and understand standards [the self-perceived standard, sub-section **2.2.4**] looks like a reflection at T^1 in my proposed T^{00} framework in Figure **3.2**, as strict adherence to set organic standards absented poor quality products at local and international levels.

On physical conversion factors, FCS 3, **LN** reflected on the physical landscape: “The sloping terrain here has worked to our advantage. We irrigate our crops with the help of gravitational force as a result of the sloppy terrain”. The presence of sloping terrain (physical or environmental factor) has been an enabling environmental conversion factor (Sen, 2005) for the choice of flood irrigation and for adapting to the new capability set of organic farming in FCS 3. The availability of water in an area, on its own, remains a good basic commodity

[Sen, 1993 or T^0 from my Figure 3.2] but its conversion into a functioning, be it bottling it as spring water, or harvesting it for irrigation or other specified purposes. Thus water availability becomes T^1 as it is the springboard for further functionings as proposed in Figure 3.2. When questioned as to whether they have shared this knowledge [co-creation and collective agency] with other farmers in the village, I learned from FCS 1, **VS** that,

...Three farmers and the youths (FCS 3) came here for a field tour and I hope they benefitted from knowledge sharing with me here.....They were impressed and they vowed to copy the practice...I haven't got the chance to go and assess how far they have gone with the practice yet, but I will make a follow up...(social conversion factor).

However, FCS 1, **VS** learnt from another farmer [social conversion and Layer 2 reflexivity external]. She reflected on the new practice [Layer 1] and accepted the idea (i.e. internalised it). Three farmers later came to learn from FCS 1, **VS** too [Layer 3], including the youths who also reflected on the new practice from FCS 1, **VS** but adopted the learnt concept with modifications [from Layer 1].

As shared in the data in subsection 5.2.1 above, FCS 10, **VC** also reflected on the influence of drought on the changes in the type of maize being planted; this reflects an environmental conversion factor induced by climate change. It might also show that environmental conversion factors, reflected in personal experience of changes in weather patterns, brought about a new capability set that transformed people's farming practices as they reflected on how to absent the impact of droughts. Such reflections happened at many levels: individual, nuclear family, extended family, community, markets and so on.

Reflexive processes also included individual conversion factors [latent] or personal characteristics such as the individual farmer's educational background. As shared above, FCS 10, **VC** reflected on personal knowledge and background and came to note that it was now unprofitable to continue farming long season varieties in a changing climate. This reflects farmers putting all options onto the table and choosing the best. FCS 10, **VC** also reflected on changing rainfall patterns as rains extend into winter thereby making it possible to have a two crop cycle in a year. It has become unprofitable to plant crops once a year when water and soils were available in most months of the year.

5.2.3 A Summative Perspective of Tensions and Enabling Factors

Apart from climate change related constraints, there were a number of other tensions and enabling factors influencing farmers' changing functionings and capability sets in the three case stories presented in this sub-section. Tensions were also discussed and reflected in the data abstracted from sub-sections **5.1.1** to **5.1.11** and also from data below. FCS 2, **BC** noted tensions as constraints emanating from the winds of change [government policy-social conversion factor and climate change as physical conversion factor, sub-section **5.5.2**]. Extension services as experts that are employed by government to disseminate innovations to the farmers, have been viewed by FCS 2, **BC** as both enablers and disablers of people's capabilities. As enablers, the government policy on free seed and fertiliser distribution (command agriculture and later conservation farming or *pfumvudza*) monitored by extension service and community leadership, absents the impact of droughts. Extension service helps in sharing knowledge of new seed varieties that are drought resilient and also they help in the distribution and acquisition of fertilisers. But government policy through extension service partly seems to have failed to absent the impact of water shortages through failing to support small-scale water harvesting techniques. I view the education offered by government policy through extension service as operating at Layer 2 which I call T^2 and not at Layer 1 or T^1 [Figure 3.2] as seed on its own does not fully absent the impact of droughts, rather, farmers might also need rainwater harvesting techniques to start operating at T^1 as found in FCS **3** (youths); **4** (SM^2), **5** (SS) and **6** (JM^2). The four case stories managed to absent the impacts of and adapt to droughts by having water harvesting techniques and devices such as water reservoirs, diversion furrows and deep trenches and so on. Research evidence from such tensions are reflected in the abstracted data as follows:

FCS 2, **BC**:...The shift in rain seasons has forced us to abandon the OPV seed variety that we had linked to farm since the 1950s....Everyone nowadays is going for certified seed varieties which are more prone to weather changes and diseases than the traditional OPV seed varieties. Certified seed varieties are also too expensive for us as compared to our traditional OPV [Tensions from the Social Conversion factors] ... Extension service helped us understand the link between the changes in climate and the new seed varieties....FCS 10, **VC**: (son to BC)....We appreciate all this help ... we have been left exposed....We just rely on government...Rather, we want the basic means to produce, water supply to be afforded at homestead level so that we can plant crops throughout the year, buy our own seeds and fertilisers if we want to.....[cf. subsection **5.1.10**]

As can be seen from the text abstracted above, while FCS 10, **VC** appreciates the social learning trajectory towards transformation as shared with extension service, he also saw the shared knowledge as disabling people's capabilities constraining the freedom of choosing seed varieties they valued and when and what to farm. This is a tension within the social conversion factor emanating from the government's extension service programme and policy. FCS 10, **VC** reflected on the alternatives to free seed distribution and alternatives to rainwater by provision of water through water harvesting techniques. I consider FCS 10, **VC**'s assertion as an observation at T^1 or transformative social learning **layer 1** and not **layer 2** or T^2 in my Figure 3.2 T^{00} framework. FCS 1, **VS** also reflected on tensions brought by her achieved functioning of fertility trenches as a water harvesting technique that was temporal and could not sustain long dry spells. **FCS 1, VS** reflected on this new capability set as a disabler as follows:

The 2014-2015 rain season was tricky but I capitalised on the first rains [early December] since my trenches were ready for the crop...The germination was good unlike the situation from most of the fields in the village...every morning when I wake up to do my field observation at 0500 hrs, I would be surprised to see most of my crop, healthy-green from morning until 1000 hrs...Thus, I concluded that my crop was benefitting from the moisture that had been retained in the maize stalks in the trenches...The maize stalks are good but they might not be good enough for a very long dry spell and that is why [T^1 in my T^{00} framework in Figure 3.2 showing evidence of inductive reasoning as she {VS}, observed that the trenches retain moisture long enough until rains come again]...While I was enjoying my new practice of fertility trenches, it was good when the rains were normal and not excessive and flooding. ...like rains that fell this year (2016-2017)...I reflected back to our old knowledge, ways of how to drain off wetlands'ridging' a raised platform [and not in a flooded trough] so that the water drains off... [cf. sub-section 5.2.4].

The above shows a transitive dimension of knowledge (cf. Bhaskar, 2016) on fertility trenches, that such an achieved functioning might not be the best for water harvesting since such trenches only offered a temporal solution and cannot sustain long dry spells. More, fertility trenches could be a source of water logging thereby negatively affecting the crop. Thus, as can be seen in the above text abstract, for FCS 1, **VS**, climate change created a major tension and disabling factor that she had to overcome using other techniques of water harvesting such as the exofield techniques of roof top water harvesting since she already had a roof of a considerable surface.

FCS 1, **VS**, used inductive reasoning [cf. subsections **2.2.9** and **5.2.1**] when she referred to the observation that the first rains (onset) were good for her fertility trenches to retain enough moisture for maize seed germination unlike in neighbouring fields within the village where fertility trenches were absent. With more rains, plant growth was also assured. She also did experiments on her new capability set on fertility trenches (3L laminated totality) and she came to conclude that the fertility trenches were good enough to retain moisture, hence were worth the agency and transformation (4D).

But, while FCS 1, **VS**, accepted the strength of the fertility trenches, she also appreciated the tensions or ills surrounded by the use of her type of fertility trenches as water harvesting techniques since these offered a temporary measure to moisture conservation and preservation which could not last long under meteorological or hydrological droughts. Thus FCS 1, **VS** saw the possibility of falling from **4D** to **1M**, when the new capability set of fertility trenches failed to sustain a meteorological drought one day. From my proposed analytical framework in Figure **7.1** based on the MELD schema, it is indeed possible for one who attained transformation at **4D** to fall back to 1M non-being.

While the fertility trenches were good as temporary measures to droughts, fertility trenches also constrained FCS 1, **VS**' new capability set as the trenches worsened the flooding situation since they retained water and promoted water logging conditions. Flooding chokes maize. However, FCS 1, **VS** sought to absent the impact of flooding by ridging, another physical conversion factor learned via social conversion factors, as she learned this approach through intergenerational knowledge transfer. FCS 1, **VS** [in July 2017] continued reflections which showed up other tensions, as discussed below:

FCS 1, VS:....this year 2016-2017, I expect...to get four tonnes and that is for our family... consumption...and for relatives in town....I also wish that if I had cattle manure then I would cease from collecting humus from forests, humus is good but it takes longer to decompose and feed the soils than cow dung could. But anyway I have to live within my means! While the trenches are working for me they have not yet been recognised by the extension offers and so no Field Day has been held at my field as yet. I think they have their own programmes to follow but I am happy, my fellow villagers now come and learn from me.

While FCS 1, **VS** wanted to claim that the fertility trenches resulted in a transformed practice that resulted in a shift from a harvest of zero tonnes of maize to four tonnes in a period of five years, she observed some tensions within her new capability set and achieved functioning. She noted that extension service (external) could not easily identify with her new practice and

so FCS 1, **VS** remained non-existent (De Sousa Santos, 2007; Bhaskar, 2016), even though her fellow villagers viewed her new capability set and valued practice as good. She also reflects on the limitations of the collection of forest humus as compared with cow dung. Considering all options (Mezirow, 2000), she quickly accepted the use of forest humus instead of cow dung, saying she had to live within her means. But, the option for dung and other water harvesting techniques remained open.

FCS 3, **LN** and **MM**, like FCS 2, **BC**, also noted tensions from small grains that were related to the production process and its palatability alongside traditional vegetable relish, making small grains not so good an alternative to maize. Small grains were also viewed as difficult to market, despite them being less susceptible to pests and droughts as shown below:

FCS 3, **MM** [on 3 June 2017]...While we learnt a lot from grandmother on the production of small grains, the process from planting stage into weeding, harvesting, shelling, stone grinding into a mealie-meal, is laborious and not easy as compared to taking maize to a hammer miller..... Small grains cannot be taken alongside any relish such as vegies as is the case with maize meal and as a result they remain unpopular amongst people in this village [despite the fact that they are resilient to droughts].We know of a colleague too, in another village, who had 25 bags [25x50kgs =1250=1.25tonnes] of small grains and he got stuck with them. He tried to market them at hospitals so that he could get the means to buy maize, our staple food, but they did not buy....and so he ended up exchanging it with maize as barter trade with those who produced traditional brew. From such experiences, even when we want to produce small grains in bulk we have to think twice! [these are some of the tensions that negatively impact the adoption of small grains]...by practising organic agriculture, we hoped this was going to solve the problem of pests [that resists heavy chemicals] since we are testing the use of traditional methods to control some of these pests [environmental conversion].

There are tensions surrounding small grains as adaptation to climate change, in that the locals do not consider small grains as their staple food crop. This creates a conflict when considering the case for small grains as adaptation to climate change, since the locals will need the means to enable them to exchange the small grains with maize, hence the resistance to practise small grain farming even when the community-based farmers are aware that maize is under direct threat from climate change and small grains could be a good alternative. The traditional maize crop, OPV, is a high yield variety but needs a long rainy season hence can only be practised by those who have supplementary water facilities, thus those who want to choose this maize variety are disabled by climate change in the absence of water for irrigation. Thus the above text abstract also show some of the complexities of navigating tensions between social and environmental conversion factors. Cattle is good for organic

manure but cattle as animals, emit a heat generating gas (methane) which is not good for global warming. Cattle and other farm animals are major sources of methane, a greenhouse gas many times more potent than carbon dioxide as a heat-trapping gas. Methane is released when animals belch, pass gas and make manure. Thus livestock are responsible for 14.5% of human-induced greenhouse gas emissions, with beef and dairy production accounting for the bulk of this (Gerber et al., 2013) and this was one tension associated with use of cowdung as organic manure.

5.3 SMALL-SCALE IRRIGATION CROP FARMING: CASE STORIES 3, 4, 5 & 6

Irrigation is viewed as an adaptation to climate change and this section looks at the research evidence from three case stories that engaged with small-scale irrigation as new capabilities sets and achieved functionings in perennial crop production and as a precursor to a market mode of farming. For each case story, evidence from the history of the practice, the production mode and commodities or inputs as well as the conversion factors and tensions, are discussed. Plate 5.8 shows the trajectory towards small scale irrigation as a new capability set for market gardening.

5.3.1 The Production Mode or Inputs to Achieve and the History: Old and New Adaptive Practices under Rainfed Maize Crop Farming and Small Grains [FCS, 3, 4, 5 and 6]

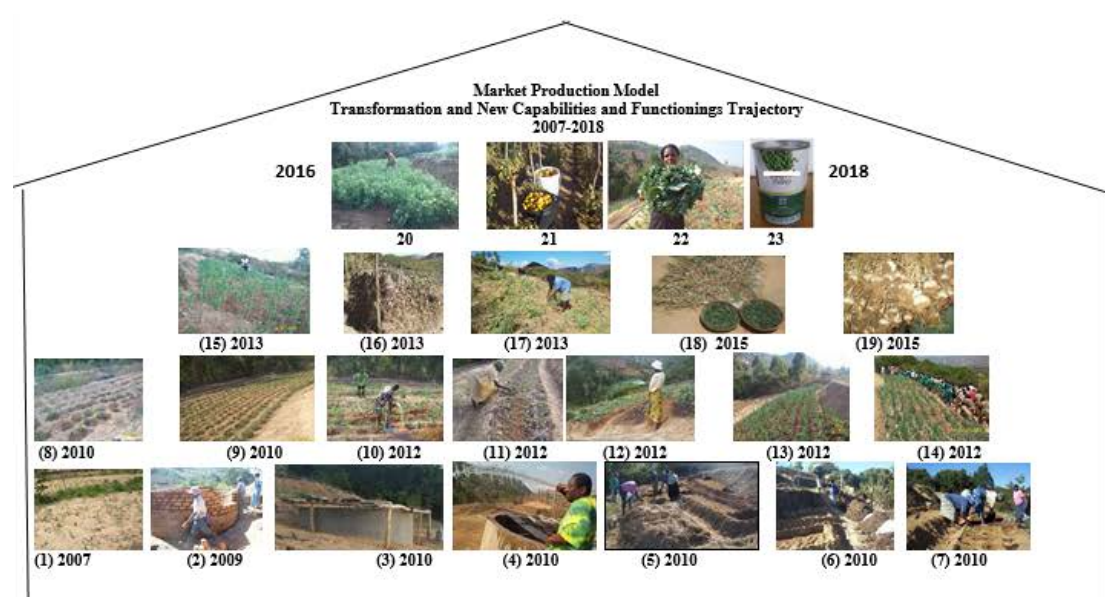


Plate 5.8: The youths' trajectory from subsistence to a 'market' mode of production

In Plate **5.8** the period 2007 and before is characterised by non-productive soils; the period 2009-2010 saw the shift to a new function characterised by the construction of water reservoirs built out of earth and brick; the period 2010-2012 saw the shift towards organic farming practice and conservation farming techniques like conservation basins, use of humus and mulch and the use of hosepipes for watering; the period 2012-2015 with the new capability set and achieved functioning of organic production under compost manure was not competitive even for local and urban markets and finally, the period 2016-2018 saw the use of liquid manure and the entry into the urban and industrial market as a new capability set. The new capability set was also characterised by scientific laboratory tests with laboratory test results for organic matter found in soils and nutritional level of the products, are found in Table **8.2**, which compares soils from organic and non-organic manure and in Table **8.3** on nutritional tests. The research evidence from FCS 3, as abstracted from the texts, is shown in the following:

FCS 3, **LN**....The period before 2009 [the year a water reservoir was built at the demonstration site] we used to wait for rains to come, plant a crop with artificial fertilisation of the soils from synthetic fertilisers.... we had to wait and pray for rains and more rains to come [evidence of a poor maize crop in Plate **5.9** Photo **1** of **2007**].

The production mode and means to achieve (commodity or inputs) in 2007 and before were hybrid seeds, infertile sandy-light soils, artificial fertilisers and erratic seasonal rains. The farming mode was subsistence and conventional monoculture. Evidence shows that the soils were no longer productive based on the 2007 maize crop shown in the Photo 1 of Plate 5.9. The youths thus shifted from the old mode of production which was seasonal rain-based and monoculture to a more diversified mode based on small scale irrigation. The shift to a new production mode was a product of a multi-reflexivity with others as collective agency as noted below:

FCS 3, **MM**... So after reflecting on the poor sandy soils [Plate **5.8** Photo **1** of **2007**, self-perceived morbidity of the soils, subsection **2.4.4**]...But we needed water...we continued reflecting amongst ourselves and consulting the community leadership on ways to sustainably harvest water from the nearby spring without causing it to dry up.. At first the community leadership ruled out a fuel powered water pump but recommended a manual bush pump. [a fuel powered pump also pollutes water sources and pollutes the environment] But without machinery, it was so difficult to fill-up the two cement and brick-built water reservoirs upgradient using human power. ...still, we further reflected on the water issue with the community elders [Plate **5.8**] and we try to have a temporary small earth built pond ... constructed some

distance away from the main community water point as a water harvesting point for water extraction by fuel powered pump into the built up reservoirs.

The production mode and means to achieve [commodities or inputs] was the constructed water cement built reservoirs as that enabled the achieved functioning and capability set of irrigation. This new mode of water harvesting reflects one traditional way of conserving water sources as the mechanisms prevented water pollution at source and so a fuel powered water pump was allowed by the community elders. Here, the water is let into an earth-built pond only when the youths want to pump water into their cement and brick water-tanks uphill. The outlet valve is opened once pumping from the earth-built pond into the watering tanks is finished so that the water continues to flow into its channel and feed the riverine-ecosystem downstream. This worked well as the water point is still functioning undisturbed as it has done for over one hundred years! On the process of reflexivity towards the shift to a new mode of farming and new capability set, the youths had this to say:

FCS 3, **LN**.....The long road towards irrigation started from learning from the spring (a community water point) that never dries up year-in-year-out (Plate 5.2). The spring (Plate 5.2 photo 1) has been flowing for over a century as we gathered from oral history. We thought of the best way we could use it to water our fields since it was a spring of centuries...

While climate change constrains the different farmers' capability sets there still remain other latent capabilities in springs and wells, that are yet to be converted to the functioning of perennial farming and food security as shown above. The transitive and intransitive (cf. Bhaskar, 2016) dimension of the functions of a spring can be noted. For a century the spring flowed and its main use was for the provision of drinking water for humans and animals and water for cooking. Strict traditional customs were observed on its use in order to avoid its imminent drying up, for over hundred years. Evidence that the spring in this case story was a commodity or input that was yet to be converted to the function of water harvesting, irrigation and climate change adaptation, and had flowed for a century, is provided below by the youth leader, FCS 3, **LN**:

FCS 3, **LN**.....One of my Aunts who is now late,.....used to tell us that she used to drink from this same small spring and water point as far as she remembered. As a point of reference, she would point out drinking from this spring when she was at the age of sevenduring the First World War [1914 –1918].she drank from the same spring during the Second World War [1939–1945]. So, we can safely confirm that the spring has been flowing for over a century now [1914-2017] ...But, to extract water from this century-old spring, we (youths) had to observe some 'Dos and Don'ts'

or taboos (cf. Dirwai, 2007) associated with the continuous or the discontinuous flow of this spring.

This was referencing transfactuality using oral tradition against world recorded historical benchmarks. Such oral evidence was used to provide evidence for the youths to shift from the old mode of production and extend the knowledge of the use of the spring from a mere source of drinking water to a source for irrigation. The trajectory to this new mode included a respect for the customs that guided the sustainability of the spring, to keep it away from different forms pollution and prevent it from drying up. FCS 4, **SM**² shared a similar experience:

The stream that passes by my homestead is perennial and we [referring to his family] have always protected this stream by observing the cultural taboos. (cf. Dirwai, 2007)... This has kept our farming project going on during the dry season. [But, the use of fossil fuel powered water-pump pollutes the environment as it adds to greenhouse gases and such is a capability disabler too].

Thus ‘Dos and Don’ts’ as social conversion factors can be both enablers and disablers of farmers’ capabilities when shifting from old to new functionings. The other new practice and new capability and mode of production was conservation farming as shown below:

FCS 3, **MM** [cf. Plate 5.9 Photos 15 & 16 respectively]... the humus collected from the bush and from the mounted compost and cow dung, filled up the dug conservation basins. This created a new mode of farming, conservation farming. [Conservation farming is a precursor for organic farming]. For peas and onion crops we did not dig basins but we dug small trenches that we filled with compost manure. ... we also applied mulch for moisture preservation [Plate 5.9 Photo 15, vegetables covered in grass mulch]. But, still, the product was not competitive at the urban open market [Plate 5.9 Photo 17 showing a failing pea crop]. ... the market complained about the quality...[Plate 5.8 Photos 18 and 19].

The humus and conservation basins were other commodities or inputs needed for the new function of organic farming which is a value addition to the products that are currently produced by farmers. Absent at this stage were soil and product laboratory testing in order to determine the quality of soil fertility and the nutritional value of the products. The poor quality of their organic product was a complexity the youths could not immediately solve without engaging the scientific morbidity of the soils and products, an aspect of the capability framework (cf. Sen, 2012). Upon further reflection the youths embarked on liquid manure as a new mode of soil enrichment:

FCS 3, **MM**.....We reflected on what our expert, then **GC** [the agriculture expert at the demonstration site in FCS 3, now based in South Africa in 2017] taught us about

liquid manure application between 2010 and 2012.... We reflected on the knowledge learnt on the use and production of liquid manure ... this time, instead of using small cans to make the liquid manure, we opted for three large drums (200 litre-containers) and this was the 'miracle-water' that took us to competitive levels in 2016-2017 season [Plate 5.9 Photos 20-23]. Thus from infertile sandy-light soils of 2007 to healthy soils [soil perceived morbidity of soil, section 2.2.4 and observed morbidity as shown in Table 8.2) and from non-harvests of 2007 to recognised products for the agro-industrial market, with canned peas in the year 2018 [Plate 5.8 Photo 23].

The above shows another new capability set and mode of production in the use of liquid manure. But, in the absence of further laboratory tests, liquid manure might look like the only answer that the youths needed for soil enhancement, but Table 8.2 shows that such liquid manure from cow dung also had limitations in terms of other soil nutrients. This shows another intransitive dimension of knowledge on liquid manure (cf. Bhaskar, 2016). As for FCS 4, SM² the presence of cow dung as part of his income made the shift towards organic farming easy. [One commodity or input for organic farming is cow dung which can be converted to the function of liquid manure]. In addition, on the new capability set and mode of market gardening under small-scale irrigation using diversion furrows, FCS 5, SS had this to say:

FCS 5, SS...My journey through winter wheat farming has been running in the family as I inherited this from my own father (late).....taught me that winter wheat has to be planted ... the first week of May, so that the harvest does not clash with the coming of first summer rains which makes the wheat to rot ... To enable this irrigation mode, there is a perennial stream that flows through my homestead... My father reflected on how best we could utilise this water...through diversion furrows, in the late 1990s. ... used his background of diversion furrows from observing water canals that diverted water from Mutare River for gold processing in the local mines.

This capability set and mode of production has its knowledge underpinned in the family as indigenous knowledge systems passed on from father to children. Such a transfer of knowledges is a social conversion factor which is a commodity or input for the function of winter wheat production. Timing of dates for planting is very important as it affects harvesting time and subsequently the quality of wheat as well as affecting planting of summer crops. Plate 5.9 shows the trajectory FCS 5, SS took in order to adapt to the new mode of diversion furrow as a water harvesting technique and a basis for small-scale irrigation.

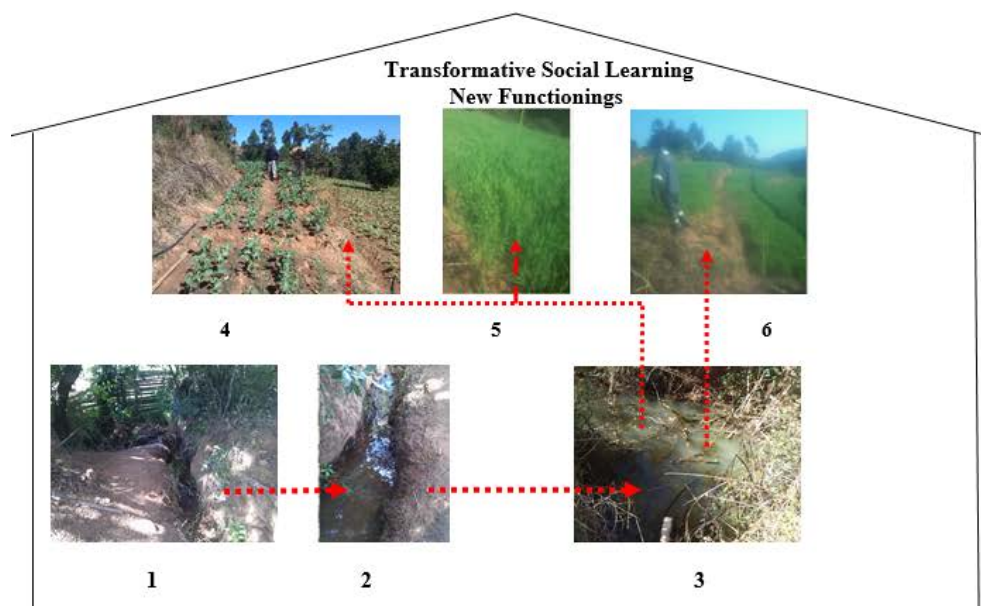


Plate 5.9: The trajectory by FCS 5, SS through diversion furrow

From Plate 5.9 photos 1 and 2 show a diversion furrow from a stream passing nearby, photo 3 shows the diverted water now in a conservation pond with an outlet pipe leading into the main crop field. Photo 4 shows vegetables produced while photos 5 and 6 show winter wheat crop. Thus FCS 5, SS produces maize crop, vegetables and winter wheat from his new capability set of diversion furrow and flood irrigation.

As an adaptation to climate change and droughts and as a way of absencing seasonal farming, FCS 5, SS (shown in Plate 5.9), utilised the force of gravity as one commodity or input needed as an environmental conversion factor to the functioning of irrigation and perennial farming. This new achieved functioning of winter wheat cropping under flood irrigation is shown in Plate 5.9, Photos 5 and 6. The commodity or inputs included a water pond reservoir fed by a diversion furrow, a network of hosepipes, knowledge on when to plant winter wheat and when to plant summer maize so that the harvesting of maize crop does not clash with winter wheat preparation dates. Such knowledge and capability set in diversion furrow for winter wheat irrigation by FCS 5, SS is what I consider to be T^1 or layer 1 in my T-infinite model. Having such a knowledge to harvest water and having the correct knowledge on when to plant winter wheat looks more sustainable than being given food handouts [T^2 or layer 2].

In the last case story in this sub-section, FCS 6, JM² had his new capability set or the valued being and doing in irrigation farming that was supported by a large head of water in the form

of one hundred thousand litres (100 000l) from ten plastic tanks of ten thousand (10 000l) capacity under solar power. The commodities or inputs in the form of solar powered pumping system and a large water holding capacity were a unique case of climate change mitigation in a poor rural farmer and in this thesis as a whole. However, there were other social and structural constraints that disabled FCS 6, **JM²** from fully practicing his new capability set despite the presence of water and the use of a sustainable solar power. More, on the shift from old rainfed farming to new capability set of irrigation, involved the scientific testing of soils and canning of products, an aspect that was absent in the rural poor before. The research evidence on this new achieved functionings is shown below:

FCS 3, **MM**. ...rains are now erratic nowadays and coupled with poor sandy soils, we hardly harvested enough maize before... but from the light-sandy soils of 2007, we enriched the soils through composts...So, with liquid manure and irrigation, we fully moved from being rain-fed subsistence to small scale market based farmers supplying urban market in 2017 and industry in 2018. More, we managed to send soils for laboratory tests on pH and against heavy metals and laboratory tests on products for various nutritional components.....

Plate 5.10 shows the collective agency and social learning trajectory towards the new capability set on a market mode of production between 2007 and 2018.

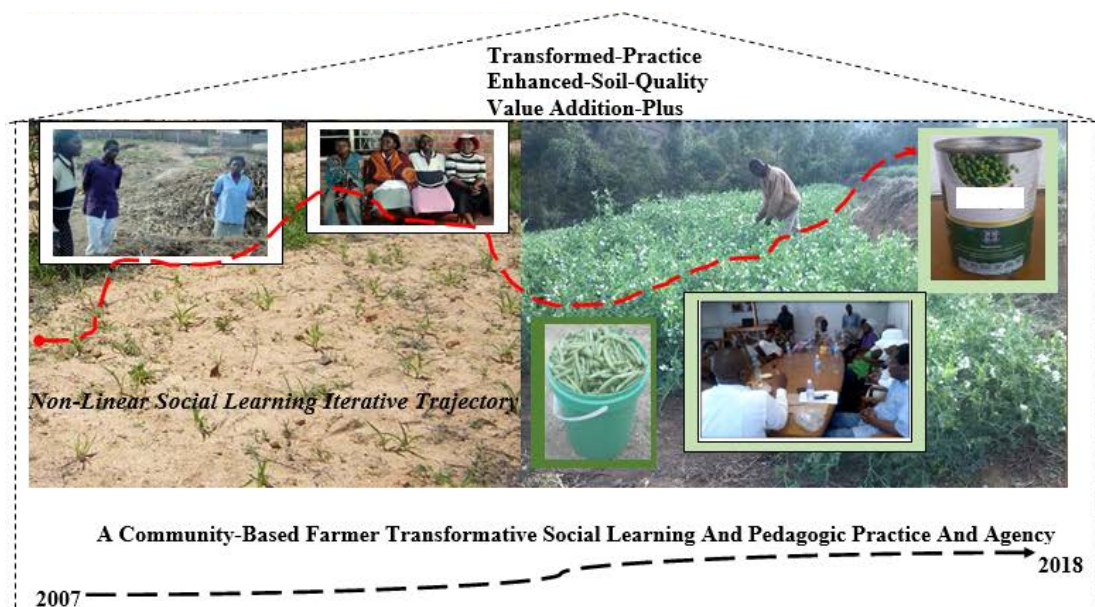


Plate 5.10: The social learning trajectory towards the market mode

In Plate 5.10, the bottom left photo shows the soil and crop situation as of 2007. The first photo top left shows the youths enriching the soils using composts in 2012 and the photo next to the youths working on composts in the youths in a focus group discussion with one of the

extension officers. The photos bottom right shows the condition of a peas crop from the same piece of land eleven years later, insert is a bucketful of fresh unshelled peas and next to it is the group of farmers in a boardroom at an agro-industry during a focus group discussion on contract farming and the insert top right is the tinned peas products from the same piece of land that hardly produced any meaningful maize crop output before 2012. Use of liquid manure as a new capability set and mode of farming was the ‘miracle-fertiliser’ that put FCS 3 on the road to be recognised by the local and urban markets. The journey was long and winding as the youths learnt together with other farmers, extension service and from and with the agro-industry on new farming practices that also were adaptations to climate change. The youths turned sandy-white soils with pitiful maize harvests of 2007 to dark-loamy soils with good products that were actually canned by one agro-industry for further laboratory tests against organic parameters in 2018. Organic farming as a new capability set and a valued mode of farming also could be associated with the capability of health as argued below:

VM.....I have collected some garlic bulbs from this field [demonstration site, FCS 3]. Garlic helps reduce my cardiac problems and reduces my high blood pressure to acceptable levels... The community-based farmers wanted to link garlic and small-grains to health issues. **TM²:** [Organic farmer 17 during a Field Tour to the youth project, July 2015, speaking on the new capability of organic farming and nutrition under irrigation].....We like practising organic farming through digging basins [conservation basins]...We do not apply artificial fertilisers nor do we apply chemicals on our plants....Look, even small children complain of painful swollen legs. We don’t know the source of such health problems but we suspect it is associated with the foods that we eat which are contaminated with chemicals and synthetic fertilisers.

Organic farming is purported to provide the capability for health and nutrition. The above also reflected the community-based farmers’ self-perceived morbidity (cf. Sen, 2012) on what constitutes a healthy diet against a healthy body [sub-section 2.4.4]. Communal farmers were able to link the new achieved functioning of organic farming to their own health challenges and eating habits.

5.3.2 Research evidence on the three Resource Conversion Factors

The capability theory’s three conversion factors noted in the four case stories in this sub-section varied by case but all had a collection of individual, collective, social and environmental influences. FCS 4, **SM²** observed the following:

... I started by attending Field Days [2013 and 2014] at the communal demonstration site where I helped the youth in taking photos and videos using my personal phone..... I played back these videos at home and reflected on the learnt practice. I discussed this with my family and extended family in the diaspora, whom I also shared the photos and videos of the learnt practice through the internet....

For FCS 4, **SM²**, it was more of a combination of individual and collective agency and collective capability from relatives in the diaspora, that helped him convert to new modes of farming practice, market gardening under small-scale irrigation. Thus a combination of personal agency [internal] and social conversion factors made FCS 4, **SM²** transform. As social conversion factor the remittances from the diaspora played an enabling role in the shift from subsistence rain-fed farming to perennial irrigation practice as an achievable functioning by FCS 4, **SM²**. In the case of the youths, the journey towards the new mode of farming, irrigation and market gardening was a combination of individual characteristics and social conversion factors through learning from and with others in the community and beyond.

FCS 3, **MM** ...We did not walk this journey alone as youths, we continued to reflect with others [communities of practice] who are our local primary school, the extension service, donor agents and the community at large, through field days [Plate 5.9 Photo 14]. ... other farmers would ask us questions and they could point out where we might have gone wrong.....[Learning is a reflexive process and is a collective process too]... We accepted to be corrected and once we correct the noted mistakes then we could recall the group on the next crop to show our appreciation of the corrected problem.Yes, ... FCS 1, **VS** noted the absence of mulch in our crops, we went for a Field Tour at FCS 1, **VS**'s field and we learnt from her.... We later invited her in 2017 to showcase the practice of mulch and fertility trenches that we had learnt from her (VS). We also recalled **CM¹** in 2015 for him and the community to see the corrected and improved practice on conservation basins.

Learning was a collection of conversion factors that included personal reflection and acceptance of ideas from others. This too was a social conversion factors as well as learning from tensions from the market itself. The passion for farming, a skill gained at school, is one other social conversion factor noted by FCS 3, **LN** below:

FCS 3, **LN**...As an individual, I have passion for farming from secondary school [social conversion] and at my own home I am the 'master' farmer there! I enjoy gardening too [personal conversion]....I attend trainings as far as Harare (capital city of Zimbabwe) [social conversion]. I also read books and training manuals that we get from the training [social conversion] such as the bee-keeping, rabbit keeping, crop farming as a business and so on. More, I learnt a lot from the local agriculture extension service about good farming practices and composts. [social conversion] ...I also learnt to change our practice from the market itself... through a series of rejection

of our products, we were learning. [social conversion]...The changing climate was also a big teacher as we had to adapt to the shifting seasons and experiences [environmental conversion]. The physical landscape also helped us in adapting to flood irrigation, powered by gravitational force [environmental conversion].

FCS 3, **LN** confirmed his passion for farming, a capability set that he valued being and doing but he too was constrained by climate change induced droughts. Thus a combination of personal, social and environmental factors (the sloppy terrain and climate change) helped FCS 3, **LN** in the conversion process from old to new modes of farming in this thesis. FCS 5, **SS** emphasised this:

FCS 5, **SS**: The physical landscape at my homestead enabled us to drain water through gravity and using a diversion furrow from a nearby stream flow (environmental conversion). The knowledge I got from my own father on market gardening and winter cropping and the theoretical agriculture knowledge that I also got from school were an added advantage (social conversion).

On social conversion factors FCS 6, **JM²** added the issue of the media as a source of knowledge for change as well as the harsh economic hardship as a socio-political factor that pushed him into a self-reliant market based mode of farming:

FCS 6, **JM²** [on social conversion factors] I also learnt about irrigation farming through informal learning from television and radio programmes in the local languages Shona and Ndebele, 'Murimi wanhasi-uMlimi wanamhla', [Today's Farmer] and television's English programme, 'Talking Farming' and from trainings by donors. These at times dwelt much on large scale irrigation farming. (social conversion). FCS 6, **JM²** ... So I can say climate change and harsh economic challenges (lack of jobs) also taught me to think of new ways of farming including irrigation so as to raise income.

5.3.3 A Summative Perspective of Tensions and Enabling Factors

Tensions regarding irrigation types as a valued beings and doings or capability sets were abstracted from the text that was recorded when the farmers interacted amongst themselves as well as during detailed interviews with the researcher, **CD**. The tensions were not uniform but varied according to farmer and size of production. Those operating at a small scale [less than a hectare] could not break even because of small quantities as shown below:

FCS 4, **SM²** While I enjoy the new practice [market based conservation farming], the small quantities that I send to the market makes my business unprofitable, once I factor in transport costs. Only if I can increase my crop production, then I can safely enjoy the profits.

The new capability set for FCS 4, **SM²**, market gardening can be an alternative to maize crop farming which recently has become constrained by climate change. But this new capability set is not without tensions. The small space, an environmental conversion factor, constrained FCS 4, **SM²** from sustaining his life and food security. He reflected retroductively through lamenting the absence of large quantities as a disabler of his new achieved functionings, market gardening. FCS 4, **SM²** and FCS 3, **LN** (youths) were the only two case stories in this thesis who successfully sent crops to one agro-industry market in 2018. The two case stories had less resources as compared to FCS 6, **JM²** who had a comparative advantage on environmental conversion factors such as four hectares of aerable land space, 100 000 litre-water reservoirs for irrigation and a sustainable solar powered water pumping mechanism. He had his own set of tensions or challenges as noted below:

FCS 6, **JM²** My crop field is quite big [the crop field is around 4 hectares and this is quite big according to this village's standard of average field size] and the fact that we are also moving towards organic farming, getting manure and making composts for a such a large field is a big challenge.

In the case of FCS 6, **JM²**, tension emanated from the demands from the organic standards', use of manure and compost which is not viable for four hectares. The issue of standards is a social conversion factor that affected FCS 6, **JM²** from practising organic farming as a new capability set and mode of production and as his valued being and doing. For the farmers practising conservation farming and organic farming, on small plots such as FCS 3, **LN**, FCS 4, **SM²** and FCS 5, **SS**, the issue of organic manure as part of the measure for organic standards and a social conversion factor, was not a tension since they could easily cover their small spaces with cow dung manure and compost. More tensions emanated from some social conversion factors coming from family social structures:

FCS 3, **LN** Do you value the idea that we cooperate by growing one crop at the same time and we sell to one big agro-industrial market one day?

FCS 6, **JM²** Producing for the agro-industry is my wish too. We need to be selling to bigger urban or to agro-industries next year (2018). One individual cannot meet the demands of an industry but when we combine forces, we can do it. ...[a year later in the winter of 2018]...We could not agree with my extended family on the logistics of the collective production project ...you know where there are profits involved there exist many ownership wrangles.

While in principle FCS 6, **JM²** agreed to the collective agency in producing a single crop for one industrial market, tensions rose in the winter of 2018. Growing one crop for the industrial

market was attempted but this did not work out because FCS 6, **JM**² was constrained by ownership wrangles from his extended family and so only FCS 3, **LN** and his youth group and FCS 4, **SM**² ended up supplying one agro-industry with a pea crop in 2018. Apart from family wrangles as a social conversion factor, constraining one from practising the mode of farming that he valued, the type of education that the community-based farmers received also provided tensions as another social conversion factor [cf. Sen, 1993] as shown below.

FCS 3, **LN**. At times we get education on farming business [through government's extension service and through donor funded trainings] but we do not get the knowledge on the markets during the farming business trainings...where to send our products and how to enter into such markets...we had many tree nurseries which ended up overgrowing without buyers...the story was the same for the ground-nuts farmers of (M-rural) district in this province [Manicaland] as noted by **CM**² (2015), the communal farmers were left with so many tons of ground-nuts without buyers... Trainings that do not spell out the marketing mechanisms seem not to be good enough for us, that is why you find people going back to their old ways of doing things instead of progressing well with the new ways that will often disappoint them in the end...

While the farmers seem to be willing to adapt to climate change in order for them to realise food security, the type of knowledge they received on the alternatives to maize crop farming, often confused and constrained them. The absence of the knowledge on markets and marketing from the trainings on farming business, often constrained FCS 3 from achieving functionings of dendrology and so FCS 3 opted out of that new capability set and alternative to maize crop farming. A similar scenario was noted in the ground nuts projects where the communal farmers in another village within the province of study, abandoned their staple food crop, sorghum, and embarked on ground nuts, they were left stuck with nineteen tons of ground nuts without a market for them and without their staple food, sorghum. This was one evidence of how a social conversion factor can constrain the farmers' capabilities. Shared knowledge if not taught from T¹ [wholesome education inclusive of where to market the product] according to my proposed T⁰⁰ model [cf. Figure 3.2], but taught from T² [how and when to produce a crop especially after supplying the farmer with a free seed], can disable the farmer or at times leave the farmer in a more desperate situation than before. Such a scenario is likely to be similar to the one reflected by a downward arrow within the MELD schema diagram from 4D back to 1M in my Figure 7.1. Furthermore on social conversion factors, the youths were not very sure on how to assist the student **CM**⁴ [cf. subsection 5.1.3 and Table 4.3.3] on attachment. Table 5.1 summarises the community-based farmers' old and new capability sets.

Table 5.1: Summary of old and new capability sets: Rain-fed and irrigation

Capability Set	Commodity or inputs and Current Practice	History	Conversion factors	Tensions
Rain-fed farming and food sustainability and nutrition (non-market mode - barter) or subsistence	<p>FCS 1, VS: Fertility trenches (in-field water harvesting technique), buried maize stalks, humus and grass from forests. Flat gradient.</p> <p>FCS 2, BC: OPV seed variety; wetland; seed exchange; conservation farming; storing OPV seed, concentrating manure in dug basins (current practice).</p> <p>FCS 10, VC: Conventional seed variety (uniform per agro-ecological region) synthetic fertilisers distributed for free by government; research from government; climate change, government policy, perennial farming, winter cropping.</p> <p>FCS 3, LN: OPV under irrigation, shared knowledge on small-grains.</p>	<p>FCS 1, VS: Before 2012 rain-fed maize production and food insecurity, 2017 maize yeilds of four tonnes and food security, barter and semi-subsistence.</p> <p>FCS 2, BC: 1950s onset rains consistently received 7-15 October, OPV seed variety used, use of cow dung and composts, storm drains and fertility pits at end of storm drains, spreading of compost manure in the crop field.</p> <p>FCS 10: Short-season varieties could not survive before 1980 (long rainy-seasons).</p> <p>FCS 3, MM: Rain-fed farming in 2007 and before, small-grain, humus collection from forests, 2010-terracing for conservation farming.</p>	<p>FCS 1, VS: Learning from others during Field and Demonstration Days (social conversion), learnt of fertility trenches and mulching.</p> <p>FCS 1, VS: Individual reflexivity and agency (personal conversion), the raised ridges as personal conversion.</p> <p>FCS 1, VS: Learning through non-formal education (social conversion)</p> <p>FCS 2, BC: The wind of change (social conversion.)</p> <p>FCS 3, MM: Learning through intergenerational knowledge transfer on small grains (social conversion).</p> <p>FCS 3, LN: Commitment to the local organic standards (social conversion) and learning from elders on how to prepare and preserve the OPV seed.</p> <p>FCS 3, LN: Individual agency on monitoring organic standards (individual conversion)</p> <p>FCS 3, LN; FCS 5, SS; FCS 4, SM¹: Sloppy terrain (environmental conversion) and climate change (environmental conversion)</p>	<p>FCS 1, VS: Fertility trenches are good for agricultural droughts of a few weeks and not meteorological or hydrological droughts).</p> <p>FCS 1, VS: Trenches retained water resulting in water logging during flooding.</p> <p>FCS 2, BC: Climate change (droughts) and the shift from OPV to hybrid short season varieties.</p> <p>FCS 2, BC: OPV should not cross breed with hybrid seed.</p> <p>FCS 3, LN; MM and the other youths: Free seed and fertiliser to youths contemplating going organic.</p> <p>FCS 3, MM: Planting and processing of small grains is laborious.</p>

Table continued on next page...

Capability Set	Commodity or inputs and Current Practice	History	Conversion factors	Tensions
Irrigation, market mode of production, food security and nutrition (including bread from wheat produced organically)	<p>FCS 3, LN: Small stream; earth water reservoir and two cement brick-built reservoirs, slope for irrigation, liquid manure. Currently (2017-2018) supplying the urban and agro-industrial markets. FCS 4, SM¹: Plastic tank, stream, earth built water reservoir, fuel powered water pump, slope, cattle for cow dung manure. SS: Perennial stream, diversion trench, earth built water reservoir, hosepipes, slope. FCS 6, JM²: Ten plastic tanks, solar powered water pump, slope and traditional knowledge to create a micro-warm climate and drive away frost during the tomato winter crops. (burning of sawdust at night around the tomato field)</p>	<p>FCS 3, LN: The two water reservoirs were filled up using human muscle and later using a fuel powered water pump. FCS 3, MM: 2010-2013 compost, humus from forests. 2015-2017 liquid manure, crop rotation, mulch. FCS 4, SM¹: 2015 fuel powered water pump and plastic tank, earth built water reservoir, diversion trench, slope, cattle for dung. FCS 5, SS: 1990s diversion furrow and earth built water reservoir, syphon innovation, cattle for dung manure. FCS 6, JM²: 2015 solar powered irrigation, 4 hectares of arable land.</p>	<p>FCS 3, LN: Slope for irrigation through gravitational force (environmental conversion), informal learning on liquid manure (social conversion), spring (environmental conversion). (Stream as a commodity or input and means of production converted into several functionings: water for drinking, irrigation and spring water for bottling by industrialists) FCS 5, SS: Diversion furrow knowledge inherited from father (social conversion), slope (environmental conversion) for syphoning and flood irrigation, dung (social conversion) for organic cropping as learnt from field days. FCS 5, SS: Personal and inherited knowledge on winter cropping (individual conversion) FCS 4, SM¹: Water tank, pump supported by relatives (social) FCS 6, JM²: Learning irrigation from print and electronic media (social conversion), climate change and harsh economic hardship (social conversion)</p>	<p>FCS 3, MM: Payment of hired labour created tensions. FCS 3, LN: Knowledge on markets lacks in the donor and government trainings, local market for organic products and small grains is poor. FCS 6, JM²: Getting manure for organic farming for a 4 ha field is a challenge. FCS 3, MM: Monkeys attracted by the trees from the 1982-1984-2008-2009 tree planting projects, are culturally spared from being. FCS 4, SM¹: Small quantities sent to the urban market do not match with the costs. FCS 3, OD: Changing prices at the urban market taught us how to negotiate.</p>

5.4 SMALL-SCALE APICULTURE (BEE-KEEPING): CASE STORIES 7, 8 & 9

This section looks at apiary as an alternative to maize crop production. Maize production has for some time been impacted negatively by climate change and frequent droughts in this community under study. Apiary thus is one of the three climate change adaptation mechanisms I studied. Evidence from apiculture was abstracted from cases 7, 8 and 9 under the main sub-headings: the production mode or inputs to achieve; the history: old and new adaptive practices under apiary farming; the research evidence on the resource conversion

factors: personal, social and environmental; and a summative perspective of tensions and enabling factors.

5.4.1 The Production Mode or Capability set and the History: Old and New Adaptive Practices under Apiary Farming and the Means to Achieve (Commodities or inputs)

The need to raise income for food security in the face of climate change that negatively impacts on maize crop farming, a staple food for the community under study, might have contributed to the conversion to a market based apiculture in two case stories, **LM²** and **LM³** while **FN** supplemented apiary with fishpond farming and conservation farming. The commodities or inputs for apiary production as an alternative to maize crop production are the apiaries, the sources for raw materials such as flowers, pollen, nectar, and water. The types of apiaries also shifted from the traditional ones made of bark and wooden hollows to modern Kenyan Horizontal Bars. But, one's social background enables or 'disables' the new mode of production and capability set as shown below:

FCS 7, **LM²** [also a teacher by profession on the commodity or inputs] I have 46 apiaries of which six are fully swarmed [functional or fully occupied by bees].I started harvesting the honey in August 2016 and I managed to get 2.5x20litres =50litres of processed honey. ... I also got buyers from Harare ... some about 280km away from FCS 7, **LM²**'s homestead). The price from the industrial market in Harare (market) was \$2.50 per kg. From that market I managed to get a total of USD75.00 in 2016....

This research evidence suggests that FCS 7, **LM²** is practising a market mode of honey production with his commodities or inputs being 46 hives of which only six are fully swarmed. The new capability set of a marketing mode of production is still done at a small scale. While FCS 7, **LM²** earned USD75.00 from six apiaries [bee-hives], literature shows that apiarists in other countries get good money from a similar number of hives [cf. subsection 2.5.2]. Whilst an apiary can be a good alternative to maize crop farming, tensions can already be observed from this new mode of production which is not fully capitalised based on the few numbers of swarmed apiaries, six out of a possible 46 for FCS 7, **LM²**. While the apiarist FCS 7, **LM²** relied on extracting honey for sale as a new capability set and a new achieved functioning, another apiarist in the next village had extended his functionings to include hiring out apiaries to plantations as another capability set and this was reported by FCS 8, **LM³** below.

FCS 8, **LM**³ At the next village (D) there is a farmer (C) who has 256 fully swarmed beehives and he hires them out to apple tree farmers in (N) area to pollinate the fruit trees...when the apple trees are at flowering stage, he strategically settles the hives at every convenient site of the fruit field. The bees do their work in collecting their loads from the apple trees and so the farmers benefit from an improved fruit harvest. The apiary farmer can also continue harvesting his/her honey while the bees are also being paid for the work done in the apple trees. Double gain for the apiarist.

This is a case of space and region (cf. Bhaskar, 2016) thus while the practice of insect pollination was absent in the village of study, it was present in a distant village and so appeared to be worth trying. The new capability set and achieved functioning of hiring out apiaries was learnt from the next village through the knowledge shared by FCS 8, **LM**³; this was then tried and tested by FCS 3 (cf. subsection 5.3.1). Apart from the apiaries as commodity or inputs needed for the functioning of honey production and as an alternative to maize crop production, other functionings are noted below.

FCS 9, **FN**: I have 22 beehives and four are fully swarmed (2016). We were given the honey extraction gear at a training in Harare (Plate 5.5). It was a one week training. Our hives are no longer mounted on trees, they are gender sensitive as women we can do honey extraction without having to climb trees. The apiaries are mounted a metre or so above ground and not high up on tree branches as was the case in the old days. [This was another new capability set or valued being and doing and the new knowledge was on gender sensitive positioning of bee-hives].

The absence of apiary gear could disable apiarists from using the apiaries to pollinate crops directly in crop fields. The new technique of mounting the apiaries just a metre above the ground was gender sensitive and enabled the female apiarists to function without tensions from climbing up trees as was used to be the case in the positioning of apiaries in the old days. Knowledge was also a special commodity or input that the apiarists gained during training as shown below.

FCS 9, **FN**: We learnt that a bee sting boosts one's immune system against malaria. Bees can predict the arrival of visitors, if a bee flies into your house it signifies the coming of a visitor. If it makes several rounds flying inside your room, it signifies the number of days the visitor is likely to spend and if the bee flies close to your eye, it signifies that the visitor is very very close to you.....

Apart from gaining technical knowledge on the construction of apiary frameworks, FCS 9, **FN** gained deep social knowledge, traditional knowledge, medicinal knowledge that is good for social development and for the development of a symbiotic relationship between humans

and bees [building a close relationship between bees and their keepers]. These are other kinds of knowledges in addition to knowing that bees are producers of honey and wax. This is part of ecologies of knowledges [cf. subsection, **2.5.2**; King, 2009]. Traditional knowledge included the use of bees to deter elephants from people's crops, a practice in place elsewhere in Zimbabwe and in Kenya (cf. King, 2009). Although not proven, the indigenous knowledge system, as noted by FCS 9, **FN**, associated with the behaviour of bees could be good for social development and for social relationships that could be developed between the apiarist and the bees themselves. This could be an important social conversion factor for the apiarist to avoid the bees swarming away. Two of the apiarists in this study had learned this new capability set as part of a family hobby while the third only learnt of the practice during Field Days and through non-formal education during training. Evidence of this is abstracted from the texts below.

FCS 7, **LM²**: Bee-keeping has been a family hobby for ages, but as a household head, I started bee-keeping in 1989 when I was still staying in (Ny) village [adjacent village to the village of study]. In 2012, due to persistent droughts we [referring to the village and the trainings they got from extension service on moisture conservation through conservation basins and mulch. cf. section 1.7] started conservation and later organic farming practice which was good for my apiaries since bees do not like any form of pesticides around....The old bee-hives that we inherited were made from bark and then we later used gumwood planks to come up with mere boxes as hives. Today (2016) I thank the donor community and climate smart agents for training us in the construction of the top-Kenyan bar that is what we are using as new technology in bee-hive making.

To adapt to the new capability set of market based apiculture, FCS 7, **LM²** reflected on the training from the local extension service about conservation basins meant to preserve moisture which had been threatened under persistent droughts. It was after the link between conservation farming and later the adoption of organic parameters such as the absence of pesticides in the crop fields, that FCS 7, **LM²** reflected on going semi-commercial by adopting a market mode for his apiary activities. The new capability set sees a change in the type of apiaries from the traditional hollow to Kenyan-top bars. The new apiaries have several advantages compared to the old ones as they provide demarcations for the bees. They are also easy to observe and monitor unlike the old wooden box type of hive that had no demarcations at all (cf. Vinga, 2019 and sub-section **5.2.2**). The knowledge on this new capability set was initially inherited from elders but later supported with training from donors. Absent also are other uses of honey such as, for example, for medicinal purposes. Absent also in this new capability set acquired by FCS 7, **LM²**, is how to separate and

capture the queen bee in order to create colonies and reduce the chance of swarming away. Unlike the other two case stories, FCS 9, **FN** resorted to apiaries after attending field days and reflected on apiary as an alternative to maize crop farming. Her maize crop has been under attack from pests that are induced by droughts. This is shown below.

FCS 9, **FN**: I started beekeeping in 2015 after having realised that maize cropping was being affected by droughts and I had to look around for other alternatives. I found apiary and fishpond farming being better alternatives that were not directly affected by droughts.

Observed climate change and frequent droughts impacted negatively on maize crop farming as shown in the evidence above, and this led to the adaptation to apiary as an alternative to maize crop farming by FCS 9, **FN**. Apiculture as a new capability set is therefore taken in this thesis as an adaptation to climate change and as an alternative to maize crop farming that FCS 9, **FN**, learnt in response to tensions from climate change.

5.4.2 Research Evidence on Resource Conversion Factors: Personal, Social and Physical (Environmental)

This sub-section looks at the evidence from personal, social and physical conversion factors in the three apiarists. All three apiarists benefitted from training that was offered by extension officers as well as donors. This reflects aspects of the personal conversion factors as all were literate and so were chosen for such trainings. In terms of social conversion factors all three learnt of apiary from others, an aspect of a social learning pedagogy. More, the apiarists also learnt from the market and such knowledge acquired is regarded in this thesis as a social conversion factor as shown below.

FCS 7, **LM**²: The urban market does not just buy any product; they look at the quality first. If the quality is good they buy and if it is not they reject.But, the rejection help in teaching us where we might be lacking especially in terms of standards that are demanded by the Harare industries (honey) and the quality of honey they demand. That made us improve on quality of honey.

Understanding the behaviour of the market was important for the apiarist when the new capability set was taken as an income generating activity and livelihood with a potential to raise income for food security and other developmental projects. Thus the rejection of the apiary product by the market was regarded by FCS 7, **LM**² as a social conversion factor needed in order to convert to the new functioning of producing quality products for the new capability set of market based production. Knowledge is therefore not always learnt from

books and trainings but through dissonance when the market rejects products on account of poor standards. FCS 7, **LM**² inherited knowledge on old models of apiaries from parents [his social conversion factors was based on intergenerational knowledge transfer]. The old beehives that he inherited from his forefathers were made from bark and later gumwood planks were used to make hollow boxes but today (2016) he has learnt about modern apiaries, the Kenyan top bar with demarcations, from extension officers and the donor world. The unique case of FCS 9, **FN** who adapted apiary from knowledge shared with others in the community as social conversion and from observed shifts in climate as the environmental conversion factors, is noted below.

FCS 9, **FN**: I also do beekeeping [apiary farming] and I initially learnt of this from FCS 8, **LM**³ during a Field Day [Plate 5.5]. I reflected on the possibility of beekeeping after appreciating the number and quality of beehives at FCS, 8 **LM**³. I also reflected on that back home with my family ...I was later trained in Harare Borrowdale. There were two women and four males from Mutasa district who were trained by Mr (S) in Harare (Plate 5.5)...I have twenty beehives with four already swarmed (functional) (2016). I am also an organic farmer, farming without artificial fertilisers and chemicals...We have cattle, goats and traditional chickens, two large water ponds and so organic farming under irrigation is easy for us.

Research evidence shows collective agency as FCS 9, **FN** was motivated to try and practice apiary from a Field Day at FCS 8, **LM**³ who had several swarms. This was evidence of social conversion factors through learning from and observing others doing a practice in the community and later from trainings. The apiarist FCS 9, **FN** also engaged in personal conversion factors through individual agency as she acted in absencing the impact of droughts by adapting to an alternative to maize crop farming, apiary and also aquaculture as a personal decision. Through training as a social conversion factor, FCS 9, **FN** also learnt the following:

We were taught that bees are like a donor, they supply you with everything while you are just resting at home (social conversion)...We were taught at training not to be afraid of bees they are like your brother or sister in-law. As an in-law you need to observe certain boundaries...you do not have to temper around their entrance as they do not want to be disturbed.

Knowledge on apiary farming started with an understanding of the tensions in maize crop farming that are normally associated with climate change; apiary was seen as an alternative to such tensions and to food security. The shared knowledge on apiary, through trainings, was a source of social conversion factors needed to convert to the new achieved functionings of apiary practice. Absent from the trainings on apiary, however, was the knowledge on markets

and knowledge on how to encourage swarming as well as knowledge on the creation of queen bees. As a personal conversion factor FCS 9, **FN** had personal agency and will power to match a fairly male dominated capability set, apiary. Her arguments are shown below.

FCS 9, **FN**: My journey into apiary farming starts from the gum tree seedlings [Plate 5.5 on FCS 9, **FN** bee-keeping trajectory]. We got 1000 tree seedlings from CD on 10 November 2009. Now that the trees are flowering they are providing shelter, nectar and flowers to the bees [commodity or input or means for production]. I then attended a workshop by Connex (**TM**³) who talked about keeping bees apart from harvesting trees for sale [Plate 5.5]. ... I reflected on that but kept wondering why I could not do it and where I could be trained. I was lucky as I was one of the two women from Mutasa district to be selected by one donor to go and train in beekeeping in Harare in 2015.

The background to the new capability of apiary farming is based on dendrology, a capability set that FCS 9, **FN** adapted back in 2009 and the trees that she planted in 2009 later provided shelter and other inputs like pollen and nectar for the bees. First it was climate change as reflected through persistent droughts that made the farmers reflect on alternatives to maize crop farming, and for **FN**, apiary. The capability set of economy and that of food security can be noted in the apiarists as some had to leave formal employment and opt for apiary while others took apiary as an alternative to maize crop farming and an adaptation to climate change and food security.

FCS 8, **LM**³: I used to work in the local forest industry but I left all that...The remuneration was not good enough (2006-2009)...I could not manage to fend for my family and yet with beekeeping, I earn many times more than what I earned a month when I was formally employed....I bought furniture from apiary, we buy food from the apiary earnings... we send our children to school and so we are now a happy family as we can now afford to survive independent of formal employment....My advice to the other young adults is that we need more apiary farmers as the market is just too big and we cannot even meet the demands of 30 tonnes per year. More, beekeeping has the capacity to reduce domestic violence [other indirect capabilities and achieved functionings]. With the availability of honey in the home, families always have cash at hand and hence less social stress and less domestic violence especially those emanating from financial stress....To other young adults I say to you self-employment through beekeeping is the way forward instead of wasting time looking for a job that hardly pays you enough to sustain your life and that of your family...We still use family labour in honey extraction and marketing.....

Apiary farming, an alternative to maize crop farming and adaptation to climate change, is also here taken as a new capability set for household livelihood and job creation for the youth. While FCS 8, **LM**³ saw apiary as job creation, he has not employed anyone yet and that might suggest that he might not have scaled the new capability set to a business level [cf. Cramp, 2008 and also sub-section 2.2.4]. While FCS 8, **LM**³ is satisfied with his production,

literature has showed that with 64 swarmed apiaries he could be very rich [sub-section 2.2.4]. FCS 8, **LM³** sees this as good money, and yet there is absence of knowledge on honey processing and knowledge on other honey products such as pollen, propolis, royal jelly, venom, queens, bees and their larvae, wax processing, which are part of the vast marketable primary bee products [cf. Cramp, 2008]. On the basic capability of health the apiarist also liked to link his products with medicinal powers to treat ailments.

FCS 8, **LM³**: Even today we still supply the local market in small quantities of 250g bottle @ \$3.00....to people who are asthmatic and those with heart problems and the general public who just love honey. The sick come and buy from our home....

Thus honey for nutritional value and for the health of the people is an achieved functioning for the local farmers in addition to selling honey to the urban markets. This is transfactuality as the farmer is able to link honey, nutrition and health.

5.4.3 A Summative Perspective of Tensions and Enabling Factors

Climate change provided tensions in the rain-fed maize crop farmers whose source of food security and livelihoods are under threat from persistent droughts and from pests. The new capability set, apiculture, from which they had hoped for food security after selling the products in order to buy maize, their staple food, also faces tensions. The tensions faced by the apiarists varied by case story but the generic tensions emanated from the lack of knowledge on the market and marketing process as well as knowledge of how to treat pests, and how to prevent the bees from swarming away while encouraging colonisation of the apiaries. Such tensions affected the new achieved functioning of honey production as food security and as an alternative to maize crop farming as shown below:

FCS 8, **LM³**: I have noted several reasons why bees seem to be scarce nowadays in this village, veld fires which were very rare especially in [Ny, an adjacent village to the village of study] village known for beekeeping, are now more frequent. Secondly if I don't have enough wax, to attract the bees, then most of my bee-hives remain empty. Also drought, the rains were not evenly distributed and there were not heavy too, resulting in less flowers.....

Lack of knowledge of splitting colonies and the creation of queen bees [cf. Cramp, 2008] as a social conversion factor, seem to constrain the apiarists' achieved functionings and so, they often blame their problem on veld fires [the intransitive dimension of knowledge on colonisation of apiaries. cf. Bhaskar, 2016]. FCS 8, **LM³**'s argument seems to be one of

inductive reasoning when he attempted to link drought and lack of flowers to the absence of bees swarming into his apiaries. This is more of a matrix analysis where absence of **X** leads to absence of **Y** [cf. Bhaskar, 2016]. Knowledge as a social conversion factor disabled the apiarists from practising their chosen valued beings and doings or capability sets [cf. Sen, 1993; Goerne, 2010; Figure 3.3]. The market and quality of the product as a socio-economic conversion factor also affected the new achieved functionings in apiary and honey production amongst the community-based farmers studied as shown below:

FCS 8, **LM**³: I have 111 beehives and 64 are fully swarmed. We harvest three to four times a year and we used to sell locally but today we sell to a Harare market. The prices are not attractive though....They say the market is flooded in Harare and yet some Harare buyers come to us and say they want 30 tonnes of honey. So, it confuses us when one buyer says the market is flooded and yet another says they actually need more.

Prices as a social conversion factor constrain farmers' capabilities. An unfavourable pricing system is seen by farmer FCS 8, **LM**³ as robbery and a tension. While the apiarists received training, practically they were constrained by pests which they could not cope with in the absence of chemicals since bees like all other insects are killed by chemicals. Such a social conversion factor and tension is noted by FCS 9, **FN** below:

FCS 9, **FN**: I got trained on how to make [construct] the beehives, to care for the bees, how to attract swarms into the hives and how to extract the honey [as new knowledge and as social conversion factors]. I have 22 hives but only 5 are swarmed with bees while some of the hives were left empty when the bees swarmed away due to ants and mice...[a tension she experienced in 2017]. We learnt from our trainings in Harare that we cannot use insecticides since they will kill the bees. But I will go to FCS 8, **LM**³ to learn on how he treats such problems. But at training they taught us to use ashes as a repellent, I am yet to try it.....

Pests such as ants cause tension with the bees swarming away and not swarming in. This is social conversion factor where absence of knowledge on treating pests disables the farmers. Transfactuality [cf. Bhaskar, 2016 on multiplicity of *structurata*] is applied when FCS 9, **FN** acknowledged that chemicals should be used to treat ants but there are other friendly methods such as the use of ashes. Like the case of crop farmers, the apiarists are also constrained by volumes, small quantities often disabled them from breaking even if they had wanted to take apiary as their sole source of living [new capability set or valued beings and doings for income generating activity]. Such evidence is shown below:

FCS 8, **LM³**I can harvest up to 200kg per harvest, so it is not easy to reach a tonne and more, 30 tonnes as demanded by one Harare market. But with more apiary farmers we will try. We continue to get trained by our local extension service

The farmers hoped that when they pull resources together [collective capability and agency] that they then can be able to meet the demands of a large market. But they are constrained by veld fires which keep on burning their hives and burning trees [the major commodity for pollen and nectar]. Thus ills or tensions are brought about through the absence of appropriate education on how to produce more honey than the 200kg per harvest from 64 hives of FCS 8, **LM³**. For a similar number of hives elsewhere FCS 8, **LM³** should be very rich [cf. Cramp, 2008 and also sub-section 2.2.4]. Therefore the absence of appropriate education is a depriver of farmers' capabilities and agency.

5.5 HOUSEHOLD BASED AQUACULTURE (FISH POND): CASE STORY 9

Aquaculture was one new capability set (Goerne, 2010) and mode of adaptation to climate change that was practised by a single farmer, FCS 9, **FN** in this study. Ideally aquaculture can be considered a large economic capability set when done at a commercial level. FCS 9, **FN** was constrained by personal [lack of knowledge for commercial aquaculture] and environmental [small fish ponds and a lack of commercial fingerlings] conversion factors.

5.5.1 The Production Mode or Inputs to Achieve and the History: Old and New Adaptive Practices under Aquaculture

FCS 9, **FN** had a brief history of aquaculture, a new capability set which she started only in 2015, but her story was of interest as the only aqua-farming venture, an alternative to maize crop farming and adaptation to climate change, in this thesis.

FCS 9, **FN**: I started formal fish pond farming in April 2015. ...Before, we had our tilapia fish already that we had to remove from our old fishponds to this monitored project fishpond.

Her commodity or inputs included fish ponds while her mode of farming was subsistence marked by trainings and observed climate change as shown below:

FCS 9, **FN**: In my fishpond farming project the mode of production (capability set) is just subsistence as we so far produce for the family and a few to share with close relatives and neighbours.We were trained at a youth training centre, the local MP paid for our training, it was USD50 per head for the training in 2015.We learnt a lot about fishpond farming [aquaculture] (cf. Plate 5.5). For every one male there must be five females, we separate the females from the males. Once there are fingerlings

we separate them (fingerlings) from adults and so on. We feed the fish (Tilapia) using chicken droppings.

While FCS 9, **FN** claimed that she learnt a lot about fish and that included sex identification and more, that fish could be fed on chicken droppings. Literature has it that chicken droppings are used as fertilisers for plankton and other plants which are then eaten by tilapia fish and not that the fish directly feeds on the droppings [cf. WRC Report, 2010]. In terms of the history of aquaculture, as was the case with her apiary project, FCS 9, **FN** made links to climate change:

Fish farming, just like beekeeping that I also do, are good for us since we can no longer rely on rain-fed farming. Rainfall is tricky nowadays and you need to have another farming type where you can get money in order to buy maize once there is a drought. So far I have only one fish pond and I don't harvest much from it.

At **1M** FCS 9, **FN** noted climate change induced drought which was absented at **2E** through aquaculture as an adaptation. FCS 9, **FN** is linking climate change with alternatives to cropping as her new capability sets. On her brief history into her new achieved functionings, aqua-culture, FCS 9, **FN** had this to say:

FCS 9, **FN**: In the agricultural season of 2014-2015, the rains came a bit late, 5 December was the date for onset rains. The rainfall distribution was poor as there was a temporary drought from mid to end December (2014) until 7 February (2015). ...there was another temporary drought with the rains only resuming in March of 2015, but then, the agriculture season had elapsed and so I reflected on gardening and fish pond farming.

Climate change and frequent droughts were the environmental conversion factors that pushed FCS 9, **FN** into aquaculture as an alternative to maize crop farming and a new capability set, her valued beings and doings. This could be inductive reasoning [cf. subsection **2.2.11** since FCS 9, **FN** observed that once the onset rains are after December then the season is not good for maize cropping and so she resorted to alternatives to maize crop farming such as gardening and fishpond farming]. Absent were water harvesting mechanisms – though erratic, the rains later came but the farmers failed to harvest the rains as water harvesting techniques were absent in FCS 9, **FN** story.

5.5.2 Research Evidence on Resource Conversion Factors: Personal, Social and physical (environmental)

The research evidence reflected different conversion factors for FCS 9, **FN**'s new achieved functioning of aquaculture and these included personal characteristics [individual reflection and individual agency], social conversion [collective agency and knowledge acquired from trainings] and environmental conversion factors [from climate change which enabled the new functions of aqua-culture. More on environmental factors is the presence of warm water temperatures and water availability] as shown below.

FCS 9, **FN**: I had the passion [personal conversion factor and hence made the choice to move into an improved mode of farming, aquaculture from what she did before 2015] for fish pond farming as I had some tilapia [also locally known as the Kariba bream] before 2015, but I wanted to be recognised in the whole district [Mutasa] as one of the first female farmers to do.... fisheries and at the same time. ..., I was also motivated by CD who showed us videos of fish pond farming in Beitbridge, a dry region of Zimbabwe. I said to myself, if people in Beitbridge are keeping fish, why I can't do it here, a region with plenty of streams and ponds in most of our gardens. I kept thinking about it, until I was approached by one extension officer who invited me for fish pond farming training, and I grabbed that chance...

FCS 9, **FN** also learnt through videos and these are thus part of the social conversion factors while the region with plenty of streams and moderately warm temperatures are also conducive environmental conversion factors needed for the conversion into the functioning of tilapia production [cf. WRC Report, 2010]. A further social conversion factor is evident when FCS 9, **FN** was trained into the new practice first at local level by the extension workers and further training at a recognised youth training centre where she was funded by one local Member of Parliament in 2015. Absent from FCS 9, **FN**'s training that was part of her social conversion factors to the capability of aqua-farming, was the post-harvest value chain and how to practise this new kind of farming using a business model, an aspect that constrains the small-scale fish farmer (cf. FAO, 2010; Britz, 2015). On the link between fish and health as a capability, FCS 9, **FN** had this to say:

We learnt from trainings that fish as white meat is good for people's health. There are people whose conditions no longer allow them to eat red meat, fish is good for them. Red meat causes gout.

Health as an achieved capability and the link between fish and the health of the people is inductive reasoning with FN observing a correlation between eating fish and good health as absention of red-meat is good for people's health [a case of transfactuality, cf. Bhaskar, 2016].

5.5.3 A Summative Perspective of Tensions and Enabling Factors

Aquaculture as an alternative to climate change and to maize crop farming had its own tensions. Some of these tensions emanated from the type of education that the community-based farmers shared through social learning. In the case with the three apiarists, the new capability set on marketing was not fully shared and this made the farmers to remain poor [cf. FAO, 2009; FAO, 2010; Britz, 2009]. While appreciating the education shared during training FCS 9, **FN** also shared the following tensions:

FCS 9, **FN**: I am now able to identify the sex of my fish which is a good starting point into fish breeding, but I do not know where to get the fingerlings yet, if I need them, where to sell the fish once I want to take the new practice as a business. We were not taught on how to market the product except the understanding that we can sell to our local communities. We were not taught on how to detect diseases (in fish) and what to do in the event of disease outbreak as was the case story with beekeeping where we were taught possible problems and how to treat them.....

FCS 9, **FN**, realised that maize crop farming was being impacted negatively by climate change and so she had to widen her alternatives to food security through the new capability set of aquaculture with the hope that the fish could be a source of food as well as a source of income that she could use to buy food. But still, this new capability set, aquaculture, was often constrained. The major constraint faced by FCS 9, **FN** in her achieved functioning of aquaculture was the lack of knowledge to make the project sustain her in terms of food security and income. FCS 9, **FN** also lacked the basic capability of education on other types of fishes like ornamental fish for home aquariums as well as their feeding habits, basic knowledge on post-harvest processing and other livelihood strategies as well as basic education on the marketing of fish [FAO, 2009; FAO, 2010, Britz, 2009].

5.6 DENDROLOGY [Tree and Shrub Nurseries] (Case Stories 10 and 11)

Dendrology was practised by many community-based farmers in this village of study in 2008, as a new capability set for income generation and as an alternative to maize crop farming during the 2006 to 2008 meteorological drought [cf. Dirwai, 2011]. But only two farmers ultimately remained in the business. Their stories were of interest in understanding the trajectories that either constrained or enabled the community based farmers to shift to such new capability sets. The following sub-section looks at the research evidence on the trajectories that were taken by the two dendrologists starting with a brief history of the capability sets and the different commodities or inputs required.

5.6.1 The Production Mode or Inputs to Achieve and the History: Old and New Adaptive Practices in Dendrology for FCS 10 and 11

The capability set or the valued beings and doings in FCS 10 and FCS 11 were small-scale commercial production. The two sold their tree seedling products to a wider market. FCS 10, **VC** moved beyond the province and district and tested exporting his products. The means to achieve or the commodities included the plastic polythene bags, water supply, seeds, cuttings for grafting and labour. In terms of how they acquired some of the inputs, the two dendrologists acknowledged the role played by **CD** [the researcher] as an enabler of their capability sets:

FCS 10, **VC**: We got the polythene pots from CD (15 000 pots) for the production of our fruit tree seedlings. We now have a protected well to supply our project with water. We still need to buy a plastic tank as a reservoir where we pump up the water from the well and then into the field.

The position of the researcher was noted in section 4.3 as part of his community engagement in his university's 5.0 thrust. In this case the researcher facilitated the acquisition of plastic pots from the donor community and supplied the dendrologists. These plastics as well as seeds and cuttings were basic commodities or inputs that were needed for the achieved functioning of dendrology, a valued being and doing. FCS 10, **VC** realised the need for water supply as an important commodity or input that was essential for the new capability set of dendrology and so he constructed a deep well in preparation for pumping the water into a mounted plastic tank while his counterpart in dendrology, FCS 11, **JC** had a perennial water source amongst his commodities or inputs:

FCS 11, **JC**: We have three permanent water reservoirs from earth constructed ponds at this household. We also have a water pump to help pump water from the reservoirs into a network of hosepipes in order to water our big exotic tree nursery project. You know gum trees need a lot of water. We water the tree seedlings twice a day, in the morning and towards the evening. We acquired 45 000 polythene bags from CD in 2015.

While environmental conversion factors such as warm temperatures of the Mashonaland Central province as well as the availability of water through water reservoirs at his homestead were crucial basic commodities for the farmer's conversion to the achieved functionings of dendrology, FCS 11, **JC** still needed the social support from plastic pots donations, which the researcher provided. Thus no single conversion factor could be found active in converting a capability set to a functioning, but rather a form of nested conversion factors were actively in

place. Evidence on the history of dendrology in FCS 10, **VC** and FCS 11, **JC** is shown below:

FCS 10, **VC**: The introduction of exotic trees in this province has a painful history. Exotic trees were a priority of the early White settlers; the Whites had installed fear in Blacks in this district by taking over all productive land and put it under exotic tree plantations. Our people therefore feared to plant gum or pine trees at their homesteads saying, 'Once the White man sees that your place is good for exotic trees then your land will be taken and you get resettled elsewhere' [cf. section 2.5; Moyo; O'Keefe and Sill, 1993; Dirwai, 2007]. [Such a socio-politico deprivation by a historical political structure can be a social conversion factor since such depriving policies could constrain farmers' capabilities.]

On the history of the new capability set of dendrology, FCS 10, **VC** reflected on how he was socialised as that had a disabling effect in how he perceived the world.

FCS 10, **VC**: We were therefore socialised in such a way that when we grow up we had to look for jobs in towns preferably. A formal job such as a teacher, nurse, doctor, policeman/woman, lawyer, clerk, accountant or even pilot. We were never socialised into being self-employed beings. ...I also looked for employment at an urban timber industry as a general hand while my wife supplemented with rain-fed farming here at home. My job as a general hand was paying me just USD110.00 in the early 2000. ... I thought of diversifying into fruit trees, hedges and flowers that have a ready market from schools, hospitals and so on ... Today we are fully established fruit tree seedling producers [a new achieved functioning] and the demand for our seedling plants and flowers is high.....

The way one was socialised seemed to have a bearing on the trajectory one was likely to take in life as noted above. Children socialised into being future employees are also likely to look for employment. Climate change as a tension and a stress also impacted heavily on the socialisation of the rural poor, in that it provided an opportunity for the rural poor to think of alternative livelihoods outside rain-fed crop farming. But it takes individual and collective conversion factors to convert to the new functionings such as dendrology rather than looking for more traditional formal employment. The following is the history to the new capability set and valued practice of dendrology as narrated by FCS 11, **JC**:

CD: (July, 2017): Mr FCS 11, **JC** can you tell me about the road that you took in your tree seedling project from the beginning up to this point in time (July 2017)?

FCS 11, **JC**: ... The road towards dendrology was not straight forward (non-linear) but one full of reflections, sharing of ideas, personal experience and so on. It started way back in 2008 (Plate 5.7) when I attended a briefing on the inception of a tree seedling project that was rolled into our village in 2008. I reflected on the advantages and disadvantages of joining such a project [individual reflectivity Layer 1]...We accepted to join in the project.

The new capability set was accepted as it was viewed by FCS 11, **JC** as an income generating venture which could absent the absence of formal employment. Formal employment is a capability set that is common in most communities and also common amongst school and college leavers in Zimbabwe. FCS 11, **JC** had this to say on self employment as a valued being and doing:

In 2009 I started my own gum tree seedling production as a backyard venture (Plate 5.7) ... From this backyard venture in Harare then, I managed to get some contracts with some tobacco farmers in 2014-2015. By 2015-2016 we got much bigger contracts with the tobacco companies themselves and this demanded a larger piece of land, more water supply, more labour since tree seedling production is labour intensive, and many plastic pots were needed too. **CD** provided us (cf. section 4.3 on education 5.0, community engagement) with 45 000 polythene black plastic pots for a start and so we moved to establish the gum tree seedling venture in MC province which is a province near most of the tobacco farmers we intended to supply the tree seedlings...I also moved from doing things at a small scale to a medium scale...I moved from funding the project using personal and family resources to accessing bank loans and that showed that I was now being recognised.....

Dendrology as a new capability set, an income generating mechanism which was also an adaptation to climate change, was a choice liked by FCS 11, **JC**. The fact that FCS 10, **VC** and FCS 11, **JC**, scaled up their dendrology activities from small-scale to medium scale might have testified that dendrology was now a valued being and doing (a capability set) with various other functionings that included income generation, job creation and better living standards. Collective agency and social learning pedagogies laid the foundation to the function of self-employment in dendrology for both FCS 10 and 11. In terms of the history of this new capability set, dendrology FCS 10, **VC** also had this to say:

I personally don't drink beer but I frequent the local drinking places to pick up the empty plastic beer bottles that I cut by the neck and plant my tree seedlings...and then fill the plastic bottle with loam soil and plant the tree seedlings and cuttings, it works well... (Plate 5.6).

While FCS 10, **VC** was collecting empty plastic beer bottles for re-use to plant tree seedlings and cuttings, he was also cleaning the environment in the process.

5.6.2 Research Evidence on the Resource Conversion Factors: Personal, Social and Environmental

As noted above personal, social and environmental conversion [inclusive of climate change risks and vulnerabilities] factors played important roles towards the shift to the new capability set, dendrology in both FCS 10 and 11. In FCS 10, **VC** climate change and harsh

economic hardship and poor remuneration led to the adoption of an alternative income generation source, fruit tree production [cf. 5.6.1]. But the social learning trajectory was more collective than it was personal as shown below.

FCS 10, **VC**: We held a tree seedling Field Day in 2016 where we showcased our products and new capability set (valued beings and doings) to other farmers. We learnt that tree nurseries have brought up many other functionings such as a market based economy, food security, nutrition from the fruits, family stability as there are less ‘family in-fights’ that are normally associated with financial deprivation, when people are self-employed in tree seedling production....

The new capability set which is also an adaptation to climate change, dendrology, apart from providing the basic capability of health, nutrition and income, also contributed to the reduction of gender based violence (GBV). Apart from the five recognised capabilities [cf. Sen, 1993; Nussbaum, 2001; 2003], there could be other capability sets like family stability as characterised by the absence of home-based gender violence, job creation, income generation and many others that the farmers valued being and doing. FCS 10, **VC** had this to say on environmental conversion factors:

FCS 10, **VC**: This village is blessed, with a cool wet climate as a result of its geographical location on a high altitude and at times we receive heavy rains...these two factors (commodities or inputs) are good for tree growth...So we thought of raising tree seedlings instead of concentrating on maize crop farming since maize was now vulnerable to the changing climate.....

The climate for Agro-ecological Farming Region 1 of Zimbabwe [cf. section 1.7; Plate 1.1] is an environmental conversion factor that enables tree plant growth and so FCS 11, **VC** reflected and opted for dendrology as a new capability set that he valued being and doing as compared to other activities. Apart from trees offering the farmers income, trees and shrubs had other functionings like improved health and nutrition to the people as well as contributing to other farming functionings like apiary, FCS 10, **VC**, had this to add:

We also produce moringa tree seedlings. Moringa is in high demand in the country for its medicinal values and high proteins levels...We also produce the bottle brush tree [Callistemon species which have commonly been referred to as bottlebrushes because of their cylindrical, brush like flowers resembling a traditional bottle brush] which attracts bees and so it is in demand from apiarists...We have many apiarists around and so the apiarists provide a viable market for our bottle brush trees...In our business we classify bottle brush under flower trees.

The community-based farmer seems to have a considerable amount of knowledge on medicinal trees and trees that could boost apiarist functionings. Such knowledge can also be classified as social conversion factors needed for the new capability sets for improved

nutrition and medicinal tree production, a shift from the common exotic tree seedling production that FCS 3, **LN** and FCS 11, **JC** were associated with. FCS 10, **VC** reflected on which tree seedlings were in demand in the community and so he resorted to the production of Moringa, a medicinal tree and to bottle brush, which was in demand from apiarists. Relevant knowledge was a capability set that was an enabler of the farmers' capability sets. Farmers do not simply adopt innovations but they adapt to what they internally value doing and being, their freedom (cf. Sen, 1993).

5.6.3 A Summative Perspective of Tensions and Enabling Factors

Different tensions were noted by the dendrologists and these emanated from the three main categories of the conversion factors that included absencing the impact of droughts. Evidence on tensions and enabling factors in dendrology are shown below:

FCS 11, **JC**: But we also learnt that most of the agents be they government or non-government are very supportive of the tree projects [alternatives to maize crop farming] at the inception of the project but there are always hurdles at the marketing stage of the product cycle....The buyers would telephone us saying put 50 000 tree seedlings by the school yard or by the roadside so that a big truck would come and collect for a big market...Day one, the truck doesn't appear, day two, it doesn't, day three it doesn't again... Day 7 maybe, when almost 30-40% of the tree seedlings are now lost, the big truck finally comes, condemns 30% and takes only 70%, if you are lucky. This was a common pattern that made most farmers abandon the project.....

The farmers realised that they could not rely on rain-fed farming because of droughts and so they opted for other products like tree seedling production which are alternatives to maize crop farming, with the hope that they could raise income which they then use to buy maize, their staple food. But tensions such as the ones noted above often left the farmers frustrated after having put significant efforts into the project. This type of tension or disabling factor can be classified under structure and policy, which are social conversion factors. Attitudes by government and non-governmental buyers seem to be meant to disempower the farmer from this new capability set and functioning thus making the farmer abandon the new practice and become desperate and continue to look up to government for food handouts. I view this as falling from **4D** back to **1M** in my Figure 7.1 of the MELD schema. But the experience by FCS 11, **JC** seemed to be a trend experienced by other community-based farmers in the thesis. FCS 3, **MM** had this to say about such a social conversion factor that was meant to disable the farmer:

Since we had gained experience in producing gum tree seedlings, we thought that was going to be our advantage....But each year the goal-posts kept changing. One year you are told we are taking indigenous tree seedlings when you had exotic tree seedlings, the following year you try to produce the indigenous tree seedlings, then you are told we take exotic or a specific indigenous tree which you had not heard of in time...The following year you then attempt to do both the indigenous and the exotic tree seedlings at the same (geographical) space and well in time and the exotic trees get diseased in the process...Maybe the diseases that attack the indigenous tree seedlings are responsible for the attack on exotic tree seedlings. The same disease also attacked FCS 11, **JC's** seedlings in the same year 2014 and he had produced the indigenous and exotic trees in the same space as we had done. In all cases, the exotic tree seedlings were taken at a low price, much to the disappointment of the farmer....

These are social conversion factors where policies kept shifting thereby disempowering the producer. The community based farmer finally gets discouraged and stops production, a supposed move from **4D** back to **1M**. While literature notes how the Black farmer was pushed away from markets in 1903 by being settled away from transport routes [cf. Kramer, 1997; section **2.4.6**; Phimister, 1977, p. 261], the current Black farmer seems to be pushed away from achieved new capability sets for markets, not by the colonial master, but by fellow countryman through disabling policies and structures. Such tensions were similar to those that also applied to other distant villages in the province of study as reported by FCS 3, **LN**:

As communal producers, we also liaised with communal producers in other crops from other villages to get their stories on this type of experience from government and non-government buyers. The banana producers from the next village (H) further north from here, complained of a similar problem...The buyer tells them to cut the ripe bananas, ready for grading and market...Day one, s/he (buyer) doesn't come, the same applies to day number two and may be up to day five.... By the time the buyer appears, some of the banana crops would have lost quality and in the market grade and so the crop gets condemned. Farmers are given all sorts of excuses as a cover-up...The villagers in H, also complained about why the buyers would tell them to cut their crop if the buyer was not ready to collect it...some community-based banana farmers lost hope in the new buyers and so resorted back to their old ways of doing things.

Thus, such a social structure can be a disabling factor to farmers' capabilities or freedoms to function. Different reasons are given by the buyers for failing to collect the farmers' products in time, but this is viewed by the farmers as a disabling tactic which discouraged them from being productive. Failure by farmers to realise their freedom to produce and market (capability set) as disempowered by a system of donor-government oriented market delays is a social conversion factor.

FCS 3, **LN**: A similar fate was faced by community-based farmers in another nearby village (W), they were advised to produce garlic which they honestly did in very large quantities....But they were all stuck with the crop as they did not have the knowledge

where to market it. So our question is why recommend a market based product without proposing the market?

Climate change risks and vulnerabilities have affected this villages as it has done to many others in Zimbabwe and in efforts to adapt and mitigate against them, the community-based farmers in this thesis are constrained in their new capability sets, disempowering them from what they viewed as their newly found salvation, their valued beings and doings. Thus social tensions or the social conversion factors can be viewed by the farmers as well calculated moves to impoverish them. Apart from the market forces, government and donor policies also negatively impacted on the farmers' new capability sets as shown below:

FCS 3, LN: More, we [representing the youth group] had accumulated over a million black polythene bags for the community gumtree production project since we did not want our community members to be constrained by lack of such resources. But in 2014, we were notified by our main buyers that the black plastics had been condemned and so they were not going to buy from us since the packaging had changed...They did not give us the new packaging except that they hinted it needed to be imported. This marked the end of the tree seedling project, with the plastics in stock, manpower on the ground some of whom were still willing to continue with the work, but that was a complete shut out...

A change in policies on packaging devises was a social conversion factor and disabler of the youths' capability set towards dendrology farming. The youths blamed the market, government and donor policies for constraining their efforts [social conversion factors]. The delay tactics by the market system pushed the youths from 4D to 1M [Figure 7.1 on the reverse arrows], thereby they finally moved out of the exotic tree seedling business. First, it was the delay tactics in taking the seedlings to the market then later the emphasis on the type of tree seedling [indigenous tree seedlings] that the youths had very little experience in (social conversion) and later the change in packaging (that needed to be imported) and then the attack of the tree seedlings by a leaf diseases. This all led to the community based farmers moving from transformation and agency to non-being as was their case story before 2008. The situation is similar to the banana producers [cf. CZI, 2017] – CZI liked to blame the rural poor for failing to meet the quality that was required for export markets while the communal farmers wanted to blame the market system. Such conflicts were disablers of the farmers' capabilities.

5.7 MARKETING (FARMER CASE STORIES 3 to 11)

To adapt to climate change, the community based farmers under study engaged in different capability sets such as dendrology, aquaculture, apiary and small-scale irrigation based farming as discussed above. All these were aimed at absencing food insecurity and raising income to buy food hence reducing over-reliance on government food handouts and enhance food security. But, to do all this, the farmers needed to engage with the capability set of marketing. This section therefore looks at marketing, a new capability set in Farmers Case Stories 3 to 11, which included crop and non-crop products. Marketing is here regarded as a new economic capability set with its functionings being determined by the scale of production. Seven of the farmers studied in this thesis showed a movement, though not linear, from small-scale barter trade to small-scale local marketing modes, and from a small-scale urban marketing mode to medium urban and regional marketing mode with one venturing into a possible export market as their new valued beings and doings. With marketing as a capability set, the farmers used the cash that was obtained from their new achieved functionings such as dendrology, apiary and market gardening which also were alternatives to maize crop farming, buy maize their staple food. To embark on a marketing capability set, was a long road for the community-based farmers with only one of the eleven case stories managing to get his activities registered during the thesis period and only one managing to access bank loans while two managed to have their products consumed by an agro-industry. Many tensions were noted as bottlenecks to penetrating the open market, especially the urban and international markets. Case Story 3, the youths led by LN managed to get their products tested under laboratory conditions as they were processed into canned foods straight from the community-based farmers' crop fields – and this was a major breakthrough! Historically the community-based farmer was deprived of markets and marketing as a capability set and more, s/he was deprived of transport to the market since 1903 [cf. subsection 2.4.6; Palmer and Parsons, 1977, pg. 243].

5.7.1 The Capability set and Commodities or Inputs to Achieve and The History: Old And New Adaptive Marketing Practices For FCS 3 To FCS 11

Climate change is at the centre of most tensions that disabled the community based farmers from realising their different capability sets in this thesis. As the farmers adapted to climate change, they open opportunities to other capability sets such as marketing in the process. The evidence of the history and inputs essential for the marketing as a new capability set included

absenting observed impact of droughts. To mitigate and adapt, the farmers engaged with mechanisms for the provision of perennial water supply. The farmers shared knowledge and they also learnt through tensions from the markets. The following shows the research evidence on the conversion factors for the functioning of markets:

FCS 3, **LN**: To embark on a market-based production model we needed a constant water supply and so we have two earth-built large water reservoirs, a water pump and a network of hosepipes. The gradient [slope as environmental conversion factor] is good too for irrigation through the force of gravity.....

The provision of perennial water supply was FCS 3, the youths' commodity or input that was essential for the functioning of marketing and the provision of water also applied to the other crop farmers, FCS 4, **SM**²; FCS 5, **SS**; FCS 6 and FCS 6, **JM**² for the conversion to the achieved functioning of marketing. As for non-crop farmers such as FCS 10, **VC** and FCS 11, **JC**'s main commodities or inputs [cf. 5.6.1] for the realisation of the capability set of marketing, were the empty plastic containers, water and an existing orchard for cuttings and graftings (FCS 10, **VC**). For the apiarists' trajectory towards the capability set of marketing had their apiaries and wax as the main commodities or inputs. FCS 10, **VC** had this to say:

The road towards marketing of my fruit tree seedlings, flowers, medicinal trees, ornamental trees and shrubs (dendrology) started with the legal registration process. The trajectory towards attaining the legal registration of our farming activities was long and reflexive starting early 2015... we then managed to register our citrus tree seedling company with the Zimbabwe Revenue Authority (ZIMRA) under the name: E&V nurseries: Specialists in fruit plants and herbs, at the end of 2015. [cf. Plate 5.6 for evidence of an invoice book and a banking facility]... The reflexive process towards registration is long and winding, but the actual registration is just easy... Every year we are supposed to account for taxes. You see we now operate legally and we feel free doing our business in town.

For FCS 10, **VC** the road to the capability set of market based economy took a legal trajectory as he managed to register a company so that he could operate freely. VC supplies the local and regional market and he is exploring possibilities of exporting his fruit tree seedlings to a neighbouring country as noted below:

FCS 10, **VC**: In 2015 we [as a family] had 16 027 plants [fruit tree seedlings and shrubs]....Trees that we produced from seed such as mangos and avocados, we sold them at USD \$2.50 to \$3.00 and those that we produced through grafting such as oranges and apple, we sold them at USD \$3 to \$5.00. ...We cannot complain much as we are now able to do many other things from the funds that we raise from the fruit trees...We can buy for ourselves maize, other foodstuffs, send children to school, build a house as you can see here... we dug and constructed a protected well for our water supply, fenced off our yard and many others....We are now happy at last as we

can now afford to hire labour and create employment for other youths in the village... More, some Harare buyers took some of our mango seedling-samples [non-fibrous Honeys] to Z [a name of a country] for a possible export market....The Honeys have a very small seed and so they have a high flesh to seed ratio...These are good for canning since they are non-fibrous...

FCS 10, **VC** transformed from subsistence to more of a commercial dendrologist who is now able to supply markets even beyond the country's borders. The new functionings of business partnership and company registration, marketing, food security and nutrition can be noted above from FCS **VC**. From a small village community, the collective knowledge on the marketing process included the help from legal experts from the urban areas who helped in exploring possibilities of export markets as shown in FCS 10, **VC**'s story. While there are many mango producers in the communal area under study and in other communal areas in the country, the type of mango that is locally farmed is fibrous and so is not good for canning and hence cannot be marketed for further processing as canned or dried mangoes. FCS 10, **VC** reflected on the different functions of mangoes and he opted for the non-fibrous that are marketable at the local urban markets and with the industrial market and possibly for the export market. For FCS 6, **JM²** the history of the capability set for marketing as shown below, took a different dimension from that of FCS 10, **VC**:

FCS 6, **JM²**: We rely on the local open market so far [referring to the period 2015-2016-2017]. The vendors from our local open market come and place their orders here and we supply them in bulk. We have veggies, onion and tomato..... You know we used to specialise in fruit trees for a very long time, we stopped all that.... we have clean energy in a solar powered pump and a very large water reserve in ten large plastic tanks to enable us do the market mode of production (new capability set and achieved functionings) through green maize... and horticulture products such as onion, tomatoes and vegetables.

Despite having the biggest area of aerable land of close to four hectares under a market based economy and despite a large water head of 100,000 litres from ten plastic tanks and despite being the only farmer using solar power in the village of study, FCS 6, **JM²** only practises his achieved functionings in the local village markets. This was different from the other two, FCS 3, **LN** and FCS 4, **SM²**, with smaller farming spaces but who managed to penetrate the urban market while FCS 10, **VC** tried to venture into an export market. The community-based farmers, upon reflection, seem to have transformed from subsistence to small-scale commercial mode of production, a move from **1M** to **4D**. As for FCS 8, **LM³** after realising a fall in maize crop production due to climate change, converted to the new functioning of market based apiary:

We now concentrate on api-culture and the money that we get from selling honey, we use it to buy maize... Our apicultural activities indirectly help farmers such as the pea and maize producers to increase their yields too since bees pollinate their crops.

This shows that beekeeping is an achieved functioning with different functions apart from honey extraction but hiring out beehives to farmers. The apiarist gets a double benefit, cash from honey sales and cash from hiring out the beehives.

5.7.2 Research Evidence on the Individual Resource Conversion Factors: Personal, Social and Environmental

To convert to the new capability set of marketing, the farmers needed collective agency as shown below:

AB: It is time that we put heads together so that we plant one crop on the same date, harvest at the same time and send our crops to the agro-industry market at the same time too... We want serious farmers who are committed to their practice. ... As for the type of bean needed by X agro-company, we need to plant the crop in January so that we harvest it before winter since beans can be attacked by frost.

Collective agency as a social conversion factor was essential for the conversion to the new capability set of a market based production mode as noted above. But there was also a need to consider environmental factors that could impact on the market based products as shown below:

TM³ [during FGD at X Agro-Industry Company with the community-based farmers and extension service]: For us to start contract farming in a community, we start by assessing some basic physical factors such as soil type, rainfall type, temperatures [these are the environmental conversion factors and getting laboratory test results on some soil or product parameters is what I refer to as 'observed morbidity as compared to the self-perceived morbidity of soils and or of a product...] and these have to suit the type of product that we want to contract the farmer to produce. ... Some crops thrive in winter, some in summer. We only engage farmers who display evidence of reliable water source/s so that the crop (on contract) will not suffer from moisture stress. Nowadays rains are erratic, we cannot contract a farmer who practises rain-fed farming.

To convert to the achieved functioning of a market based practice, the farmers needed to have a steady or reliable water source for irrigation, capital and relevant technical knowledge on water harvesting and pumping techniques. For the farmers to send soils for pH value testing [the observed morbidity of soils], they needed capital and relevant knowledge and such are the social conversion factors since these standards can enable or disable the farmers from

practising their new capabilities. The researcher helped by sourcing for funding from his university to help the farmers get their soils and products get tested and this was part of education 5.0 community thrust (cf. section 4.3 on the position of the researcher). Poverty and lack of relevant education are two main deprivations of people's capabilities as noted by Sen (1993). A favourable climate, reflected through a reliable summer rainfall as well as cool to moderate winter temperatures, enabled annual farming of crops including for agro-industry. Droughts, floods and frost disabled the community-based farmers as they deprived the farmers of practicing their new capability sets of market based production for food security, nutrition and to supply the agro-industries. The youths shared more experiences on the conversion factors towards the movement towards the new capability set for marketing.

FCS 3, **SM**¹: We were taught farming business by G [a donor agent]. Now we start by taking a sample of our produce to the market [urban hypermarkets] and if the market favours our product then we come back to the site and pack the produce in larger quantities ... We have receipts as evidence of what we sell. ... Today (7 July 2017) I personally bought a water pump for my own organic gardening activities as I learnt from the youth garden project that market gardening without irrigation is not sustainable....

The youths' capability conversion factors to the function of the new capability set of a market based economy included social factors when they shared knowledge through training from extension. They also engaged with personal conversion factors when the youths reflected upon themselves as individuals and and so they came to appreciate irrigation as a valued being and doing that was essential for perennial farming. On other functionings derived from the new capability set of marketing, the youths had this to say:

FCS 3, **OD** [in 2017]: The income that we get from the market [from the organic garden project] contributes to buying food and to schooling since I am still in university. ... I also learnt that farming can be a good source of income [market based farming] and it is not always that youths should look for formal employment...When properly organised, farming is good an employer too... I also learnt that time is over that people should rely on rainfed farming but irrigation too.

The new capability set of a market mode of production for food security and well-being is shown to be bearing fruits since the farmers can now pay for school fees and so on. Commenting on the laboratory test results as a new capability set that could boost the achieved functioning of marketing, FCS 3, **LN** had this to say [interview was done after the laboratory test results in Figures 8.1 and 8.2, were out].

... we now look forward to be recognised as real organic farmers and so claim our own share in that market and get better prices from the market since the results from the laboratory tests are favourable to us... Who knows we can see our canned products breaking into an export market from 2019.

From the above statement 4D seems to be a process in transition just as 2E and 3L. Only when the farmers attain the recognition and an export status and only when they could process their own products into canned outputs, could they name the world [cf. Freire, 2005] and fully transform [cf. Bhaskar, 2016].

5.7.3 A Summative Perspective of Tensions and Enabling Factors

Tensions from the new capability set of marketing emanated from the market itself as well as from policies as recorded from the evidence below:

FCS 8, **LM³**: Their pricing system is not good for us the apiary farmers... We sell at (USD) \$2.50/kg and in 2016 I managed to sell \$120kg (\$300.00) but this price is not good for us because we cannot break through... We rely on sales from apiculture in order for us to buy maize, our staple food, send our children to school and pay for our medication. ... The buyers even said that they want to reduce the price to \$1.25/kg, they are saying the market is flooded there in Harare and so the prices go down... We continue talking to them. We expected the price to go up to \$3.50 and not reducing as they are suggesting... Most apiary farmers here are not happy with the prices and so they hold onto their product and resort back to selling to the local market instead.

The market forces can be a major depriver of farmers' capabilities. Absent is the issue of contracts before the farmer engages into production and such a lack of knowledge is also regarded in this thesis as a social conversion factor. The apiary farmers also developed mechanisms to cope with unfavourable prices from the market by holding back their products until the market was favourable. This is another social conversion factor as such knowledge was learnt from the market behaviour itself. But farmer FCS 8, **LM³** still has hope so he says, 'We continue talking...' More reflections on tensions from the market are noted below:

FCS 10, **VC**: The challenge is that while the samples of our non-fibrous mangos were warmly received by our Harare market for possible exports, the numbers that the large market require are just beyond our production commodities or inputs such as , water availability, plastic pots and labour....

Large quantities as demanded by the market can be a tension that the small-scale farmers fail to cope with as they are constrained by the means to achieve or the commodities or inputs. Tensions also arise from quantities; the farmer operates at a small scale while the market,

including export market needs quality products in large quantities [cf. subsection **2.4.6**]. Tensions also emanated from lack of knowledge on the quality of products and the quality of packaging. The small-scale farmers simply picked any packaging some of which were unhygienic thereby increasing the rejection rate of products by the market as noted below:

FCS 3, **SM**¹: For our organic garlic crop, we packaged some samples in black plastic bags and the packaging was automatically condemned by the market...But during the reconnaissance for the same market, such conditions were never stated. ... Once we had managed the packaging issue correctly, there came the quality and quantity issue...To fight that, we had to buy a suspended scale that could measure up to 20kg so that we would do our weighing at home and go to the market with the exact or slightly above quantities....More, with the right weighting, quantities, quality and correct packaging, there came the hurdle of registration...This VAT system was something that we had little idea about at that time (2013). So we resorted to sending our pea products to the open market (urban) where such conditions were not in place.

The youths learnt from the market that consumable products should be of high quality and treated hygienically from source and that included the packaging. Such social conversion factors were also in line with export standards [cf. Confederation of Zimbabwe Industries, 2017]. For quality products, hygienic standards need to be observed from source starting with the producer her/himself's personal hygiene and his/her surroundings i.e. ablution facilities must be available and conditions must be free of contaminations like chemicals and other pollutants as the youths later learnt from the market. The youths managed to absent the issue of weight by buying their own weighing device. As for registration of activities, FCS 10, **VC** [cf. subsection **5.7.1** and Plate **5.6**] managed to register his activities and that was a big breakthrough for the community based farmers as they now learnt [social learning] about the process from one of their own. But this type of learning from mistakes often constrains the small-scale farmers. They need to share this wholesome knowledge with extension officers and with the market through the communities of practice workshops at the inception of each product cycle. Further tensions emanated from the youths' new capability sets of organic farming and marketing which they claimed had absented the application of heavy chemicals and pesticides, but were constrained by pests and diseases that attacked their crops in the absence of the use of heavy chemicals.

FCS 3, **JM**¹ [2015-2016]: The marketing journey has been bumpy...[cf. subsection **5.7.1**; **5.7.2**]....We learnt from the market in 2015 that timing of the dates for planting of the peas-crop was very important...early February so that by March or April we will be the first to supply the market and get good price from our peas-crop. If we delay in planting then the market will be flooded by June and July and the prices

fall... Had we been using chemicals, we could be planting throughout the year and maximise on the off-season market but because of diseases and aphids that attack peas in the hot season, we cannot do that since we are doing organic so we rely on winter cropping.

This is more inductive reasoning [cf. subsection 2.2.9] where the youths observed that it was going to be profitable to supply peas throughout the year but this could not be done since summer peas were often attacked by pests and diseases which they could not absent without the use of heavy chemicals which in their case story was not permissible given the strict organic conditions required. So, they remained restricted to winter pea cropping which is less susceptible to pests. But the youths did not despair.

FCS 3, **JM**¹: But we are happy in terms of peas we have created a name for ourselves, the buyers now phone us in advance enquiring if we will be supplying peas on Mondays or Saturdays... **WM**... Lack of awareness and education about the benefits to people's health and the environment from organic products, is the main problem we get from our uninformed market today... The procurement manager at K shop, actually said when people come for shopping we do not have much time to explain to them how each product was produced hence customers rely on their perception of the product that is relying on how the product looks from the outside appearance.

The youths realised that they created a name in pea production and such a realisation within the MELD schema is at 3L totality which is valuing and agency that is needed to transform at 4D [cf. Bhaskar, 2016]. The youths also used retroductive reasoning [cf. subsection 2.2.9] in coming up with dates for planting. They realised that if they delay in planting their pea crop then the market will be flooded and they could run into losses, but if they planted early then they could be part of the early lucrative market which was profitable. Dates and timing are very important in farming and this could also be noted in the case of FCS 5, **SS** with his winter wheat cropping [cf. subsection 5.15; Plate 5.9] which had to be planted during the first week of May and the dates automatically determined the dates for the summer maize crop that had to be harvested way before the first week of May. Thus social learning through experience and lessons from the market enabled the youths to transform to the new achieved functionings of income generation. On pricing, the youths had these observations:

FCS 3, **OD**: I observed that there were only five major buyers of peas at the urban market in Mutare [*Musika wehuku*] ...whenever they saw our (supplies) trucks entering the market at 0530hrs, then they would determine the prices of the day as guided by the quantities as observed upon entry through the market security check-point. ... You only get excited when the prices favour the farmer... But I am happy, we are now part of the pricing system. ... They also wait for our truck to arrive in the

morning before they determine the peas-price of the day...Worse, the urban open market does not distinguish our organic products from the conventional ones so we had to compete on quantity, quality and size with conventionally produced products.

The tension noted above was from a social conversion factor emanating from the market forces. The youths were now part of the being of the urban pricing system. This shows a possible move from non-being 1M to being 4D [cf. Bhaskar, 1993] since the youths were now able to name the world [cf. Freire, 2005]. While this was transformation at 4D after absencing ills on quality, quantity and size, since 2013, the youths had one more tension: how to make the market recognise their products so as to fetch a higher price associated with organic products the world over. More tension since the market is yet to appreciate the link between organic products and good health [cf. transfactuality; sub-section 2.2.4]. The youths also learnt of the gap in the lack of appreciation by the market of healthy organic products. Food security should not only concern enough food but the quality of food [cf. FAO, 1994; IPCC, 2014]. To determine the organic status of their products, the youths had to send their products for laboratory tests [cf. Tables 8.1 & 8.2]. In terms of the current liquidity crisis in the country (2017-2018), the youths had this to say about how they learnt to bust this.

FCS 3, **OD**: We managed to get some little hard cash when most of the country experienced a liquidity crunch. We supplied the urban open market on average eleven buckets [11x20kgs=220kgs] every Monday and the same quantity every Saturday for a month or so. This meant 440kgs per week at a cash price range of USD \$3-4 per bucket [20kgs of unshelled peas] and that meant we pocketed a range of [USD (\$33-\$44)x2] which culminated to USD \$66-\$88 (cash) per week and that is [USD \$264-\$352] cash in a month of a four week cycle... I am personally happy to have discovered that cash was still available for those rural poor who exchanged a farm produce for money at the open market. Money was not readily available for those who wanted to withdraw it from the bank... Now that we understand their 'game', that supply and demand determine prices, next time if only we acquire a cold-room, then we are going to keep our agro-products fresh for a much longer time and supply the market only when supplies are low while demand and prices increase.

The youths claimed that with a product at hand, cash was not a challenge at all. They never failed to bring back cash each time they sent products to the urban open market. They claimed that a relationship existed between the product and cash availability and the absence of a product with absence of cash. The link between product availability and cash seems to be the basics that was absent in most of the farmers' operations. By reflecting on the use of cold-rooms as a preservation mechanism, the youths have used retroductive reasoning that if they can keep their products until off-season, then the product will fetch a higher price, but for that

to happen, they needed a preservation mechanism [cf. transfactuality; sub-section 2.2.4, Harvey, 2005 {the case of commodity as value in motion}]. This also shows the power of reflexivity at 3L laminated totalities as the youths weighed up different options in order to break even. The community-based farmers also learnt of tensions from the market through the donor community as shown below:

CM²: First identify your market before you put seeds into the soils. ... you need to know which crop is needed by who and when and at what stage of maturity...Peas for instance people eat the fruit itself or the outside skin (baby peas)...You can have a very good pea crop but none can be bought if you are not clear with market demands and standards. This is the type of education that we want to offer to farmers together with our colleagues in Agritex....

While the donor talked about how to explore market demands, absent was the knowledge on which markets and how to access them including issues of hygiene, packaging, legal registration as described above. Knowledge as a social conversion factor can enable or disable a farmer from realising his/her new capability set, freedom and achieved functionings. Commenting on tensions caused by the type of some donor projects that are not congruent with the locals' needs, the youths had this to say:

FCS 3, MM: At times there are just too many donors around with many projects... Some of the projects we can see straight from the project inception that they are not even viable in our village. ... But we just accept the projects because we do not want to scare away donors. 'Tomorrow' we will need their help in other projects. If we sound 'impossible', they will not sponsor our village in times of need.

The youths showed that they accepted some of the projects for future security even if they were not happy with them. So they accepted the trainings and the projects even though they could see that they would not last long. Tension arose as the community farmers reflected that their acceptance of some projects was not transformative but as a result of fear. This is an act of coercion and alienation [Lotz-Sistka, 2016 on her example of Sophia absenting waste in order to avoid punishment]. Tensions noted by one agro-industry are also shared below:

TM³ [2013]: You see if you as our local farmers are failing to produce enough for our industrial consumption, then we go out of the country to source for the products... I still wonder why you as our local farmers still fail to support your agro-industries simply by being productive....It was going to be good if you our local farmers get enough education to produce more so that we buy all products from them....You will be able to send children to school, seek specialised medication when you are ill or have enough to buy food and clothing. You simply require proper farming methods... But before you bring the...product to the market, we expect you to grade your product by removing all unwanted staff...grading at homestead level.....We buy 120 tonnes of

... after every six months...yes, but at present we are not taking any as our processing machine is down...We rely on importing...and that is quite painful as we often see... at the public market abandoned products rotting by roadsides...Learning of such successful stories from farmers bring satisfaction to us we see how best we are contributing to society through job creation at household level and at national level as an industry.

Tensions as noted by agro-industry emanates from a lack of knowledge as a social conversion factor. The community-based farmers produce for the local market but they fail to link their products to industry where they are needed in bulk [transfactuality on lack of raw materials from the local farmers as reasons why agro-industry seems to be operating below capacity]. The issue of market constraints has some historical background [subsection 2.4.6; Phimister, 1977, p. 261]

A native is handicapped to a considerable extent in the sale of his produce; not having as yet adopted any other means of transport than the old fashioned 'pakamisa' ..., they are obliged to sell their grain to traders (aggregators) who make a double profit, viz on the goods and on the grain, and have also to pay transport to the place of consumption. (Phimister, 1977, p. 261)

Table 5.2 shows a summary of the old and new capability sets of marketing of non-maize crop farming products.

Table 5.2: Summary of the old and new capability sets on markets for non-crop farming products

Capability set	Commodities or inputs for Current Practice	History	Conversion factors	Tensions
Non-Crop: Apiary operating at a small-scale market production mode and a new capability set (LM² and LM³) Apiary operating at subsistence level, a new capability set (FN) LM³: Apiary for economic reasons as a capability set	FCS 7, LM²: 65 beehives, six are fully swarmed, indigenous and exotic trees, flowers, fruit trees-orchard, slope, cow-dung for manure-organic cropping. LM³ has 111 beehives and 64 are swarmed. LM³ talks of other villager who hires out 265 apiaries to apple farmers (new functioning). FN: 22 bee-hives with 4 fully swarmed in 2016 but lost one swarm in 2017	LM²: Rain-fed agriculture and bee-keeping as a family hobby or venture done at subsistence level, honey exchanged with other goods at village level (barter) FN: Trained in apiary in 2015 LM³: Apiary was a family hobby, serious apiary after the economic challenges of 2006-2009	LM³: Harsh economic hardship and poor remuneration in the timber industry, climate change and the fall in maize production yield, pushed me into full-time bee-keeping. (social conversion) FN: Availability of over 1000 trees in her off-field lot (environmental conversion), training in apiary (social conversion), individual agency (personal conversion)	LM²: Rejection of product by market help improve on quality, he also blamed veld fires from next village for the emptiness of 40 of his beehives, blames drought and subsequent lack of flowers for lack of swarming into his beehives LM³: Veld fires from next village in 2016. (and not the absence of knowledge on queen bee creation and hiring of queen bees) FN: Of four fully swarmed hives in 2016, one had bees swarming out due to ants and mice in 2017

Non-Crop Aquaculture FN: Fish pond farming at subsistence level and barter as capability sets	FN: has two fish ponds, breeds Tilapia fish	FN: Used to keep Tilapia fish as a hobby and alternative to crop production, in 2015 got trained in fishpond farming	FN: She was funded by the local Member of Parliament (MP) to get trained in 'commercial' fishpond farming (social conversion)	FN: Subsistence level, the issue of markets was not carefully handled at training, on Tilapia feeds from chicken droppings (tension on knowledge)-tilapia are mostly herbivores and feed on planktons and other plants-chicken droppings are fertilisers
Tree Project (Dendrology- a branch of Botany) A new capability set VC: Fruit tree seedlings at commercial level JC: Exotic tree seedlings for marketing LN: Community-based seedling production for marketing	VC: The commodity or inputs include polythene plastics, a protected deep well, existing orchard for cuttings-grafting and labour, has a registered company for ease of marketing JC: Three earth-built reservoirs, a fuel powered water pump, polythene plastics, Eucalyptus seeds and hired labour	VC: Climate change challenges and poor maize harvests and poor job opportunities between 2006 and 2009), legally registered as a fruit tree producer in 2015 JC: Economic hardships of 2006-2009, joined tree seedling project in 2008-9	VC: Harsh economic hardships (social conversion), climate change (environmental conversion), poor remuneration in primary industry employment (social conversion) JC: Harsh economic hardships of 2006-2009 and droughts, forced him into alternative to formal employment (social and environmental conversion), access to bank loans.	VC: Early European Settlers installed fear in Blacks into believing that planting exotic trees will have their lands confiscated by the early White settlers. MM: Harsh economic hardships led to the start of the tree project, poor marketing. JC: Harsh economic hardships, poor knowledge on diseases, tensions on marketing. LN: Tensions on marketing (disabling conditions)
Market LN: Urban market tree seedlings and horticulture SS: Local market - horticultural JC: Tree seedling marketing VC: Market fruit tree seedling production JM: Market horticulture	LN: Commodity or inputs-small scale irrigation, two water reservoirs, pump JC: Three earth-built water reservoirs, pump, all weather road SS: Diversion furrow, earth-built water reservoir VC: Protected deep well, orchard and seed. JM: Inputs include 100 000 litres (10 Plastic tanks)	SS: Market horticulture since 2010 LN: Market horticulture 2013, gum seedlings 2008-2014. JC: Market seedling production since 2009 JM: Market gardening since 2015	SS: Diversion furrow (environmental conversion) LN: Irrigation by gravity and syphoning (environmental conversion) JC: Three water reservoirs (environmental, and knowledge (social and personal conversion) JM: Ten Plastic tanks (environmental conversion)	LM ³ : Harare buyers want 30 tonnes while he can raise only 200kg, prices shifts due to market forces (supply and demand), scale of production between the community-based farmer and industry. JC: Gum seedlings attacked by a rare disease LN: Shifts in prices and in the delivery of gum seedlings JM: Type of irrigation not congruent with what agro-industry wants

5.8 CONCLUSION

This chapter has looked at the capabilities question, the valued beings and doings that the farmers' case stories engaged with from old to new functionings under climate change risks and vulnerabilities. The commodities or inputs and outputs were also viewed alongside the conversion factors that enabled and disabled the new capability sets. For each case story that has been looked at, the different tensions as capability enablers and constrainers were carefully considered. The current farming practices have been categorised into four main groups: crop and non-crop farming and market and non-market capability sets. The crop farming has been further grouped into rain-fed and irrigated crops. Under rain-fed farming, FCS 1, **VS** currently values fertility trenches for in-field water harvesting and soil enrichment as a new capability set. FCS 2, **BC** still currently values his traditional maize cropping, the open pollinated varieties (OPV) mainly in wetland gardens to preserve the seed that he inherited from his parents since the 1950s. His type of traditional maize crop is constrained by a change in climate from long rain-seasons to short ones. With the availability of water for irrigation, he was willing to remain focused on his traditional maize crop as his achieved functionings and capability set.

For irrigation, FCS 3 led by **LN**, FCS 4, **SM²**, FCS 5, **SS** and FCS 6, **JM²** valued a market based economy as a new capability set that was characterised by perennial crop farming, rotation of crops, composting and mulching. The commodities or inputs that the youths used included a small stream, a water pump and two brick-walled water reservoirs. The youths valued local and mainly urban and industrial marketing of their crops. FCS 4, **SM²** valued doing market gardening and engaged in conservation farming and was moving towards organic practices. The resources that FCS 4, **SM²** used include withdrawing water from a nearby stream into an earth built reservoir and from there water is pumped into a 10 000 litre plastic tank uphill from which water is withdrawn through the force of gravity where it is fed into a network of hosepipes for irrigation. FCS 4, **SS** valued doing irrigation farming of garden crops and winter wheat. The resources of **SS** included a stream where water was extracted via a diversion trench into a pond uphill from which water was withdrawn through syphoning into a network of hosepipes and crops were irrigated through flooding and through the force of gravity. FCS 6, **JM²** valued a market mode of farming under irrigation. His resources included 10 10 000 litre Jojo tanks powered by solar pump. In terms of non-crop farming, FCS 9, **FN**, FCS 7, **LM²** and FCS 8, **LM³**, all apiarists, valued doing a practice that

is an alternative to climate change affected rain-fed farming. FCS 7, **LM**² and FCS 8, **LM**³ valued bee-keeping for both local and national markets as his new capability sets. FCS 7, **LM**² and FCS 8, **LM**³ learnt of apiary from older generations and the new practice of Kenyan key bar from the government and donor training. Apiary based marketing was their new capability sets. FCS 10, **VC** and FCS 11, **JC**, two non-crop farmers, valued doing dendrology [tree seedling] production as an alternative to crop farming and as a capability set, the valued beings and doings. The two valued a market mode of production for local and regional markets with FCS 10, **VC** exploring exporting some of his products. The resources included seeds, existing fruit trees for grafting and plastic pots. Tables 5.1 and 5.2 summarised the farmers' conversion factors and tensions or the constraining factors to the farmers' achieved functionings. Therefore this chapter looked at the first research question on the community-based farmers' capabilities of which different capability sets were identified. The next chapter looks at an analysis of the community-based farmers' social learning and conversion of their capabilities.

CHAPTER SIX

ANALYSIS OF FARMERS' SOCIAL LEARNING INTERACTIONS AND CONVERSION OF RESOURCES INTO FUNCTIONINGS FOR NEW ADAPTIVE FARMING PRACTICES

6.0 INTRODUCTION

The goal of the qualitative data analysis in this chapter was to uncover emerging knowledges, patterns, concepts, insights, and understandings (Patton, 2002) of the community based farmers' social learning (SL) pedagogic trajectories. This chapter showed a nexus of knowledge generation that was transferred from and between stakeholders that is from farmer agents to farmers, from agro-based industry to farmer agents and from farmer agents to other farmer agents, from farmers to other farmers, from the urban open market to the farmers and from the farmer agents to agro-industry. The social learning framework by Wals (2007) and the six sequential processes [also called moments] are used as the analytical tools in this chapter on social learning. This chapter addresses the main research question:

'How can and does social learning facilitate or constrain the conversion of resources into functionings and new adaptation capabilities of communal farmers in the project site in the face of increasing climate change and associated climate variability related socio-ecological risks and vulnerabilities?'

And sub research questions:

'Do, and how do the learning processes and practices in the community of practice promote or constrain conversion factors (personal, social, environmental) for turning resources into new functionings and capabilities that respond to socio-ecological climate variability and longer term climate change induced risks amongst farmers? How are they (community-based farmers) currently learning their farming practices?'

In this chapter I analysed five adaptive practices in the social learning trajectory based on the six 'sequential moments' or activities that help when trying to analyse, design and monitor social learning [cf. Wals & Heymann, 2004; Wals, 2007, p. 499] and these are as follows: orientation and exploration, (self) awareness raising, deframing or deconstructing, co-creating or joint (re) constructing or reframing, applying or experimenting and reviewing. The following section addresses the sub-research questions using the sequential moments as recommended by Wals (2007, p. 498).

6.1 SOCIAL LEARNING FOR ADAPTIVE PRACTICE 1: TRENCH BEDS, CONSERVATION BASINS, MULCH; LIQUID MANURE [ANAEROBIC METHOD] AND INSECT AIDED CROP POLLINATION

Adaptive Practice 1, benchmarked by the construction of fertility trench beds and mulch as was the case in FCS 1, **VS**; conservation basins as was the case in FCS 2, **BC** and FCS 3, **LN**; application of liquid manure [anaerobic] and insect aided crop pollination as was the case with FCS 3, **LN**. The following research evidence was based on the six moments of the social learning pedagogy and trajectory:

6.1.1 Orientation and Exploration: Research Evidence

On orientation and exploration in FCS 1, **VS** kept wondering on how best she could shift from a situation of food insecurity [a recursive and self-reflective on perennial poor harvests]. **VS** engaged in a reflective and reflexive [Layer 1] process as an individual until one Mrs Y, a neighbour, asked her to accompany her to a Field Day at *Gogo Hildah*.

FCS 1, **VS**: At first I was reluctant [exploring key challenges to be addressed] as I felt that was not going to change my situation [deframing] but I further discussed the issue with my daughter overnight and together we reflected on some benefits in attending that Field Day at Gogo Hildah's homestead.

FCS 1, **VS** during orientation and exploration on the new knowledge as a capability set, reflected on a personal level [Layer 1 reflexivity] then on a family level with her daughter [Layer 2 reflexivity]. Through orientation and exploration, FCS 1, **VS** identified Gogo Hildah as a key actor to the new capability set of nutrition of the soils, fertility trenches as the key issues explored. Research evidence from FCS 2, **BC** involved orientation to the new capability of education on conservation basins as a farming adaptive practice. Below is what he and his son, **VC** shared:

Today [referring to years after Zimbabwe's independence in 1980], we have been taken by the winds of change. Everyone nowadays is changing...We are going for certified seed varieties which are prone to weather changes and diseases and are too expensive for us...FCS 10, **VC** [son to **BC**]: Through observing shifting in rainfall patterns in the 1980s when we experienced major droughts in the country, it was no longer reasonable for us to plant the long season varieties (SR52) or the traditional *Hikiri-king* (Hickory King). The shifting seasons [climate change/variability] actually forced us to adapt to new seed varieties.

Orientation in the case of FCS 2, **BC** involved the winds of change from climate change, government policies and the donor community as well as from seed companies, through

research. These winds of change led to reorientation of the farmers' adaptive practices. Thus change and exploration in this case was benchmarked in a wider constellation of socio-historical and political influence leading to an internally related case in a totality [cf. subsection 3.4.3; Lotz-Sisitka, 2016]. The reflexive process was at a national level guided by knowledge as a capability set through education from extension service, seed companies and from observed weather changes. The key actors here were the government, the donor agents and the seed companies while the key issue was climate change, which triggered reorientation of old practices to new ones. On orientation and exploration the youths FCS 3, **MM** noted the following:

Before 2012, from this crop field and demonstration site we could hardly harvest any meaningful maize crop...We further reflected with our Granny here in...on how best we could move into an organic....Granny advised that we start with small grain, rapoko, for it enriches the soils and does not need artificial fertilisers and was drought resistant too. We readily accepted that idea.

Reflexivity in this case story, started with self as the youths reflected on what existed: the poor soils and poor harvest under drought conditions. The youths identified elders [Layer 2 reflexivity] as key actors to explore ways of shifting from maize crop farming under a conventional mode to organic farming under compost and liquid manure. This was a way of absencing two ills: poor harvest and poor soil fertility. The youths also reflected and explored that small grain, rapoko, could enrich soils [enhanced soil nutrition as a new capability set or the valued beings and doings] in the absence of synthetic fertilisers and so could absent the use of artificial fertilisers. This was also part of traditional knowledge systems [cf. referential detachment through not accepting modern science as the only epistemology to draw on for the issue of soil fertility, Lotz-Sisitka, 2016, pp. 318-339; subsection 3.4.3].

6.1.2 (Self) Awareness Raising: Research Evidence

On self-awareness, the following provided part of the research evidence from the activities that FCS 1, **VS** engaged with:

After experiencing poor harvests...I kept wondering how best I could shift from such a situation... I was shocked to see the huge harvest Gogo Hildah was showcasing during the Field Day that she held...I was really moved to see such an elderly woman of her age producing such huge maize harvests while us [much younger elderly women] were starving ...Since I do not have cattle manure, I rely on putting humus from the forests and the maize stalks into trenches and it is working well.... But I am happy, I weaned myself from food insecurity [begging bowl] to food security and now the other community-based farmers come and learn from me.

Self-awareness in FCS 1, **VS** involved self realisation that to remain in the old farming capability set was getting her nowhere and so she had to reorient and ‘deframe’ from old to new farming practices. Self-awareness was also evoked by observing how a much older member of the community had a high maize yield when she [FCS 1, **VS**] was struggling with food security. FCS 1, **VS**’s personal agency was triggered by old Gogo Hildah as a key player, who was needed for FCS 1, **VS** to accept and transform to the new functionings. FCS 1, **VS** now realised that she too had the potential to be a source of knowledge as the other farmers came to learn from her. Self-awareness, too, was a reflective and reflexive process at an individual level, Layer 1 and at a community level, Layer 2. From her comment, “I was moved”, FCS 1, **VS** came to realise how deprived she was as she had failed to produce a high maize crop yield, a function that a much older woman in society valued doing and being. On self-awareness FCS 2, **BC** had this to say:

But we still practise our traditional maize crop under... and mainly in our gardens (wetlands) since they need a longer time to mature and they need to be away from the conventional seed varieties, they can cross pollinate and we lose the seed.

FCS 2, **BC** reflected on self-awareness as he acknowledged that OPV seed varieties needed to be planted away from the conventional seed varieties since there would be cross-pollination that could pollute his maize crop variety, the OPV [cf. sub-section 3.4.3 on transfactuality]. FCS 2, **BC** reflected further on orientation and exploration [cf. sub-section 3.4.3] when he failed to abandon his old maize variety OPV by absencing the impacts of drought through planting his traditional long season maize seed variety in wetlands and gardens.

6.1.3. Deframing or Deconstructing: Research Evidence

In the case of deframing or deconstructing the old practices, the youths had this to say:

FCS 3, **MM**: So after reflecting on the poor sandy soils [cf. sub-section 5.3.1; Plate 5.8]... we opted for the small grain [resilient to droughts and enhances soil fertility] and then moved into organic farming. FCS 3, **LN**: The rains in some cases, never came until we lost the crop to droughts... Now...irrigation, we have realised that today (2015), we plant crops throughout the year and long season maize variety (OPV)... since we can water throughout the year. With a fuel powered water pump in place we realised our dream to move towards organic farming and towards a three crop cycle ...For the peas-crop, we had to fill in the manure in small trenches and not basins [as was observed at FCS 1, **VS** during a Field Tour] this time...The product was not competitive at the market [cf. Plate 5.8 Photo, 17]. ...we reflected on liquid manure, a technique we learnt from GC.

In this case story the youths FCS 3, **MM** and others deconstructed the frame of rain-fed maize crop farming as the only means to ensure food security as they opted for small grain and later organic gardening crops as alternatives to conventional maize crop farming that is now prone to climate change. The youths deconstructed the old frame of rain-fed maize crop farming under artificial fertilisers, into new innovation functionings such as the conservation basins, mulch, compost and small trenches. Deconstruction is evident when the youths realised that the use of composts and conservation basins were not good enough after several experiments. Their organic products were not competitive on the market and so they opted for liquid manure. Deconstruction was also done by the agriculture agents when they compared old and new practices during the Field Days, evidence of which is shown below:

CM¹: Long time ago people used to practise shifting cultivation as a way of resuscitating soil fertility [cf. Kramer, 1997, p. 160, on how the Shonas used to prevent erosion of soils]...Nowadays where is that land to waste?...Today you remain here where you are settled and so you try to improve the soils to take you for generations. Practise conservation farming, put manure in the conservation holes... make composts for your soils to remain healthy...Here we have witnessed intensive agriculture, farming on a very small piece of land but with very high yields... Let us all utilise the very small portions that we have in order to survive out of them. [cf. Plate 5.2]

CM¹ was addressing part of the social aspect from the three pillars of ESD, Agenda 21 [cf. section 1.2] as well as deframing people's minds from the notion of shifting cultivation to sedentary farming under soil conservation. The emphasis was deframing wasteful farming methods on the small pieces of land that people already occupy, as reflected through soil erosion and other types of environmental degradation, and move towards sustainably conserving the soils.

6.1.4. Co-Creating-Joint (Re)Constructing or Reframing: Research Evidence

The youths engaged in co-creation and joint reconstruction with extension officers, other youths, donor agents and the community, as they shifted from old to new capability sets and achieved functionings to adapt to climate change.

FCS 3, MM: We reflected on what our expert (then **GC**) taught us about liquid manure...but this time instead of using small cans to make the liquid manure, we used three large drums (200 litres) and this was the 'miracle-water' [cf. Plate 5.8] that took us to competitive levels in the 2016-2017 season.

Co-creation was done through reflection on what the youths had learnt previously on liquid manure and through a recursive and a reflective process as a group, they experimented on liquid manure now using larger containers than they had used before. This time they increased the quantity of the liquid manure in proportions of one third cow dung against two thirds water. Reflecting on co-creation from old farming practices to the new capability functioning of fertility trenches, FCS 21, **VS** had this to say:

There, [at *Gogo Hildah's* Field Day] I learnt of how to bury maize stalks into trenches and also learnt about mulching where maize stalks and cobs were used in the process...I observed that the mulch she used, later decomposed and was dug into the field as manure, this darkened the soils and improved her [soil]...The maize stalks and cobs in trenches acted as a sponge...[cf. subsection 5.1.1]... I kept asking Gogo Hildah how she got it right and she explained again and again...The rotting maize stalks would retain moisture and add to soil fertility... I continued to think over it as I also shared my thoughts with my daughter...The following day, we started the trenches, because we did not have good maize stalks we started by filling the trenches with humus and top soils from the forests... and reflected and say, 'how come *Gogo Hildah*, old as she is, has managed to embark on such a great innovative farming technique, why shouldn't I?

Knowledge co-creation was reflected when FCS 1, **VS** learnt how to conserve soil moisture through burying maize stalks and maize cobs, a new capability set and an achieved functioning of food security and that for absencing temporary droughts, from Gogo Hildah who took her time explaining the process. Co-creation on its own was not enough for transformation to take place; FCS 1, **VS** also reflected by herself about the knowledge that she had just learnt, before she adopted it. She also shared the reflections with her daughter at home. This was reflexivity Layers 1 and 2 in a multi-layered reflexive recursive process of co-creation. After transforming to the new capability of education on the achieved functioning of fertility trenches and food security, FCS 1, **VS** shifted from non-being to being as she became a source of knowledge co-creation with other farmers now coming to her for knowledge as shown below:

Three farmers and the youths came here for a Field Tour and I hope they benefitted from knowledge sharing with me here...I demonstrated to them what I had learnt from *Gogo Hildah*...showcased how I use grass mulch, leaf-mulch, maize cobs and maize stalks buried in fertility trenches to enhance soil fertility...The youths were impressed...but I will make a follow up...I emphasised to them that the maize cobs and maize stalks conserved water in the soils.

On knowledge co-creation, FCS 1, **VS** reflected with the youths on the knowledge she had acquired from *Gogo Hildah*. In this case FCS 1, **VS** was now the expert-other, sharing new

innovations and achieved functionings with other farmers and the youths. To consolidate the monitoring and evaluation process to see whether or not the youths had understood the processes and were doing exactly as she had taught them, FCS 1, **VS** noted: “But I will make a follow up”, thereby making co-creation of knowledge, a recursive process. Co-creation was also not a process that took place amongst and between farmers but between the farmers and external forces like seed houses, researchers, donors and extension services as shown below:

FCS 10, **VC**: Seed houses, extension service and researchers in the country therefore introduced short season varieties to adapt to the reduced rainfall season...people have attained education, formally and informally, we have come to realise that it is unprofitable to waste a certain time of the year, idle... [cf. subsection **5.2.1**]

The knowledge co-created with external forces helped the farmers to adapt and to transform upon reflection especially on the benefits derived from the new capability of education, and its corresponding functionings in adaptive farming practices. The children, through poems they recited, also co-created knowledge on new farming functionings, knowledge of which was appreciated by the farmers and by extension service as shown below:

ChdPoem³: Knowledge is power, today we witness how locally available resources are utilised...We have witnessed how to protect our resources through good farming practices, conservation-terracing as observed during this Field Day...We have learnt of natural and nutritious food production...This farming practice has opened a new era in this community, we salute you (organic) farmers.

In the poem the child noted that they had jointly learnt and observed terracing as part of a new conservation farming practice, the valued beings and doings, together with others during the Field Day. The child also pointed out the lessons they learnt on the natural farming practice (organic) from FCS 3, at the demonstration site. Extension services had this to say in appreciation of the co-created knowledge from the school children during a keynote address at the same Field Day:

CM¹: I, together with many of you, must have learnt a lot from the children's poems...The children have just reflected that teachers are moving with time on environmental education... children made my task easier as they said most of what I wanted to say... conservation farming... is farming that conserves the soils, there is massive terracing that was done here, there is mulching of crops to conserve moisture, there is manuring of soils through composts...Try to compare this field with that of farmers who are still applying synthetic fertilisers, you will observe that the soils here are much richer... [cf. self perceived morbidity of soils, subsection, **2.4.4**]. Manure supported soils will remain strong for a long time...We encourage all farmers to use the cultural method that we find here, use of manure. Organic food is good for our health as was said by one farmer here present. ...[on spacing for pea crop]...Peas

have a tendency of ‘nesting’ and you need to spread them apart hence there is need to leave a walkable gap after every 4 rows.

The knowledge co-created was on conservation farming, a new capability set and achieved functionings. This was introduced by the children through a poem and later, extension services brought in the technical advantages of conservation farming to the soils, the capability of nutrition. The link between organic products and good health was also co-created between the farmers and the extension services [cf. subsection **5.2.1**, inductive reasoning]. Knowledge on climate change was also co-created as shown below:

CM¹: When people use artificial fertiliser when the rains are scarce, there are gases that are associated with some of our fertilisers and the gases from these fertilisers rise into the air [beyond the atmosphere] disturbing part of the air called ozone layer...Apart from reducing the destruction of the ozone layer [mitigation, cf. subsection **2.4.5**], manure helps in making up the soil structure ... it provides the binding network to soil materials for it to be called rich and productive soil ...On the cultural methods that we can use to control pests, rotation of crops and mixed farming where we plant onion and garlic within the same space with your crops is good [also called permaculture].

Knowledge of good farming practice was also mixed with knowledge of disaster risk reduction as the extension officers co-created knowledge on absencing heavy chemicals and pesticides through applying cultural pest control methods [cf. sub-section **3.4.3** on distancing]. The extension services brought knowledge to the farmers as they too learnt something from the farmers’ practice and from the children’s recited poems. The link between application of synthetic fertilisers and the destruction of the ozone layer was one ‘knowledge’ that was shared [cf. sub-section **3.4.3** on transfactuality and referential detachment; Lotz-Sisitka, 2016, pp. 318-339]. Extension shared the knowledge that while the locals might want to reduce the use of artificial fertilisers that contributes to the destruction of the ozone layer [referential detachment] and subsequently to climate change, communal farmers cannot fully solve the global problem without recourse to changing the global perspective on conventional agriculture and agricultural-economic models that are based on the massive production of synthetic fertilisers and more, to the free distribution of fertilisers by government and donors [cf. Lotz-Sisitka, 2016]. Co-creation therefore was a multi-layered and nexus process. The extension service compared soils from synthetic fertilisers and those from cow dung manure, mulch and grass compost, and noted that the soils from natural manure are richer and darker [cf. subsection **2.4.4** on self-perceived morbidity of soils]. The soils that extension claimed were dark and rich, were also later tested for pH and manure content and the results pointed that the observations by extension and the claims by the

youths about the morbidity of the soils, were correct [cf. Table 8.2 and Table 8.3]. At times there was more alienation than transformation which the youths resented:

FCS 3, **MM**: At times there are just too many donors around [cf. sub-section 5.7.3 on tensions] with many projects....But we just accept the projects because we do not want to scare away donors...If we sound 'impossible', they will not sponsor our village in times of need. So we just accepted the training.

From the tensions noted above and in sub-section 5.7.3, the farmers accepted some of the co-created knowledges, not because they appreciated them but they feared being victimised. This reflects a possible case of alienation and not transformation as change is viewed as external and at times through coercion and not internally and sustainable [cf. sub-section 3.4.3 on alienation and not transformation; Bhaskar, 2016 on Sophia]. While there was co-creation of knowledge through the donor funded projects, not all projects were viewed by the youths as viable but they still accepted these projects for fear of reprisals from the donor community. Even when they saw that the knowledge they were getting was not covering all they needed to know, they feared questioning. In this case, poverty remained one of the disablers to farmers' capabilities. On the capability of nutrition, farmers also co-created the knowledge about differentiating organic products from non-organic products as shown below:

PM: The taste between an organic product and a conventional product are totally different...artificial-fertiliser-produced veggies have plenty of water coming out during cooking, something I do not experience when cooking organic veggies... FCS 3, **LN**: the synthetic fertiliser produced veggies quickly wilts whilst the organic veggies resist moisture loss much longer...I sent our pea crop to the open market... I did not tell the women [buyers] that our product was organic. After two days, our pea crop was still fresh, whilst the synthetic fertiliser produced peas, had started showing signs of wilting ...The women asked, 'how come your peas crop still looks fresh as compared to the other ones that we bought from other producers on the same day we bought peas crop from you? We actually, kept both sets of peas crops under similar conditions.' I replied, ours is organic and they asked again, 'what is that?' I then explained...

Knowledge co-creation was non-linear as the farmers learnt from the market while the market learnt from the farmers too. The farmers could also learn from experience as they cooked the products and so on [cf. sub-section 3.4.3; Lotz-Sisitka, 2016, pp. 318-339, on isolation since the farmers lacked the scientific mechanisms to test the differences between organic products against conventionally produced products]. The comment by the women with reference to organic products, 'What is that?' might have suggested that the general public might be lacking an awareness of organic products as a nutrition capability. In addition, the products

were later laboratory tested to ascertain some of the organic parameters [cf. Table 8.1]. On water harvesting, **MNA** had this to say:

I learnt of water harvesting and...water reservoirs [water shelter as a capability set] to supply water for irrigation in this project...When one gets to a water point, one can perceive seeing crocodiles,...others can perceive taking a cold bath whilst others think of market gardening [on the capability of education on the different functionings of water]....In this project water is extracted from a tiny stream down gradient but can feed two large reservoirs [shelter] up-gradient, a process that does not disturb the smooth flow of the stream [cf. sub-section **5.1.3** and Plate **5.2**]...., this piece of land has a steep gradient, see how much energy the farmer spent on terracing?...Is there anyone who can confirm any form of erosion here?... This shows will power [cf. sub-section **3.4.3** on transformation and alienation]. In other districts we are struggling with people as they are unwilling to dig just simple contour ridges to combat soil erosion.

In the research evidence abstracted above, knowledge co-creation went from farmer agent, extension service to the farmers and vice versa as extension also learnt of the farmers' will power to conserve soils, an aspect that was missing from other districts. The farmers who gathered at this Field Day thus learnt from extension service, of personal agency as a motivating factor to transform to new functionings from the comment, 'This shows will power.' There was co-creation of knowledge on conservation farming and terracing to absent soil erosion [cf. sub-section **2.2.10**; inductive reasoning, wherever terraces were observed, soil erosion was combated and vice versa and so terracing combats soil erosion under conservation farming]. Co-creation of knowledge also came from the observed practice, use of gradient to convert water to the function of syphon irrigation down gradient, an environmental conversion factor. The next section shows research evidence on applying and experimentation.

6.1.5. Applying/Experimenting-Research Evidence

Some experiments were carried out by the youths, FCS 3 on the use of mulch and liquid manure against a change in production. The youths also sent soils and products from their crop field that they claimed to be organic [cf. self-perceived morbidity] for laboratory tests, marking a final conclusion on the road towards organic farming claims. The other experiment was from FCS 1, **VS** who made observations on the conditions of crops after applying fertility trenches. Figure **6.1** shows experiments on liquid manure [anaerobic method], digging basins, grass mulch and insect aided crop pollination and crop production between 2012 and 2018 which were done by the youths.

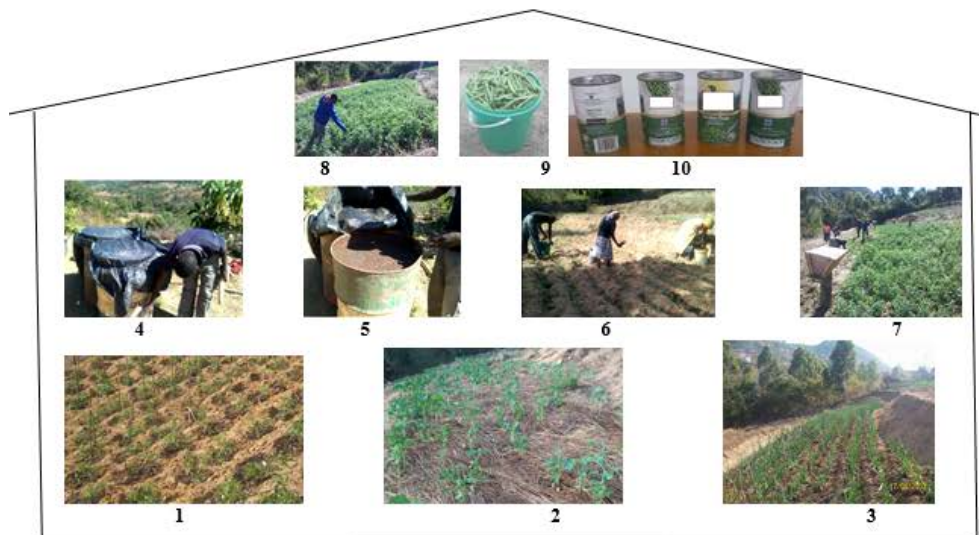


Plate 6.1: Small-scale innovations: basins, mulch, liquid manure & insect pollination

Photo 1 above shows a tomato crop under conservation basins, photo 2 shows vegetables under grass mulch, photo 3, garlic under mulch, photos 4-5 liquid manure processing of, photo 6 application of liquid manure, photo 7 use of apiaries to pollinate peas crop, photo 8 a healthy peas crop, photo 9 a bucketfull of fresh unshelled peas and photo 10 canned peas from the same field crop. The pedagogic trajectory towards the new capability sets of small scale innovations, is narrated by the youths at the demonstraton site as follows:

FCS 3, **MM**: By 2013... the humus collected from the bush, composts and cow dung, filled in the conservation basins [Photo 1]. For the peas and onion crop we had to fill in the manure in small trenches [Photo 3]...We also applied grass mulch for moisture preservation [Photo 2] but the crops were not competitive. FCS 3, **LN**: We experimented on the use of liquid manure [cf. sub-section 2.6.1]...This time we increased the volume [of liquid manure] from the small watering cans to 200 litre drums...This we did at a proportion of 30% cow dung and 70% water...[Photos 4; 5; 6]...Liquid manure was our miracle-fertiliser [cf. sub-section 5.1.3; Plate 5.8]...as the crop quality and quantity drastically increased..

The youths experimented with mulch, compost and coddung manure that they spread in the field. From the experiment, the youths concluded that their organic products were not competitive on the market, in size and quality. The youths later reflected and experimented on liquid manure which worked well as the youths finally managed to send their peas crop to the industrial market. The youths concluded that whenever they used mulch and compost alone the product could not match the products that were conventionally produced, in size and quality, but when they used liquid manure, the product would grow in size and in large quantities [inductive reasoning on liquid manure as the miracle water]. The idea that liquid

manure was responsible for the good harvest was a self-perceived morbidity of that type of manure and not observed morbidity since the youths did not put the liquid manure under laboratory test. But the youths managed to send the soils from their crop field to test for pH and manure analysis while the peas crop was laboratory tested for nutritional components and for the absence of heavy metals. Through a long reflexive process which started in 2013, the youths finally convinced the agro-industry to can their pea crop and they sent the canned peas for further laboratory nutritional tests [Table 8.1]. Three faculties from my university played a leading role in laboratory testing of the soil and the product, thereby opening up space for a 'Whole institution approach,' [cf. sub-section 1.2 on scaling the GAP; section 4.3 on researcher position; Table 8.1 and Table 8.3]. From FCS 1, VS also had stories to tell about her experiments and conclusion.

Before the year 2012 my maize crop farming was traditionally rain-fed...maize harvest could hardly fill up a small dish...The first year I shifted from my old farming practice to this new one [fertility trenches],... I harvested 20x50 kg bags of maize [cf. subsection 5.2.1]..., and now [2016-2017 season] as you can see [Plate 6.1], I am expecting 4 tonnes.....What I noticed was that every morning when I woke up to do my field observation at 05h00 hrs, I would be surprised to see most of my crop, healthy-green from morning until 10h00 hrs when it showed signs of moisture stress [cf. subsection 5.2.3]...I observed again around 17h00hrs the crop was ever-green again....I concluded that my crop was benefitting from the moisture that had been retained in the maize stalks in the trenches for a period more than I had expected such that very few of my plants wilted... [cf. sub-section 5.2.3]

FCS 1, VS reviewed the progress she had made in terms of food security as her maize yield shifted from a few kilograms before 2012 to a harvest of four tonnes in the 2016-2017 farming season, after engaging social learning and the new functionings of fertility trenches under conservation farming. Fertility trenches are an in-situ water harvesting technique. FCS 1, VS liked to attribute the good harvest to fertility trenches, which is a form of inductive reasoning as she observed a correlation between an increase in the use of fertility trenches and a corresponding increase in maize yield each year between 2012 and 2017. She concluded that the fertility trenches were responsible for the capability sets and achieved functionings of nutrition and food security. On experiments and observations by FCS 1, VS [cf. sub-section 5.2.3] helped the farmer to conclude that when she applied fertility trenches [buried maize stalks and cobs in trenches] as moisture conservation mechanisms, the crop did not wilt under temporary drought conditions. Like scientists, FCS 1, VS would observe the condition of her maize crop in the morning and in the evening and she finally concluded that

the innovation helped with retaining moisture [cf. sub-section **5.2.1** on abductive and inductive reasoning].

6.1.6. Reviewing: Research Evidence

FCS 3, **LN** reviewed the knowledge that he had learnt on insect pollination and observed that it was good to position the apiaries at the edge of the fields and not in the middle since the first experiment had failed. He had this to say on the different experiments:

FCS 3, **LN**: We learnt of the insect pollination of crops from FCS 8, **LM**³ [Plate **6.1. Photo 7**] and from books... We experimented on insect pollination by putting one swarmed hive in the pea plants with several empty others. [cf. sub-section, **5.1.3**]. We failed to work... due to bee-stings ...[The youths further reviewed literature from the training manuals and discovered that the hives were supposed to be put at the edges of the field and not at the centre]...We are our own monitors we don't need someone to keep checking on us whether or not we are still practising organic farming year in year out, it is now part of us.

This was a case of transformation [cf. sub-section **3.4.3**] since the youths were not coerced into practising organic farming. They reviewed that the practice was now part of their life since they loved doing and being organic practitioners and that they perceived that the soils from which they were producing products were also free of heavy metals and pesticides. Apart from trusting that their practice was organic [cf. sub-section **2.4.4**, on self-perceived morbidity] the youths managed to challenge the positivist approach by sending their own products and soils for laboratory tests [cf. Tables **8.1; 8.2; 8.3**]. But, at times the achieved functionings could also create new challenges for the farmer as was the case with FCS 1, **VS**'s flooded trenches below:

FCS 1, **VS**...You see my field does not drain fairly well. While I was enjoying my new practice of fertility trenches, it was good when the rains were... not flooding.... the intensive rains that fell this year [2016-2017]...I did not come out of my field throughout... I reflected back to our old ways of draining wetlands, ridging, instead of furrowing as is the case story with my fertility trenches...this time I had to make sure the maize crop was on a 'ridge' a raised platform so that the water drains off. That is how I survived...

FCS 1, **VS** reviewed the disadvantage of trenches under flooding and water logging conditions and so she reflected on another knowledge capability, the raised ridges which could drain the flooded trenches. She reviewed her fertility trenches and came to appreciate that they were not good under flooding conditions, so she acted on ridging instead of furrowing. On other achieved functionings associated with FCS 1, **VS**'s new knowledge

capability of conservation farming and her realised high yields, she had this to say on rural development:

You see, with the availability of water, and with more people doing this type of farming [fertility trenches], then the transport system...to the market will improve as there will be more [transport] companies operating...ferrying our agricultural products to the urban open market....Even our neglected dirty road will be repaired once it becomes busy...

In her review FCS 1, **VS** saw her practice as one with the capability (potential) to bring rural development into the transport sector with improved infrastructure once production increased. This was an inductive reasoning [cf. sub-section 2.2.9]. On co-creation, FCS 10, **VC** reviewed that one person could not solve the current environmental problems:

I can say trying to concentrate on your own knowledge and understanding of environmental issues does not pay...We all learn from others and with others... Together people bring out different views on the changing weather patterns, 'The 'don't you see this and that concept', [with reference to observed weather changes] sets the tone for debate nowadays [This was an emphasis that people learnt with and from others].

FCS 10, **VC** came to realise that environmental issues and climate change in particular were such a gigantic phenomenon that could not be grasped or solved by one individual, but needed a sharing of ideas, co-creation [cf. sub-section 3.4.2 on In-process]. Thus absencing the ills of climate change and its indicators, global warming, droughts, cyclones and floods, is always in-process as it is a gigantic task and remains incomplete for as long as greenhouse gases continue to be produced [cf. Lotz-Sisitka, 2016, pp. 318-339]. On review and dissonance as well as deconstruction and reframing, Farmer Agent **MNA** had this to say from a historical perspective with reference to the new practice observed during a Field Day in 2015.

Historically people were forced by law to make deep storm drains and because there wasn't enough knowledge [education] on why the practice had to be done..., people [Black Africans] resisted that [dissonance as the practice was viewed as punishment and oppression]...Only a few Black people later realised [deframing after observations] that the quality of soils in their fields was deteriorating as rich and fertile soils were washed away by sheet erosion [in the absence of storm drains or contour ridges then] resulting in poor yields....But, the steep gradient is also a blessing in disguise as it is naturally good for irrigation [environmental conversion factor], the water reservoirs [water shelter as a new capability] as you can see are in the upper gradient, feeding irrigation water down gradient..... The mulch decomposed and was dug into the soils as manure, this has darkened the soils...Soils no longer look sandy as is the case in the surrounding places here.....[cf. sub-section 2.4.4, self-perceived morbidity of the soils]... A few of us are in the tendency of negatively changing the soils, they settle in a rich piece of land, waste it, and think of migrating

to yet another rich piece of land, only to repeat the wasting process over and over again..... If you want to enjoy life to old age, a healthy old woman, then go for foods which are naturally produced.

De-construction of knowledge on the storm drain construction which were viewed as punishment by the Black Farmer [cf. sub-section 3.4.3 on alienation as compared to transformation]. The new knowledge as a capability set is that the deep contour ridges or storm drains then, are actually good for soil and water conservation. Co-creation of knowledge on soil conservation and healthy foods [nutrition as a capability] was also shared between the extension agent and the farmers during the Field Day where more than fifty participants were present. The absence of knowledge that organic manure produces high yields and was as effective as the synthetic fertilisers, seems to have made communal farmers remain static [cf. sub-section 3.4.3; Lotz-Sisitka, 2016, pp. 318-339], as the farmers continue to wait for free synthetic fertilisers from the government or to struggle to buy expensive synthetic fertilisers whilst they have plenty of cow dung manure in their homes. To absent the notion that synthetic fertilisers are the best for soil enrichment, FCS 3, LN and the youths sent two soil samples for manure analysis [cf. Table 8.3; sub-section 2.4.4 on observed morbidity of soil].

6.2. SOCIAL LEARNING FOR ADAPTIVE PRACTICE 2: INVERTED BOTTLE-DRIP IRRIGATION, SYPHONING WATER AND FLOOD IRRIGATION

Practice 2 involved innovations that adapted to temporary droughts such as the inverted drip irrigation done by FCS 3, JM¹ when her fuel powered water pump was down; the innovation of water syphoning which was propelled by gravitational force from FCS 3, LN and the diverging furrow technique for flood irrigation from FCS 5, SS. As in the previous section, the six social learning moments determined the analysis. Different orientation and exploration [cf. subsection 2.3.1; section 3.2; section 6.1; Wals, 2007, p. 498] processes were noted in Practice 2: the inverted bottle-drip irrigation, syphoning flood irrigation and diversion furrows. The research evidence was based on the six moments abstracted from these new innovations as have been documented below:

6.2.1 Orientation and Exploration

On an orientation to the bottle-drip irrigation, FCS 3, JM¹ had this to say:

Our water pump developed a major technical engine problem and knocked off... We were stuck with a quarter hectare of tomato crop in the field... We had to reflect on

other ways of irrigation apart from syphoning and flooding until we replaced the water pump...

The orientation process to the new capability set and innovation was evoked by a technical problem to the existing water pumping system. The key issues of concern or key challenges to be addressed by the youths in a way that connected with their own prior experiences and background, were the temporary water shortages which were a result of temporary drought induced by the absence of irrigation since the water pump had developed a technical fault. From FCS 6, **JM²**, reporting on his new capability set on absencing winter frost, had this to say on orientation:

FCS 6, **JM²**: From our ten plastic tanks we utilise flood irrigation down gradient... in winter we do not just irrigate our tomatos but we also burn sawdust to create a micro-warmer climate around the plants and so reduce frost, a traditional knowledge system we learnt as we warmed our selves overfire the at night.

On orientation, FCS 5, **SS** had this to say on water syphoning as a new knowledge capability and achieved functioning:

We used to water crops using dishes and watering cans from our water pond reservoir, but I reflected with FCS 3, **LN** who demonstrated how water can be extracted from a water reservoir using hosepipes through the syphoning technique.

The key stakeholder was FCS 3, **LN** who shared the knowledge on syphoning with FCS 5, **SS** and so FCS 5, **SS** explored this new technique and transformed.

6.2.2 Self-awareness: Research Evidence

On self-awareness, FCS 3, **JM¹** had this to say:

Sticking to a technology that was no longer functioning was not helpful as the crop was succumbing to moisture threat. ...We had to think fast and look for other ways of irrigation ...

FCS 3, **JM¹** the youths were aware that whining and harping about water shortage was not going to help the tomato crop survive moisture stress when their water pump broke down and so they reflected on an alternative irrigation mechanism, the inverted bottle-drip.

6.2.3 Deframing or Deconstructing: Research Evidence

On deframing and reconstruction, FCS 6, **JM²** had this to say:

I had to reflect on our old ways of how we were kept warm at night in winter, by lighting a fire...We had to burn sawdust [cf. Plate 5.4] to try and suppress condensation and frost at ground level...Village Head² **EM**...I actually wondered, this time of the year, during the hot sun of October [due to climate change, this time

of the year is mostly dry], to get an invitation to an organic onion project in an open field... I came only to prove if it is true that people can do viable farming when the rains are nowhere near... Now I have the answers, it is possible to farm throughout the year as long as you have water.

EM, Village Head², deframed on the notion that crops could only be raised during the rainy season. At **3L Totality**, the Village Head deconstructed his reality on rain-fed farming as the only mode of farming in a communal area as he witnessed and observed a king onion crop under irrigation during the hot month of October.

6.2.4 Co-creating-Joint (Re)Constructing or Reframing: Research Evidence

On co-creation, all the practices had their roots within the group of farmers under study and from external forces. Evidence of co-creation is shown below:

FCS 3, **JM**¹...The inverted bottle drip irrigation was an innovation that we learnt from a video that **CD** brought from Muzarabani [cf. section 4.3 researcher position and education 5.0]... where it was used by a small-scale tobacco farmer...In the video, demonstrated how the inverted bottle works and so we experimented on it and moved into the innovation... FCS 5, **SS**: I reflected together with FCS 3, **LN** and FCS 8, **LM**³ during a Field Tour that, the use of cans and dishes to water crops was labour intensive...**LN** demonstrated on how to pump out water from the reservoir,... through syphoning.....

In the above cases co-creation of knowledge involved deframing as each farmer had to deal with the deconstruction of the knowledge that s/he had before and accepted the new capability set which worked elsewhere. As for FCS 3 the female youth **JM**¹, learnt from the video that was shared with her via the phone by **CD** that she had to interpret the technique as it was demonstrated on the video from another province. Co-creation in this case was mediated by a video.

6.2.5 Applying/Experimenting: Research Evidence

Figure 6.2 shows three different innovations and new functionings that were a result of experiments done by the youths and the other farmers in the project.



Plate 6.2: Flood irrigation, the inverted bottle-drip and burning sawdust to absent frost

Regarding Plate 6.2 FCS 3, LN had this to say on flood irrigation; inverted bottle-drip and burning sawdust to absent frost:

Since 2012 we were watering our crops directly from a garden tape attached onto the water reservoir and through a hose pipe..., in most cases this was labour intensive..., we reflected on other ways of irrigation...We experimented on getting water directly from deep into the water reservoir [syphoning] and straight into the field trenches and basins using a 40 inch hosepipe as flood irrigation...It worked [Plate 6.2 Photo 1]...We learnt of this type of syphoning from a video from a village in Beitbridge, CD shared the video with us here in the community-based garden project... we experimented on the new innovation using a much bigger hosepipe and from a much deeper and bigger water reservoir than what was learnt from the video, it worked better...We learnt from X-High school [a Harare high school that was practising organic farming under drip irrigation] that irrigation has to be done during the day when the sun is hottest because that is when the plant fully utilise the water in food production [photosynthesis]...so, we shifted from irrigating during the evenings and early morning to doing it during the day light.

From FCS 3, LN and the group of youths co-created knowledge from farmers from Beitbridge in the Matabeleland South province, by means of a video. The youths quickly put the innovation under experiment. So, the co-creation process did not always involve face-to-face contact but videos were able to mediate learning too. Co-creation of knowledge here is taken as a laminated process as farmers learn through sharing knowledge amongst themselves, learn through ICT and videos from other villagers, learning from the formal school system, learning through trainings, learning through non-formal education such as print and electronic media [cf. Bhaskar, 2016, *spatio-distantia*] where an innovation was absent in this particular village but present in other distant villages. The timing of watering from evenings and early morning to midday was also tested after it was learnt from a school in Harare through a video. FCS 3, JM¹ had this to say regarding the experiment she carried out on the inverted bottle-drip irrigation (see Plate 6.2 Photo 2):

FCS 3, **JM**¹: The inverted bottle-drip with two holes as we learnt from Muzarabani... could last those three weeks of watering a plant-station... but in our case as we experimented on this new innovation, having two holes one at the bottom and one at the top (lid), the drip could not last, five days of watering a plant-station. ... We don't know why our inverted bottles failed to last the three weeks that the MC province farmers enjoyed and so we had to do another experiment by reducing the number of holes from two to just one small one on the centre of the lid of the bottle cap. ...With one hole, the inverted bottle-drip irrigation technique worked better and lasted longer than 5 days.

The youths experimented and observed that the time taken to empty the same inverted drip bottle was far less at their site than it was from the province where they learnt of the innovation. Instead of the two holes that they had learnt about, they resorted to one and the water lasted longer than five days but still was less than a week. It served the purpose, however, as their fuel powered pump could be replaced.

6.2.6 Reviewing: Research Evidence

On review, FCS 3, **LN** noted that there were many capabilities in the people in the different provinces of the country that they learnt from.

FCS 3, **LN**: We learnt a lot from other farmers around our community and from farmers from other villages.....that we should not just sit on our potentials (capabilities and freedoms), but we should put our capabilities (potentials) into practice (functionings). Through experiments and learning together with others we have managed to move towards market gardening and supplying industry...

The comment from FCS 3, **LN** that there are plenty of opportunities that are yet to be converted to functionings is what Muir (2016) referred to in the comment that Africa is lauded as the continent of opportunity, but, is also considered the sickest one on the planet. But through co-creation, deframing and experimenting, the poor African farmer seem to be slowly identifying her/his space on the planet. FCS 10, **VC** reiterated the importance of co-creation when he reviewed the sources of knowledge that he interacted with:

FCS 10, **VC**: On the changing weather patterns, we learn from our extension officers, formal education at school. By being at school you gain a lot of knowledge from teachers, peers or even from reading books...More, our parents and grandparents are a source of new and old farming methods too. Learning starts with playing pots [games before formal education], and what the extension officers do is to strengthen the knowledge that we get from many other formal and informal sources.

FCS 10, **VC** in his review, noted that learning on climate change and farming practices starts from an early age and is strengthened through formal, non-formal and informal learning.

6.3 SOCIAL LEARNING FOR ADAPTIVE PRACTICE 3: BREAKING INTO MARKET MECHANISMS

Breaking into the market as an achieved functioning, orientation and exploration [cf. sub-section 2.3.1; section 3.2; section 6.1; Wals, 2007, p. 498] was a long and winding trajectory for the farmers. The youths started marketing in 2012 with a horticultural crop like peas, vegetables and tomatoes after irrigation farming was introduced following the exploration of droughts as a disabler to rain-fed farming. On deframing or deconstructing [cf. sub-section 2.3.1; section 3.2; section 6.1; Wals, 2007, p. 498], the youths, FCS 3, challenged their own practice as the market challenged the quality of their crops, and so they transformed. Instead of giving up, the youths complied with the standards that the market demanded.

On applying and experimenting [cf. sub-section 2.3.1; section 3.2; section 6.1; Wals, 2007, p. 498], the youths in FCS 3 came up with observations that they could use to distinguish the organic and conventional products as part of their experiments [cf. sub-section 6.2.4]. Reviewing or assessing the degree to which the self-determined issues or challenges have been addressed [cf. sub-section 2.3.1; section 3.2; section 6.1; Wals, 2007, pp. 498], the youths in FCS 3, reviewed that with liquid manure, flood irrigation, conservation basins, fertility trenches, accessible transport to market, their organic products were now as competitive as those conventionally produced. FCS 2, **BC** also assessed and reviewed how the community-based farmers shifted from barter to a monetary market economy. The research evidence in this section has been analysed according to the six moments of the social learning trajectory as follows:

6.3.1 Orientation and Exploration: Research Evidence

The different farmers in this study shared their different trajectories and below is the experience from FCS 6, **JM²**:

We started market gardening in 2015...you know we used to specialise in fruit production...now we have clean energy in solar powered pump and a larger water reservoir in ten plastic tanks [shelter for water as a capability with many other functionings] to enable us do a market production mode in green maize and horticulture...such as onion, tomatoes and vegetables...

The availability of the commodity or input or the means of production through ten big plastic tanks of 100 000 litre capacity, enabled FCS 6, **JM²** to shift from a subsistence mode of farming to market gardening. He discovered that it was no longer worthwhile to do subsistence rain-fed farming and fruit tree farming, once he acquired a large water capacity in

solar powered pump and a large water reservoir capacity. Orientation to the new capability was propelled by the availability of water and the market.

6.3.2 (Self) Awareness Raising: Research Evidence

The youths raised self awareness around their practice as something determined by the market and below is the research evidence from FCS 3, the youths:

FCS 3, **SM¹**: Once we had managed the packaging issue correctly [cf. sub-section 5.7.3], there came the quality and quantity issues...To fight all that, we had to buy a suspended scale that could measure up to 20kg so that we would do our weighing at home... [cf. sub-section 5.7.3]

The youths realised that they had to comply with the standards that the market set in order for them to break into the market mode, **3L** detotalising in order to transform.

6.3.3. Deframing or Deconstructing: Research Evidence

On dissonance and deframing FCS 3, the youths had this to say:

FCS 3, **LN**: The marketing journey has been bumpy [cf. sub-sections 5.7.1 and 5.7.3]... We worked through liquid manure and we drastically improved on quantity, quality and size in 2016... they said, all is now good but we only procure from registered suppliers and not unregistered people... today (2017) we enjoy selling to the urban market. FCS 3, **OD**: We learnt from agro-industries during our trip to the industries that they needed from farmers like us, raw materials for them to fully operate. It is our duty as farmers to produce such raw materials in bulk for the development of industry and without raw materials industry cannot grow. Industry in return will offer us the youths and university graduates, jobs...So, if we don't produce in large quantities then industries might remain shut down and we don't get jobs.....

The market made the youths deframe as their products faced rejections. The choice for the youths when faced with dissonance, was to give up or improve, and they chose the latter. Thus the youths learnt that they were supposed to comply with market demands or else they were not going to get income. In addition, the youths learnt that they were supposed to register their activities to enable them to supply products to the urban hyper/supermarkets. The correlation or causal relationship between the supply of raw materials to the industries and job creation for the university graduates, was an inductive reasoning, noted by the youths: the 'X cannot exist without Y' concept [cf. sub-section 2.2.9; Sabai, 2016, p. 183].

6.3.4. Co-creating-Joint (Re)Constructing or Reframing: Research Evidence

The youths also co-created knowledge together with the market and the donor agents as noted below:

CM²: I would like to summarise my talk by saying our education to farmers should not just end at food security but farmers have to produce with surplus for sale... First identify your market before you put seeds into the soils... Knowledge of marketing is quite wide....which crop is needed by who and when and at what stage of maturity [cf. sub-section, **5.7.3**]. **FCS 3, MM:** The donor and government agents train us but they do not give us enough knowledge on markets [absence or ills, Bhaskar, 2016]. We lost much of our peas-crop due to lack of knowledge on markets, at the inception of the project..., they all played delaying tactics without coming out in the open that they did not want our product until the product over-ripened and was subsequently out of season...Imagine how much we lost in terms of transport costs, labour and productive time, going to a market that kept giving demands and promises but not taking your product until it is out of season...That was a way of pushing us out of business.

The youths realised that the knowledge they were getting from the market was not helpful and at times dishonest, creating losses to the youths in the process. In the case of FCS 3, co-creation of knowledge with the donor community on market mechanisms at times was viewed as disabler of their capabilities. Historically the issue of markets was structurally designed to disempower the Black farmer [cf. sub-section **2.5.4**; Palmer and Parsons, 1977, p. **243**].

6.3.5. Applying/Experimenting: Research Evidence

On applying the learnt concepts and experimenting on social practices, the youths had this to say:

FCS 3, OD: Now that we understand their ‘game’, that supply and demand determined prices, next time if only we acquire a cold-room [cf. sub-section **5.7.3** and sub-section **2.2.7** retrodictive reasoning].

The youths observed that price on the open urban market was determined by supply and demand. This was through continuous observation of how market prices were shifting. They applied this knowledge in order to respond to the market forces so as to absent ills from markets. In addition, the youths applied retrodictive reasoning: if they had a cold room in future then they could hold onto their products until the off-season when they would fetch more money since there would be fewer of these products on the market [cf. sub-section **2.2.7**]. On why the youths abandoned dendrology as an achieved capability in 2012, the youths said this after experimenting with the different market demands:

FCS 3, **MM**: Since we had gained experience in producing gum tree seedlings [cf. sub-section 5.6.3]... each year the goal posts kept changing... The following year you try to do the indigenous trees, only to be told, 'we take exotic or a specific type of indigenous tree', which you had not heard of in time... The following year you then attempt to do both ... at the same space and time and the exotic trees get diseased in the process and none are taken by the market... We tried to negotiate on why the market was not alerting us at the beginning of the year on which tree seedlings the government and the donor agents were interested in and at what price. That information was not always available to us.

The youths experimented with each type of tree variety that the market said they wanted, but the market kept changing their demands. The youths did not give up and kept experimenting since they valued doing the tree nurseries [dendrology], but the market kept disempowering them. The information on which tree seedlings would be on the market was not made available to the youths in time and so they felt disempowered. After each successful experiment, the market changed its demands and when they tried to produce the two main tree seedling varieties, the exotic and the indigenous, at the same time and in the same space, the exotic trees became diseased. Historically, the issue of markets was structurally designed to disempower the Black farmer [sub-section 2.4.6; Palmer and Parsons, 1977, p. 243]. When climate change activist **WM** tried to help the organic farmers to market their pea crop, she also experienced the tension from the market as shown below:

WM: Yes, I did check, the peas-crop [in the supermarkets] were not organically produced. We shared knowledge [with the supermarkets] on organic products and their advantages over the much bigger conventionally produced crops, but their argument was that the organic farmers should compete with the inorganic farmers, on size and quantity of products, without that they are likely to lose out.

WM observed and cross-checked the size and quality of peas on the shelves of the urban supermarkets and discovered that the big inorganically produced peas were more attractive than the organic ones to the buyers [cf. sub-section 2.4.4 on self-perceived morbidity; Sen, 2002b], especially in the absence of scientific tests [cf. sub-section 2.4.4 on observed morbidity, Sen, 2002b]. The organic farmers had to work harder to improve on size and the general appearance of their crops which they did through experimenting with liquid manure. The fact that the rural farmers knew of the health benefits of organic products which the urban market was not aware of, might have reflected an epistemic-ontological shift in knowledge on nutritional and healthy organic foods where the non-being (rural) was better equipped than the being (urbanite).

6.3.6. Reviewing: Research Evidence

Upon review of the whole process the youths felt that they were now being recognised as beings as shown below:

FCS 3, **OD**: I am happy, we are now part of the pricing system. They [buyers from the urban open market] also phone us to check if we are coming to the market and with what quantities [cf. sub-section 5.7.3]...to have discovered that cash was still available for those rural poor who exchanged a farm produce for money at the open market [cf. sub-section 5.7.3].

The youths reviewed that cash was readily available in exchange for agro-products at the market. Thus, if people produce the goods, they can easily get the much needed cash. If they produce excess then they can export and earn forex. The rural poor linked production with monetary returns, an epistemological ontological perspective that seemed to have been lacking in the general farming population in the country at the time. A review made by a climate change activist **WM** revealed that the media needed to play a leading role in public education about climate change adaptation as shown below:

Public education is needed in our people maybe through the media. The media just needs to refocus, more on productive issues than they focus on social issues as is the case today...Our people like farming but information on weather is sometimes absent from some of our news bulletins and whenever it is available, it is often marred by a musical background much to the frustration of the farmer who can hardly hear anything.... The different shops and hotels also need awareness on what organic production is all about, and, its role in climate change adaptation.

The review made by the climate change activist **WM** proposed that the main problem towards climate change adaptation through organic farming was the absence of agency from the local media in knowledge co-creation. The media was blamed for neglecting awareness campaigns on the health benefits of the organic mode of production, to Mother Earth, to the health of the soils and to the health of the people [cf. sub-section 3.4.3 on static].

6.4 SOCIAL LEARNING FOR ADAPTIVE PRACTICE 4: PARTNERSHIPS AND BUSINESS REGISTRATION

On partnerships and business registration as new achieved functionings, FCS 3, the youths moved into partnership with industry while FCS 10, **VC** who learnt from the challenges that the youths faced in trying to break into urban markets without the necessary legal papers, managed to register his new functionings as a private company. FCS 11, **JC** also managed to enter into dendrology contracts with big tobacco companies and could access loans from the

bank, a sign that he was now recognised as a business partner. Involved in the exploratory trajectory towards business partnership were the agro-industry, the donor agents, climate change activists, a local bank and the farmers. Plate 6.3 shows the trajectory that the youths and FCS 10, VC followed in exploring business partnerships and small company registration:



Plate 6.3: Collective learning through the Community of Practice model: Villagers, Agritex, university and agro-industry and a registered company emblem

From Plate 6.3 photos 1 and 2 show the farmers in a FGD at an agro-industry discussing contract farming. Photo 3 shows the company emblem from FCS 10, VC and photo 4 shows the canned products from the community-based farmers studied. The trajectory for partnerships and business registration has been long and complicated. Plate 6.3 illustrates partners involved in workshops that is the agro-industry and the community-based farmers, the extension service, climate change agents, advocates of organic farming and the university. The one community-based farmer FCS 10, VC who successfully registered his venture took a reflexive and recursive trajectory towards business registration. The analysis on partnerships and business registration followed the six moments of the social learning pedagogy. Orientation and exploration [cf. sub-section 2.3.1; section 3.2; section 6.1; Wals, 2007, p. 498], Agro-industry¹ explored opportunities for the community under study towards the functionings of partnerships and to be contracted for farming in tomatoes, peaches, mangoes and beans for the industrial market. The research evidence has been analysed according to the six moments of the social learning process as explained below.

6.4.1 Orientation and Exploration: Research Evidence

On orientation and exploration into partnerships, the donor agent and climate change activists explored, together with partners and the farmers, possible markets to send the farmers' products as shown below:

WM: We help the farmer in every aspect including marketing all agro-products... There are farmers with goats, we do not hesitate to market them, that is our work...

we want to empower women in every aspect, so women come up with viable projects that we as climate smart will help promote... Get registered and be in our database... For us to be able to make 'noise' in higher offices we need a large number of farmers in our database... No preacher ever prepares a sermon for an 'empty church' – that will not make sense. I need a large following in my 'church', 'climate smart'... **CM²**: I have been pleased with your presentation [referring to **WM**] especially where you talked about connecting the rural farmers here present with ... markets out there ... We have farmers who are stuck with tonnes of round nuts [cf. sub-section **5.3.3**] and do not have a market, what's your advice?

The orientation and exploration process reflected in inter-agency interaction and synergies where partnership between agents was made possible by the Field Day approach. The farmers' practice provided a platform for network and synergies for the agents. In this case the donor agent trained farmers in production using a business model but absent in the training were the real markets to send the products and so he had to consult other agents with marketing expertise. This looks like a case of static [cf. sub-section **2.4.4**; Lotz-Sisitka, 2016], the absence of markets for the farmers' organic products remained constraining and disabling the farmers from moving from 1M to 4D transformation [cf. Plamer, 1977; Kramer, 1997]. On orientation and exploration towards company registration FCS 10, **VC** had this to say:

FCS 10, **VC**: The road towards the marketing of my fruit tree seedlings (dendrology) started with the legal registration process. The trajectory towards attaining the legal registration of our farming activities was long and reflexive starting early 2015 during a Field Day at FCS 3, **LN** who lamented about how the youths at the demonstration site were finding it tough to market their products in towns without the relevant legal papers. I reflected on that [cf. Plate **5.6**] and made several enquiries with friends in the legal community in town where I used to work as a security guard, on how best I could have my activities legally registered.

For FCS 10, **VC** registration of the company was the precursor for market based farming of his dendrology as achieved functionings and as a capability set [fruit tree project] [Plate **6.3** Photo **3**]. The trajectory involved learning from the challenges that the youths faced, FCS 3, **LN** who had problems in marketing and selling his organic products in town. The lessons from those challenges faced by the youths motivated FCS 10, **VC** to register and absent legal challenges, a social conversion factor that could possibly disable his new capability sets.

6.4.2 (Self) Awareness Raising: Research Evidence

Self-awareness raising can lead to eliciting one's own frames for Practice 4, Partnerships and Business Registration. **TM³** had this to say:

For us to start contract farming in a community, we start by assessing some basic physical factors such as soil type, rainfall type, temperatures and these have to suit the type of product that we want to contract the farmer to produce [cf. environmental conversion factors]...We only engage farmers who show evidence of reliable water source so that the crop on contract will not suffer from moisture stress. Nowadays rains are erratic, we cannot contract a farmer who practices rain-fed farming, but one with some sort of irrigation facilities...Long ago farming education to our community-based suppliers, was done by our agronomists who used to extension service the farmers...gave farmers knowledge on when to plant, when to spray, what and which fertilisers to use and how to identify possible diseases that could affect the end product.

TM³ had to start by exploring the major environmental factors within the community that they want for the function of contract farming and as awareness to the farmer on industrial requirements and expectations. These are also the capability commodities [cf. Figure 3.3] and environmental conversion factors that are needed for the conversion to the function of contract farming. The agro-industry also reflected on its current constraints, the absence of agronomists in the agro-industries as constraining the functionings of farmer to farmer extension services for contract farming to be effective. On self-awareness, Village Head² **EM** shared these reflections on the absence of water as a disabler of the community's capability to supply the agro-industries:

EM: In order for this community to be contracted to produce for big agro-industrial markets the village needs constant water supply mechanisms...We have a big dam nearby but it is way down gradient and so the dam only benefits farmers and communities that are further down gradient and not us....The National Water Authority came here and we had a need analysis workshop with them...Our communal area is more on a raised plateau ...it was going to be very difficult and expensive to extract water from the nearby dam as we need a big water pump, communal reservoirs and a pipeline from the dam up gradient into the village.....

The Village Head² was aware of the environmental conversion factors [a dam located down gradient which is supposed to supply water to a community located up gradient] as limitations for his community in terms of contract farming: absence of a constant water supply at community level and absence of household water harvesting techniques [capability commodities Figure 3.3]. The community was aware of a big dam nearby but the water could not easily be extracted to supply the community since the dam is at a lower gradient. The community needs a large electric powered water pump, pipeline and reservoirs in order for the village to realise the achieved functioning of contract farming under irrigation. Such

knowledge was co-created with the water authority of the country during a needs analysis workshop with the village elders and the community in general.

6.4.3. Deframing or Deconstructing: Research Evidence

In terms of deframing or deconstructing for Practice 4, Partnerships and Business Registration, **WM**, a climate change activist had to deframe the notion that things had to be given free to community-based farmers especially when they wanted to operate a business model. She had this to say:

To link you [organic farmers and dendrologists, tree growers], I have with me a green texta-cash card [cf. Plate **5.6** Photos **9** and **11**] which is important for you to have [upon payment of a fee of USD10]. The green card is as good as any other bank cards that many of us possess [name of bank that supplied the cards was removed]. ...You can bank and withdraw money from it...The purpose of the card is for direct linkage between you the farmer and the buyers...All monetary transactions, upon sales...the green texta-card is also good...we will compile a register of organic farmers and other climate smart practitioners into a database. We will use the database for...lobbying for workshop funds, linking buyers and producer. Apart from the bank card...we are working towards a possible tree seedling bank...At the bank they will be cared for until the next planting season.

Apart from deframing the notion that things should always be given for free, the farmers had to buy the green-texta card from the bank through the activism of **WM** who was in possession of the green-texta cards. **WM** also deframed the notion that all leftover tree seedlings would go to waste, and introduced the concept of a tree bank for extra tree seedlings throughout the country to be cared for until the next rainy season. The tree bank was a new concept in climate change adaptation [cf. sub-section **3.4.3** for the in-process concept]. The bank card, like the canned tins and the print-outs from the laboratory tests, all were artefacts that came as a result of my PhD journey.

FCS 10, **VC** also had this to say on deframing the company registration process: “I reflected again with FCS 3, **LN** at the demonstration site on the enquiries that I had done in town [on the issue of company registration] and he further encouraged me to go ahead and register”. In this case story FCS 10, **VC** had to deconstruct the myth that private company registration was a difficult process. FCS 10, **VC** shared with FCS 3, **LN** the information on company registration that he had gathered from friends in the legal fraternity in town. In terms of small company registration, FCS 10, **VC** became an expert and was then being consulted by the other farmers, including the youths, on the trajectory towards company registration as shown below:

FCS 3, **LN**: [during an interview held at FCS 10, **VC**'s homestead during a Field Tour on 25 June 2016] I learnt a lot from FCS 10, **VC** on how he managed to register his activities...He went a step further and managed to legalise his activities and today we are here to learn from him on the road towards business registration...He cleared our fears and anxiety as he managed to clearly explain to us how simple the process is after all...

Deframing in this case also provided knowledge, a social conversion factor needed for the company registration process. This was co-creation, **3L laminated Totalities** as the youths valued the trajectory of their counterpart FCS 10, **VC** towards company registration. This had started with the youths who shared their plight with the other farmers including FCS 10, **VC** on how they had struggled with the absence of legal papers when carrying out their business in town. FCS 3, **LN** appreciated the knowledge on company registration as co-created together with **VC**; to **LN** this was a deconstruction moment as it was much simpler than he had imagined initially.

6.4.4. Co-creating-Joint (Re)Constructing or Reframing: Research Evidence

Co-creating-joint (re)constructing of ideas for Practice 4: Partnerships and Business Registration on reframing, agent **AK**¹ had to deal with dissonance as shown below:

AK¹: Can you elaborate on the issue of contract farming?...What are your expectations? We need to learn it from you together with our farmers...[in response] **TM**³: Why would we risk giving someone a contract [farming contract] who has an unreliable water source? ...Most of our crops fall outside our rain-fed staple-food-crop calendar and that means farmers might have to thrive on harvested water. ...We advise you to go and think of ways of harvesting and harnessing water if you want to be part of our contract farming project... We are always learning in this process, every contract is unique with its own set of challenges. **AK**¹: As a farmer agent, I also want to understand my position in the contract farming scenario ...The farmer enters into a contract with you, and I provide knowledge and expertise to the process, the farmer submits the product to you and s/he gets money and how do I benefit?... I just need some clarification. **TM**³: That is a good question, the extension officer's benefits are long term, some benefits are indirectly realised...Fortunately we view the extension officer as a government employee trusted by the government to help the people learn better farming practices for the development of society.... Having said that, she or he is paid for that. [helping the people learn better the farming practices for the development of society]

While knowledge on contract farming was being shared between the farmers and agro-industry, tensions started to emerge as social conversion factors on the role of the extension services in the new mode of contract farming in communal areas. Such dissonance could disable learning and could thwart the programme as was the case in this community where of

20 potential farmers only two, FCS 3, **LN** and the youths and FCS 4, **SM**², managed to send some crops, as individuals, to agro-industry in 2018, with the community capability disabled [cf. sub-section 3.4.3, a case of inaction; Lotz-Sisitka, 2016, pp. 318-339]. **TM**³ had this to say about other benefits that contract farming could give to extension:

However, if the extension officer is thinking outside the box, then she or he too should ask for a piece of land from government or from her/his local community where s/he can produce own product and develop a demonstration site for the farmers to learn better from him or her. When the farmers will be sending in their products to us, s/he [the extension officer] too will send her or his own products too... An extension officer who works hard in the community, making the people productive and sending products to the market, the market will not ignore the brains behind the good products. ...That is how most agro-companies manage to recruit good agronomists. Different NGOs who are into agro projects will quickly snatch you out of that community, give you a car so that you spread your good knowledge to the entire country.

This marked a shift in the extension service epistemology and ontology from a reality where they viewed themselves as demonstrators of knowledge, to ‘doers’ of the practice. In the new approach extension service provides demonstrations from their own sites and did not demonstrate from the site of a champion farmer. They also needed to demonstrate that they were champions. Such deframing and reconstruction and dissonance was not easy to take from the extension officers. The absence of *incentivisation* to the farmer agent was also noted as an ill in the farmer-industry-contract equation and as a disabler to the farmers’ new capability sets and achieved functioning of contract farming. In this knowledge co-creation exercise, the issue of defaulters was dealt with as described below:

BM: How do you deal with defaulters? **TM**³: We do impose a collective punishment once we encounter a defaulter in your group... If one of you decides to run away with our product or decides to sell the product to other buyers, we recover our costs from the group. It is the group that will deal with the defaulter because the group knows where to locate her or him...The important point is to learn that in contract farming, the contract is signed by a group and not a single individual and so, legally the group is responsible for the behaviour of its individual members.

Knowledge co-created together with the farmers and extension service included how to deal with defaulters but absent was the knowledge on how to deal with the industry when it breaches the contract and the community-based farmers lose in the process. In terms of the issue of role conflict emanating from communication channels, the extension services had this to say:

AK¹: At times in group-work like this, we need to iron out the issue of communication channels...In some projects, the corporate world likes to deal directly

with the farmer and the extension officer gets information from the bottom and at times it might have been distorted. Is it not good for the corporate world to deal with the extension officers and agronomists who will deal with the farmer on the ground? By so doing I can see no conflicts of roles here. **TM³**: [in response]. We are not here to disrupt your relations or your learning structures with your farmers, but we are here to make sure your goals are achievable in harmony with your existing frameworks....We are actually happy that you have accompanied your farmers and have learnt together of our industrial demands...We would not have liked a situation where the farmers were here without you.

Extension was advocating for a top-down approach rather than a bottom-up approach which they felt could create conflicts. Industry learnt from extension service in the same way as extension service learnt from industry and from the farmers themselves. Learning was co-created and reciprocal too. Co-creation of knowledge was also a process of strengthening practices and agency as it was also a form of dissonance and resistance to change of practice. The issue of role conflicts was ironed out through co-creation of knowledge. This was also a time of dealing with dissonance in the group. Apart from just producing the crop, the agro-industry co-created knowledge on the set standards for products that were acceptable at the factory as described below:

CM³: We maintain our international standards (ISO) in the production process and as a result the raw materials that we procure from farmers must be of high quality and of set standards. Before you bring a crop to our industry, you send to us a sample of that crop for our laboratory tests [cf. sub-section **2.4.4** on observed morbidity; Sen, 2002b]. We put the ...crop under observation to examine against ... size, presence of weevils or other after harvest pests, presence of chaff, and evidence of blemishes on the crop itself...For moisture content of the crop, we only accept a product for industrial production if the laboratory test results are at 98% level as a set benchmark for supplying your crop to this company...It is good to remember that we don't just take in whatever ...product a farmer brings in, we look out for quality in the product.

Co-creation of knowledge at this stage was good for the new achieved capability of contract farming and business partnership as each side in the contract had a chance to ask questions before any conflicts at the stage of supply to the industry, were encountered. "When you produce a crop, look out for the things that we have talked about and make sure the crop is dry and with a very low moisture content," as emphasised by **CM³**.

6.4.5. Applying/Experimenting: Research Evidence

Applying/experimenting for Practice 4, FCS 3, **SM¹** had this to say:

We were taught farming business by [G, a donor agent]...Now we start by taking a sample of our produce to the market and if the market favours our product then we

come back to the site and pack the produce in larger quantities...FCS 3, **LN**: Unlike in the old days when we were selling our products to the local market. Today [2017] we enjoy selling to the urban market.

Penetration into the urban market was full of trials and experiments until the youths made a breakthrough. They learnt how to penetrate the urban market from different stakeholders, but it was now time to test all that knowledge by getting into the real market. Breaking into the urban market was difficult, a reflexive, reflective and recursive process as the youths continued experimenting with new market demands.

6.4.6. Reviewing: Research Evidence

Reviewing or assessing for Practice 4 Partnerships and Business Registration, FCS 10, **VC** had this to say:

I then managed to register our citrus tree seedling company with the Zimbabwe Revenue Authority [ZIMRA] under the name [E&V nurseries: Specialists in fruit plants and herbs] at the end of 2015. We managed to get an invoice book and a banking facility [cf. Plate 6.4]... In 2015 we had 16 027 plants [fruit tree seedlings]. ... We sold the trees at varying prices....Trees that we produced from seed such as mangos and avocados, we sold them between USD \$2.50 and \$3.00 and those that we produced through grafting such as oranges and apples, we sold them between USD \$3 and \$5.00 [cf. subsection 5.7.1]...We [as a family] are now happy at last as we can now afford to hire labour and create employment to other youths in the village...

In his review FCS 10, **VC** noted that the new capability set of dendrology [fruit tree production] was an alternative to climate change-prone maize production as well as an achieved functioning for marketing, food security and nutrition and more, job creation. FCS 10, **VC** started as a job seeker in town but later managed to register his own company; now he claims he is a creator of employment for other youths in the community [cf. sub-section 3.4.3, transformation]. In another review, a youth, FCS 3, **OD**, had this to say about transforming to market based farming:

FCS 10, **OD**: I also learnt that farming can be a source of income and it is not always that youths should look for formal employment. When properly organised, farming is good as employer too. I also learnt that time is over when people should rely on rainfed farming but irrigation too...The most interesting part in this farming practice [market mode] is the marketing itself, the way we negotiated with the buyers in an urban market and how the prices changed each day were good lessons for us the young farmers.

Youths learnt how to navigate the harsh market space. FCS 3, **OD** learnt from the practice and now he reflects on job creation as a result of irrigation and market based organic farming

[cf. sub-section 3.4.3 on Actual] when the youths managed to absent the ills of unemployment.

6.5 SOCIAL LEARNING FOR ADAPTIVE PRACTICE 5: DIVERSIFYING AND DEVELOPING ALTERNATIVES

The social learning trajectory that was followed by three apiarists, a dendrologist and an aquaculturalist has been analysed using the six moments of social learning. Each case story has been followed and research evidence provided. On orientation and exploration [cf. sub-section 2.3.1; section 3.2; section 6.1; Wals, 2007, p. 498], for adaptive practice 5, diversifying and developing alternatives such as aquaculture and apiary, FCS 8, **LM**³, an apiarist, explored his new capability set and achieved functionings through learning from others, learning from the donor agency, and learning from private buyers from Harare as he faced challenges from the market. FCS 8, **LM**³ shifted from doing apiary on a subsistence level to a market based achieved functionings as alternative to maize crop farming which of late has been less resilient to droughts and pests. The other apiarist FCS 7, **LM**² explored how his parents used to construct the old apiaries from bark and wood and he learnt new ways of constructing apiaries from the donor community. For the aqua-culturalist FCS 9, **FN**, she explored how she shifted from fish farming as a hobby to more organised farming of tilapia. The dendrologist FCS 11, **JC** reflected on unemployment and saw dendrology as an alternative to maize crop farming and one that could absent unemployment. The research evidence based on the six moments is presented below.

6.5.1 Orientation and Exploration: Research Evidence

On orientation and exploration for adaptive Practice 5, apiarist FCS 3, **LM**³ and aquaculturalist FCS 9, **FN** and the dendrologist FCS 10, **JC** had this to say on orientation and exploration.

FCS 3, **LM**³: Today we specialise in selling honey to a bigger market in Harare. I don't know the name of the company since we deal with a middleman... In return, we buy maize and other foods from the honey proceeds... FCS 9, **FN**: I had the passion [cf. sub-section 2.4.4 on the personal conversion factor] for fish pond farming as I had some tilapia fish before 2015, but I wanted to be recognised in the whole district [Mutasa] [cf. sub-section 5.5.2] as one of the first female farmers to do beekeeping, fisheries and organic farming, at the same time... FCS 10, **JC**: The tree nursery project by the youth had many challenges especially from marketing, I reflected that I needed to start by recognising the market, sign genuine contracts then resume production.

In the exploration process, FCS 3, **LM³** discovered that it was easy to access maize through buying from others while raising money through alternatives to maize crop production. This might look like another breakthrough towards transformation and absencing poverty and food insecurity. Deframing the idea that maize crop farming was the only way to get the staple food maize, was good reflection and enabled FCS 8, **LM³** to venture into apiary as an alternative to drought prone maize crop farming. In the case of FCS 8, **LM³** was able to transform through the actual and being empirical [cf. sub-section 3.4.3; Lotz-Sisitka, 2016] by absencing the ills of food insecurity, a climate change risk from vulnerable maize crop farming, by doing apiary and selling apiary products like honey and wax; then he was able to buy the maize that he needed for his staple food and chicken feed, as well as other basics and to cover the costs of sending his children to school.

6.5.2 (Self) Awareness Raising: Research Evidence

On self-awareness raising, eliciting one's own frames for adaptive Practice 5, diversifying and developing alternatives, FCS 8, **LM³** noted the following:

We observed that nowadays the rain seasons have become tricky [shifting seasons]. This makes maize farming difficult with poor or no harvests at all...we chose to concentrate on apiculture which has always been a family venture but at a very small scale [just a hobby]. We now concentrate on apiary as we get money which we then use to buy maize...I used to work in the local forest industry [name withheld] but I left all that, the remuneration was not good enough [cf. sub-section 5.4.2]... I could not manage to fend for my family and yet with apiculture, in a year, I earn many times more than what I earned when I was formally employed... I wasted time in the formal employment sector, it was not worth the time I spent.

FCS 8, **LM³**, the apiarist reflected on the challenges that he experienced from droughts which culminated in poor maize harvests and from formal employment which did not pay him enough to take care of his family and to buy food. He reflected and compared the old capability set in the family, apiary, which was less costly to run as no fertilisers and seeds and pesticides were needed, no labour for weeding and so, he saw value in this capability set, apiary and so he transformed into a recognised apiarist. His comment, "I wasted time in the formal employment sector, it was not worth the time I spent" illustrates that FCS 8, **LM³** came to the 'I see it!' or 'eureka' moment, [cf. sub-section 2.2.3], via a road to transformation or **4D**. FCS 8, **LM³** realised that his new achieved functionngs and agency absented the impacts of drought, food insecurity and unemployment.

6.5.3. Deframing or Deconstructing: Research Evidence

In terms of the research evidence based on deframing or deconstructing for adaptive Practice 5, diversifying and developing alternatives such as aquaculture, apiary and dendrology, FCS 8, **LM**³ had this to say:

Their pricing system is not good for us the apiary farmers... We sell at (USD) \$2.50/kg ... in 2016 I managed to sell \$120kg (\$300.00). This price is not good for us ... We rely on apiary sales in order for us to buy maize ... our staple food, send our children to school and pay for our medication. ... The buyers [Harare] even said that they want to reduce the price to \$1.25/kg, they are saying the market is flooded there in Harare and so the prices go down. We continue talking to them...[tensions and conflict in the deconstruction process]... But the same Harare buyers are also saying they want 30 tonnes from us... on the other hand they say the market is flooded... Anyway we need more farmers to join us, the more we are the better....As an individual I can just supply 200 kg per harvest, so we want many farmers to join us in apiary... meet the demand on large quantities like the 30 tonnes.

The farmers were challenging the pricing system from the urban market that kept fluctuating. Conflict arose when the same market that claimed to be flooded with honey and honey products was demanding 30 tonnes, a capacity that was too big for the small-scale farmers. The apiary farmers reflected that they could still service the Harare market at a low price as long as they supplied honey in very large quantities and so they reflected that they needed more farmers converting to apiary so as to meet the demand. This is a retrodictive reasoning [cf. sub-section **2.2.7 RRREI(C)**], that is, one cannot imagine feeding the urban market from small quantities without mobilising other apiarists.

6.5.4. Co-creating-Joint (Re)Constructing or Reframing: Research Evidence

On co-creation or joint (re)constructing of ideas for adaptive Practice 5, diversifying and developing alternatives such as aquaculture, apiary and dendrology, FCS 11, **JC** said this about the youths:

I learnt together from and with the youths and other villagers since 2008, on how to produce quality tree seedlings and how to market the trees. ... I was one of the 52 communal members who performed different tasks in the tree seedling project... in Muchena village ... I learnt how to procure the seed, do the potting, seeding, thinning, trimming of roots and disposition of the final product to the market and how to care for leftovers through root-pruning. ... As a participant, I continued to reflect on what exactly I might need in order to start my own gum seedling project [also called commodity or inputs or means]. More I learnt from the youths, on how they struggled with the market from verbal contracts that were not binding. The buyers told them that they were coming ... they don't come until the tree seedlings now by the roadside go to waste ... I reflected on that ... In my new venture I start by signing a binding contract with the buyer then do the product.

Knowledge was co-created amongst the community-based farmers and the market challenges led to more learning. In terms of exotic tree seedlings, the community learnt together with Connex, [forestry extension service], who provided technical expertise on the production and the post-season care. Shared together was the knowledge on contractual agreements and that the government agents were to play a leading role in coordinating the distribution and marketing between the villagers and the tobacco companies, which did not fully happen. The behaviour by the government agents and the donor agents and the buyers in general made dendrology activities amongst the youths remain static [cf. sub-section **3.4.3**] instead of going forward. They liked being dendrologists and they even had the knowledge to produce and care, the inputs (plenty of plastic pots), the capacity to prepare the seed, but still they were disempowered by a market structure that did not want to promote the activities in the youths, by poor market strategies especially through transport constraints. [cf. sub-section **5.6.3**, when the youths lamented: “But each year the goal-posts kept changing”]. Constraints that are rooted in transport and market are noted as two major disablers of the community-based farmers and these have come a long way since the history of commercial farming in the Black Zimbabwean communities as noted in the quotation [cf. sub-section **2.4.6**; Phimister, 1977, p. 261] below:

A native is handicapped to a considerable extent in the sale of his produce; not having as yet adopted any other means of transport than the old fashioned ‘pakamisa’ [i.e. carrying on shoulder or human head], they are obliged to sell ... to traders who make a double profit on the goods.

Without organised transport and a proper market, the community-based farmers cannot fully realise their capabilities and hence have not been able to transform since the early 1900s. Challenges too were a source of knowledge co-creation for the community based farmers as that determined the state of static or transformation. For the aquaculturalist, FCS 9, **FN**, co-creation involved training at a local youth training centre.

We were trained at M youth training centre [cf. sub-section **5.5.1**]... we learnt that for every one male [fish] there must be five females... We feed the fish from chicken droppings.

While there was co-creation of knowledge during training, some of the knowledge needed clarification. Literature claims that chicken droppings are used as fertiliser to fresh water planktons [phytoplankton, usually rich in green algae, also includes diatoms, blue-green algae, and true flagellates] and other plants which are then used to feed fish. While the knowledge is co-created, the knowledge that tilapia feeds on chicken or even pig droppings

might have been misinterpreted [cf. sub-section **3.4.3**, referential detachment]. Absent were other knowledges like that fish recognise those who normally feed them and such knowledge could be good as part of the social conversion factors and for the close relationship between the fish farmer and her products.

6.5.5. Applying/Experimenting: Research Evidence

On applying/experimenting for adaptive Practice 5, diversifying and developing alternatives such as aquaculture, apiary and dendrology FCS 8, **LM**³ had this to say:

We used to sell (honey) to our local market in the village. Even today (2017) we still supply the local market for...400 grams @ \$3.00 to people who are asthmatic and those with heart problems and the general public who just love honey [cf. sub-section **5.4.2**]... The buyers [urban] even said that they want to reduce the price to \$1.25/kg [cf. sub-section **5.7.3**] and this is far below the local price... Most apiary farmers here are not happy with the prices and so they hold onto their product and resort back to selling to the local market instead.

The apiarists have tried to experiment with quantities and prices comparing the local and the urban market. They get more money per small unit measure when they sell to a local market and yet the local market only takes very small quantities compared to the bulky urban buyers who buy at suppressed prices. But once the farmers feel short-changed they claimed that they hold on to their products and sell to the local market [cf. sub-section **3.4.3**, static and not transformation].

6.6 REVIEWING

Reviewing or assessing for adaptive Practice 5, diversifying and developing alternatives such as aquaculture, apiary and dendrology, FCS 11, **JC** the dendrologist had this to share:

The knowledge [on dendrology] that I gained from... Muchena village helped me to move into the new business...without much hurdles. I learnt most of the pitfalls [tensions] that we faced...and these, I had to address [absenting] such as provision of water supply, a good road, the plastic pots, the seed, labour and and how to remunerate such type of part-time labour, working on markets and signing of contracts...

In this review FCS 11, **JC** noted a winding trajectory that was marked by learning through experience of constraints that led the youths to drop from a possible transformation in dendrology despite most of the commodity inputs in place, back to non-being in 2012 [cf. Figure **7.1**, the downward arrow on the MELD schema]. From **TM**¹ a review of the training was done in the community of study in 2012:

... we cannot just produce trees to replenish the ... environments, you have to benefit economically [cf. section **1.1**; sub-section **6.1.3**, on three pillars of ESD]... You can survive on tree production,...sales of timber, ...seedlings, fruits for your nutrition or you can keep bees for honey... that we [Government agency] can help you to market... In whatever you do, aim for quality products. ... What draws us back is the issue of contractual agreements... You might not be familiar with contracts, these are the legal documents that you sign upon agreeing that you will supply so many tree seedlings of such quality and on such a date....We therefore need to work hard so that we meet the demands of the market and those of the contracts... you plant at the same time, maintain the same quality... send the number of your tree seedlings to a central point, ... will give our Forestry offices the total number of tree seedlings from this village. Our office then coordinates with the tobacco companies so that the tree seedlings are collected as one bulk consignment from this village. Each of you will be paid according to the number you would have supplied.

The government agent on training of tree seedling production emphasised the co-creation of knowledge. The community in a FGD outlined the advantages of trees and these were written on a flip chart. The agro-extension educationist then presented on the quality of tree seedlings that were good for the market. **TM¹** shared with the community information on the potential markets and contracts. **TM¹** tried his best and songs were even compiled in his name by the community, sung in praise of his knowledge. However, despite all this theoretical knowledge shared in 2012, the community produced thousands of trees which they failed to market with the government and other donor agents delaying with transport provision until the tree seedlings ultimately became a loss [cf. sub-section **5.6.3**].

6.6 CONCLUSION

This chapter analysed the social learning processes in the farmers' adaptive practices in climate response to risks and vulnerabilities using the six sequential moments of social learning as the analytical framework within the community of practice model which was benchmarked by activities during the Before Harvest Field Demonstrations [Field Days] and Field Tours. The chapter has identified five adaptive practices each addressing the research questions on social learning as outlined in section **6.0**. FCS 1, **VS** reflected and explored on new ways of farming, fertility trenches that enrich the soils whilst conserving moisture, observing a series of poor maize crop harvests before 2012. FCS 1, **VS** experimented with the new practice and it worked as her maize yields increased from zero tonnes before 2012 to an estimated four tonnes in 2017. FCS 2, **BC** explored his current practice [conservation farming through conservation basins or and composts] and how it had been influenced by winds of change. The orientation and exploration of FCS 3 [the youths] involved reflecting as a youth

group and as individuals on the old rain-fed farming which was now constrained by climate change and poor soil fertility. Case story 3 deconstructed the perception that they could not farm throughout the year by harvesting water from a small stream for irrigation. The youths co-created knowledge on syphoning and inverted bottle irrigation together with other communities in Zimbabwe through interacting by means of videos. The youths' review revealed that with liquid manure the crop yields were higher and better in terms of quantity and size, than when they used compost, conservation basins with dung and fertility trenches. In terms of apiary, the two apiarists FCS 7, **LM**² and FCS 8, **LM**³ reflected on and explored the disadvantages linked to old apiaries were constructed from bark. Upon reflection and co-creation, they adopted the new Kenyan horizontal [key or T] bar. The two apiarists also reflected on (self) awareness that with climate change, rain-fed crop farming was no longer the best option and so they reflected on the alternative of apiary. FCS 7, **LM**² and FCS 8, **LM**³ also experimented with two markets, the local and the national. The two reviewed that the local market paid higher than the national market but only for small quantities while the urban market paid lower per kilogram but demanded the products in very large quantities, up to 30 tonnes [economies of scale]. FCS 9, **FN**, another apiarist and aquaculturalist, co-created knowledge on her practices through training in Mutare and Harare and reflected on the benefits and thus she transformed. FCS 9, **FN** co-created knowledge in a communities of practice on apiary through Field Days. The orientation and exploration for FCS 10, **VC** and FCS 11, **JC** on dendrology included reflections on the community tree seedling projects of 2008-2012. The tree seedling projects were constrained by marketing, diseases and transport. Learning in all the case stories was non-linear, reflexive, reflective and recursive. However the use of the six sequential moments of Wals was used at a broad level. As can be seen from the data, use of such a framework is heuristic rather than ontologically congruent.

CHAPTER SEVEN

ANALYSIS ON THE GENERATIVE MECHANISMS SHAPING SOCIAL LEARNING AND THE CONVERSION OF RESOURCES INTO NEW FUNCTIONINGS AND CAPABILITIES ASSOCIATED WITH ADAPTIVE FARMING PRACTICES

7.1 INTRODUCTION

This chapter addressed the last research question [cf. sub-section 1.6.1], using Bhaskar's MELD onto-axiological chain. The MELD schema, an analytical tool in sub-section 3.4.3 and in Figure 3.6, comprises four degrees stadia or a measure of length [cf. sub-section 1.7.4, cf. Hartwig, 2007, pp. 295-296], from 1M to 4D. Figure 7.1 below shows the MELD Schema which combines dialectical critical realism, capabilities theory and the social learning process.

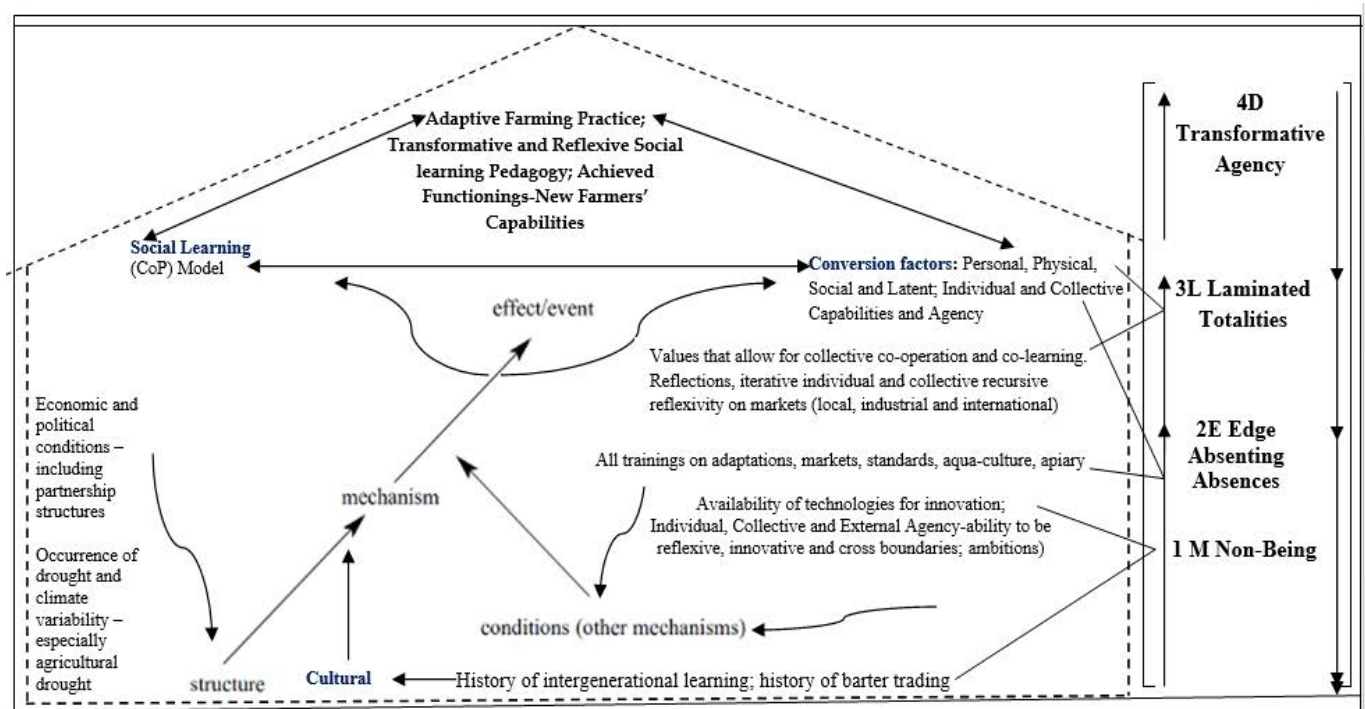


Figure 7.1: The MELD Schema [Axiological framework] for transformation

From Figure 7.1 each of the four moments (1M-4D) are illustrated in conjunction with evidence based on the capabilities theory and the social learning process. To identify

generative mechanisms at 1M, events and experiences that constitute the three overlapping domains that of the real, the actual, and the empirical, are illustrated. The three overlapping domains look at what is present and what is absent, what should change and who should change, what change is good and what enables and constraints change (Schudel, 2020). Figure 7.1 thus shows that intergenerational learning, cultural factors, the socio-economic and political structures, and events like the occurrence of climate induced droughts, and the availability of small-scale farming innovations and technologies, existed as the causal powers of things at 1M. Drought, an event of climate change, also shown in Figure 7.1, triggered aqua-culture, apiary, dendrology and market based farming as adaptations. But, socio-economic, cultural and political structures are the underlying reasons which the farmers could not observe or experience using human senses, but often constrained and enabled their (farmers') adaptive practices. 1M marks the foundation for 2E. At 2E, begins the process of change through absencing and presencing that is looking at what is yet to be realised and what possibilities could be mobilised for the ills noted at 1M to be addressed (ibid). At 2E this was achieved through trainings in; apiary, aqua-culture, dendrology and market oriented farming practices. 3L denotes laminated totalities (Lotz-Sisitka, 2016) meaning there are many ways or compromises of doing things (Schudel, 2020) in the choices that farmers make and have in order to change the way they view and engage absences at 2E.

From Figure 7.1 3L, also referred to as axiological or values oriented, reflects the dialectical possibility of values shaping praxis, emerging from the values perspectives or interpretations of the researcher and that of the research participants from the different trainings and awareness campaigns through Field days. 3L also looks at values that allow for collective co-operation and co-learning, reflection and iterative individual and collective recursive reflexivity on markets as well as the production of new philosophical accounts of reason, rationally and practical wisdom (Lotz-Sisitka, 2016) like having alternatives to maize crop farming in order to access maize through raising income from alternatives to buy maize, a staple food. 3L totality also involves taking two or more things together (reflexivity) or as a whole via consideration of internal relations" (Bhaskar, 2016, p. 129) like practicing apiary alongside organic farming practices that absents use of heavy chemicals which harm the soil and kill the bees. At 4D in Figure 7.1, transformative praxis that is practically possible and morally defensible actions in the context of farmers' climate change adaptations, is illustrated. 4D is thus the moment of deciding what to do and of knowing how to do so in

terms of the farmers' climate change adaptation (Schudel, 2020). This encompasses new achieved functionings like apiary, aqua-culture, dendrology and market oriented gardening.

7.2.1. IM concerned with Non-Identity, Stratification, Multiplicity, Depth [knowledge of what is and what isn't]

From Figure 7.1, **1M** [Non-being] encompassed the existing structures that included government policies on food production in response to climate change, socio-cultural conditions [inter-generational knowledge transfer], historical, economic, political conditions as well as partnership structures as noted above. **1M** also entails the availability of technologies for innovation and the individual and collective agency that is the ability to be reflexive and to be innovative. These have been identified in the studied categories: crop and non-crop farming, market and non-market mode of production and in rain-fed and irrigation farming as follows:

➤ Government policy: Research Evidence

On government policies FCS 10, **VC** [cf. subsections **5.2.1**] had this to say:

Government policies such as the shift towards provision of free seed and fertilisers after independence, meant that people had to practise farming using the same seed variety in the same region and the same village.

What exists is the policy on the provision of free inputs (seed and fertilisers). Apart from government policy on existing modes of food production, researchers also played a role in changing the maize crop production landscape as noted by FCS 10, **VC** [cf. sub-section **5.2.1**].

We understand research came up with the new seed varieties that adapt to the short rain season and frequent droughts... The problem that was discovered... was that they were quickly attacked by weevils ... before you even harvest the crop.

The identified constraint or ills brought up by research, on the new seed variety that was less resilient to pests like weevils and this was absented at **2E** through alternatives to maize crop farming mechanisms and through the re-introduction of the OPV under small-scale irrigation and in gardens.

➤ Climate change and occurrence of agricultural drought: Research Evidence

FCS 2, **BC** valued farming his traditional OPV maize seed variety, but his OPV farming activities were restricted to wetland gardening because of climate change induced droughts.

Compared to the current short season maize seed varieties that are recommended by research and distributed for free by government, FCS 2, **BC** still values his traditional OPV maize seed variety which he thought produced a better maize meal, but absent, was water for irrigation and the water harvesting techniques for him to practise the farming of a maize seed of his choice in his main maize crop field:

Today onset rains have shifted, creating a shorter season which can no longer support our traditional maize crop which needed more time to mature [sub-section, **5.2.1**]... But we still practise our traditional maize crop [OPV] [cf. sub-section **5.2.1**] under rainfed agriculture, but mainly in our gardens ... since they [OPV] need a longer time [a long season maize seed variety] to mature...but away from the conventional seed varieties.

FCS 2, **BC** still values his open pollinated variety [OPV] but absent is the means to water this long season maize seed variety and so he has resorted to planting it in gardens which are commonly found in this study area, in wetlands [conflict from wetland conservationists]. To absent cross pollination and the risks of losing out the treasured OPV, FCS 2, **BC** removed the OPV crop from the main open field where he was farming the conventional short season variety. Absent were the means to enable the cropping of OPV in the main crop field, water supply. On what is and what is not at **1M**, FCS 1, **VS** also reflected on poor harvests before 2012.

Before the year 2012 my maize crop farming was rain-fed, [but the rains were erratic and the agriculture seasons were characterised by frequent droughts since the year 2000] without...natural manure...[sub-section **5.2.1**]...My maize harvest could hardly fill up a small dish *chibage chekukanga maputi*... [translated as a harvest that was suffice to produce a few small packets of popcorn as she could hardly produce a 20kg mealie-meal bag for her staple food]... I kept wondering how best I could shift from such a situation.....

At **1M** what existed at FCS 1, **VS** was food insecurity. Absent was a sustainable farming practice and also absent in her crop field was soil fertility or mechanisms for soil enrichment such as artificial fertilisers or even natural manure. In terms of droughts as what existed at **1M**: FCS 10, **VC** said:

Through observing the shifting rainfall patterns in the 1980s when we experienced major droughts in the country, it was no longer reasonable to use the long season varieties, OPV...[sub-section **5.2.1**; sub-section **6.2.1**]. The shifting seasons ... forced us to ... adapt to new seed varieties. Seed houses in the country therefore introduced short season varieties to cater for the reduced rainfall season.

Absent in FCS 10, **VC**'s observations on droughts were alternatives to adapt and mechanisms to resuscitate the long season maize crop seed variety under the current dry conditions (i.e. water harvesting). On droughts as **1M** FCS 3, **MM** said:

Before 2012 we could hardly harvest [the period was also characterised by climate change induced droughts] any meaningful maize crop [cf. Plate **5.3** and Plate **5.9**] showing the situation in 2007]. ... It was basically 'white sandy' infertile ... it was non-productive for maize cropping but good for non-cropping production.

Having noted what was [**1M**], in terms of poor soils and droughts, mechanisms were absent for soil fertility enhancement to enable maize crop farming so as to realise better maize crop harvests. Absent also were the water harvesting mechanisms for perennial production of crops and these were absented at **2E**.

➤ **Cultural history of barter trading: Research Evidence**

Historically the Shonas had a history of barter trade [cf. Palmer and Parsons, 1977] and this was noted by FCS 2, **BC**: "We never sold the traditional seed crop [OPV], but barter trading where we could exchange with other products within the village". Absent in barter trading were monetary transactions which was vital for the exchange for other commodities and services. Barter trading also had to be absented for the capability functioning of food security and health and nutrition at **2E**. Apiarist FCS 7, **LM**² also sometimes exchanged honey for other products:

I see it as a better option [selling honey products to an urban market] than selling to our local market where at times prices are always negotiated downwards or at times the product is often exchanged with other products where money is scarce [barter]. On barter and aquaculture, FCS 9, **FN** said, "I have not really started selling my fish harvest but I share one or two with my neighbours, yes.....we exchange fish with other goods [barter] [cf. sub-section **5.5.1**].

While barter still exists in the community, absent is monetary exchange, especially problematic when the farmer wants to buy other goods and services.

➤ **Cultural history of intergenerational learning: Research Evidence**

On **1M**, intergenerational knowledge transfer was noted to be existing in this study. FCS 3, **LN** said:

We learnt from elders like FCS 2, **BC** that this type of maize crop is similar to the then SR52 and requires a lot of water [cf. sub-section **5.2.1**; sub-section **3.4.3** on transfactuality], long season variety. On how to treat traditional maize seed variety OPV against after harvest pests, FCS 2, **BC** said, "To prevent weevils [attacking the

stored seed crop], we normally hang the seed maize ... in the kitchen where there is soot [traditional knowledge] and whenever we do that the seed is not attacked by weevils at all [induction-observations and abductive over a long time]. More, on traditional knowledge and innovations, FCS 6, **JM**² [cf. subsection 5.3.2; De Sousa Santos, 2007] had this to say: “in winter of 2016 we burnt sawdust throughout the night ... smoke drives away frost from my tomato crop.

The traditional knowledge system could be tested scientifically when the burning sawdust created a warm micro-climate and created a temperature inversion with warmer temperatures at ground level while cooler temperatures were above ground and such a scenario might not look good for frost occurrence. While the intergenerational knowledge transfer was noted to be existing [**1M**] within the farmers, absent were ways of bulky post-harvest maize storage. On learning through collective agency and dissonance, through culture as a constraint to people’s choice of crops to be planted FCS 2, **BC** said, “*Rapoko* yes, traditional rice yes, sweet potatoes, yes, we used to have all those here but never mhunga, a millet variety... [cf. sub-section 5.2.1]. ‘That one is prohibited in this village and district as it is believed to be a wish for droughts.’”

Existing culture could be a social conversion factor that could enable or disable the farmers’ adaptive practices. In this case while the government and development partners were advocating for small grains like millet, culturally millet is unpopular in the village of study. Thus while some farmers might have valued the production of this type of small grain crop, culturally they were constrained. Millet is also good for organic chickens’ stock feeds and yet within the village of study the production of that type of small grain crop is prohibited. On traditional maize seed [OPV] making process, FCS 3, **LN** said, “We also learnt from elders [intergenerational] how to prepare seed maize (OPV) ... by removing the tip and the bottom of the maize cob.”

➤ **Availability of technologies for innovation: Research Evidence**

On current farming practice [**1M**] with water harvesting innovations, FCS 3, **LN** the youth and FCS 1, **VS** noted:

Luckily in this demonstration site, we have ‘irrigation’ facility and liquid manure as new innovations [cf. sub-section 5.2.1]. ... We plant our OPV [traditional maize seed and a long season variety] during the dry period of September and we harvest it by March after five months... On her current innovation FCS 1, **VS** said, ‘..In this new practice [fertility trenches], I dig trenches as you can see and bury all the maize stalks. I also collect humus and grass from the forests... bury them too... These rot, provide manure and retain moisture for my crops... [cf. sub-section 5.2.1] [cf. sub-section 5.2.1]

Identified at **1M** also, were two micro-irrigation mechanisms under flood irrigation from small stream and fertility trenches where buried maize cobs' spongy characteristics retain water in the soil. Absent at **1M** from FCS 1, **VS**'s innovation was a sustainable water supply or a sustainable water harvesting technique. Other existing innovations included the divergent furrows by FCS 5, **SS** who had this to say:

To enable this irrigation mode [flood irrigation from a diversion furrow]...there is a perennial stream that flows through my homestead...My father reflected on how best we could utilise this water...through diversion furrows, in the late 1990s. [cf. sub-section **5.2.3**]

What existed is the stream that had flowed past his homestead for many years and what was absent was the knowledge to convert it to the function of diversion furrow and flood irrigation. FCS 5, **SS** used the bucket system to water his crops from the water pond and reservoir where he conserves water brought in by his diversion furrow, and that was time consuming and less effective, a constraint. This had to be absented at **2E**. On the orientation to the existing bottle-drip irrigation, FCS 3, **JM**¹ had this to say at **1M** experiencing a temporary drought:

We were stuck with a quarter hectare of tomato crop in the field [cf. sub-section **6.2.1**]...We had to reflect on other ways of irrigation apart from syphoning and flooding until we replaced the water pump ...The inverted bottle drip irrigation was an innovation that we learnt from a video...where it was used by a small-scale tobacco farmer.

What existed was a temporary drought and absented the observed temporary drought at **2E** was enabled by the new innovation of the inverted bottle drip irrigation. The youth experimented with these as temporary measures. In their experiment, each inverted bottle did not last more than a week and so the youths had to absent this new innovation again and use a fuel powered water pump at **2E**.

➤ **Values that allow for collective co-operation and co-learning**

At **1M**, values for co-learning were also enabled by the shifting seasons [climate change] where one man could not come up with all solutions, but collective effort and agency, government policies and research all needed to be included. FCS 10, **VC** had this to say:

Before 1980 short season variety crops could not survive [cf. sub-section **5.2.1**]...in this village...these would mature in the mid-rain-season thereby giving farmers harvesting and storage challenges...Seasons are changing and country policies also change and all these make the farmers change so as to move with time and seasons...

Seed houses in the country therefore introduced short season varieties to cater for the reduced rainfall season....

Noted at **1M** was drought and government policies and research coming in place at **2E** to absent the impact of drought. Absent at **1M**, were alternatives to either long-term or short-term maize varieties which were less resilient to a changing climate. Thus absent was collective education on water harvesting techniques.

➤ **Availability of alternatives to crop farming: Apiculture (Beekeeping)**

FCS 7, **LM**² [on what is and what is not or non-being-**1M**] had this to say on apiary farming as his new capability set and achieved functionings:

Apiary has been a family hobby for ages [sub-section **5.4.2**], I continued with apiary as a hobby though...The old apiaries [bee-hives] that we inherited were made from bark and then we later used gumwood planks to come up with mere boxes as the hives.' Other existing functions for apiaries that were found at **1M** were noted by FCS 8, **LM**³ as '...At the next village (D) there is a farmer (C) who has 256 fully swarmed beehives and he hires them out to apple tree farmers in (N) area to pollinate the fruit trees [cf. sub-section **5.4.1**] ...The bees do their work in collecting their loads from the apple trees and so the farmers benefit from an improved fruit harvest... The apiary farmer can also continue to harvest his/her honey ...the bees are also being paid for the work done....

Apiculture existed at **1M** as a hobby but absent was apiculture as a business function. Also absent at **1M** were other functions of apiaries such as hiring out by the farmers under study as a new capability set and achieved functionings. Absent also at **1M** were the new type of apiaries, the Kenyan-T-Bar, which was later absented at **2E** after trainings. This too was absented at **2E**.

➤ **Availability of alternatives to crop farming: Aquaculture**

FCS 9, **FN** reflected on the existing new capability set and achieved functionings of aquaculture that she started in 2015 [cf. sub-section **5.5.1**], on what it was she did as aquaculture and what was absent:

Rainfall is tricky nowadays and you need to have another farming type where you can get money in order to buy maize once there is a drought...In the 2014-2015 the rains came a bit late [cf. sub-section **5.5.1**]...the agriculture season has elapsed and so I reflected on...fish pond farming...In my aquaculture fishpond farming project the mode...is just subsistence as we so far produce for the family...

Droughts and erratic rains were found to be existing at **1M**. These prompted the new adaptation to aquaculture. Absent was aquaculture as a business as it was regarded as a hobby

and yet FCS 9, **FN** wanted an alternative to maize crop farming that could be used to buy maize, her staple food.

➤ **Availability of alternatives to crop farming: Dendrology**

On the existing functioning of dendrology, FCS 10, **VC** had this to say:

The introduction of exotic trees in this province has a painful history [cf. sub-section **5.6.1**]....Our people therefore feared to plant gum or pine trees at their homesteads saying, ‘Once the White man sees that your place is good for exotic trees then your land will be taken’ [confiscated]

The absence of tree planting in the village was thus partly the result of the historical political structure of the land and this conflict and absence had to be absented at **2E**.

7.2.2 2E (second edge) concerned with Absence and Negativity (knowledge of what could be done differently (knowledge of what could be))

From Figure **7.1**, **2E**, Edge denoted values that allow for collective co-operation and co-learning. This includes reflections, iterative, individual and collective recursive reflexivity on markets and innovations. The core meaning of dialectic has to do with change, argument and/or the ‘axiology of freedom’ [cf. sub-section **2.2.2**]. Research evidence at **2E** are shown below:

➤ **Personal and collective agency on absenting rain-fed farming practice: Ability to be reflexive and innovative**

FCS 3, **MM** the youth on collective reflection as the first step in absenting food security and adaptation to climate change by considering organic farming, said:

We further reflected with our Granny...advised us that we start with small grain [cf. sub-sections, **5.2.1** and **6.1.1**]... People ask questions on our practice ...and at times we failed to address the questions ...to experiment and change on the practice...But we do not walk this journey alone as youths, ...the local primary school, the extension service, donor agents and the community at large, through Field Days...[On absenting food security and income for a hammer milling exercise, FCS 3, **BD** spoke about the knowledge co-created with Granny],...I also learnt a lot from my grandmother especially how to grind the small grains into a mealie-meal...Today (2017) ...I cannot starve because I don’t have money to pay for hammer millers to process my small grains, I do it by myself.’ [cf. sub-section **5.2.4**]

To absent food insecurity, poor soil fertility and climate change induced drought at **2E**, the youths moved into organic farming and started with small grains, rapoko, which were said to

enrich soils by absencing synthetic fertilisers. Moreover, absent from granny's knowledge was other knowledges on soil enrichment apart from *rapoko*. Soil infertility was later absented through conservation basins, mulch, compost and application of liquid manure and rotation of crops. At **2E** where collective agency and reflexivity to absent food security and climate change induced droughts, played a part, FCS 4, **SM²** said:

I started by attending Field Days... at the communal demonstration site [sub-section **5.3.2**]...back these videos at home and reflected on the learnt practice. I discussed this with my family and extended family in the diaspora,.....through the internet....., we ...agreed to embark on a similar project like the one at the youths' demonstration site, but using a different type of water reservoir...a plastic tank.

The trajectory at **2E** absencing subsistence farming and moving towards market gardening for FCS 4, **SM²** was a reflexive and recursive process which included use of technology as videos from the demonstration site were shared with relatives in the diaspora who upon further reflection funded a 5000 litre plastic tank and a fuel powered water pump before FCS 4, **SM²** realised transformation from rain-fed to market based irrigation gardening. Regarding the trajectory to absent food insecurity and droughts [in-field water harvesting techniques], FCS 1, **VS** said:

After struggling with poor harvests for some time [absence of food security], I heard of a Field Day... at *Gogo Hildah's* place where the use of fertility trenches was being show-cased. There, I learnt of the new practice, digging trenches. [cf. sub-section **5.2.2**].

To absent the impacts of drought and food insecurity at **2E**, FCS 1, **VS** had to attend a Field Day which included a demonstration on the use of fertility trenches. She accepted the new capability but with modifications. Instead of using maize stalks, as was demonstrated by Gogo Hildah, FCS 1, **VS** had to collect humus from forests to begin and later used maize stalks after realising a series of good harvests from the new capability function. Regarding absencing the impact of droughts and moisture loss, FCS 10, **VC** said this on conservation farming:

Nowadays we do conservation farming where cow dung manure is concentrated in a single hole [cf. sub-section **5.2.1**]...unlike the old methods where manure were spread on top of the crop...We also learnt from extension service to reuse the same hole several times since it has enough nutrients.

The conservation basin was applied to absent temporary drought since they retain moisture longer than bare ground would do. Conservation basins also absented soil infertility since it is filled with cow dung. The innovation also absences poor harvest. FCS 10, **VS** noted co-

creation with extension and self-reflexivity on droughts in order to accept the new innovation. FCS 2, **BC** on **2E**, absented the impact of droughts and the old traditional seeds, OPV from the main crop field had this to say:

We have been taken by the winds of change [cf. sub-section **6.1.1**], we left our old practice and have been taught... to plant the modern seed varieties.

At **2E**, FCS 2, **BC** has been sharing ideas collectively with extension services to absent droughts by adapting to short term maize seed varieties and abandoning the long season seed variety OPV that he had traditionally been planting. For in-field water harvesting FCS 2, **BC** adapted to conservation farming where conservation basins were used to conserve moisture and absent soil infertility. At **2E**, FCS 6, **JM²** absented rain-fed farming and poor knowledge on irrigation:

I also learnt about irrigation farming through informal learning from television and radio programmes...[cf. sub-section **5.3.2**]...These, at times dwelt a lot on irrigation farming [centre pivot]...I also learnt about the need for irrigation through the donor trainings on Farming Business...and we came up with the idea of a solar powered system to supply ten plastic tanks...So I can say climate change and harsh economic challenges...also taught me to think on new ways of farming including irrigation so as to raise income...

At **2E**, learning to absent rain-fed farming through irrigation was a collective and recursive effort that involved non-formal education through media, Field Tours and collective reflection on climate change together with family. The harsh economic hardship the country faced and the need to absent formal employment meant that FCS 6, **JM²**, had to shift to a market based farming mode. At **2E** FCS 3, **MM** on dissonance, conflict and conformity to set standards as learnt through the practice, had this to say:

We accepted to be corrected and once we correct the noted mistakes then we recall the group...to show our appreciation of the corrected problem [cf. sub-section, **5.3.2**]... FCS 1, **VS** who had noted the absence of mulch in our crops...We later invited her in 2017 to showcase the practice of mulch and fertility trenches that we had learnt from her.

For a monitoring exercise, the youths had to recall FCS 1, **VS** who had demonstrated on mulch, so that she could certify that the innovation learnt had been applied properly. Thus at **2E** the youths had to deal positively with the reframing, reconstruction and dissonance, instead of remaining static in their old practices.

➤ **Personal and collective agency on absenting the old apiaries**

At **2E**, FCS 7, **LM²** the apiarist had this to say on absenting the old apiaries:

I thank the donor community...for training us and encouraging the top-Kenyan bar that is what we are using as new technology in bee-hive making [cf. sub-section 5.4.1]... has... advantages as compared to the old, ...the new provides demarcations for the bees to [colonise] operate from,... I have noted several reasons why bees seem to be scarce nowadays in this village, veld fires... don't have enough wax... Also drought, the rains were not evenly distributed...

While FCS 7, **LM**² learnt of the new type of apiaries, the Kenyan horizontal bar from the donor agency, he adapted and so he valued doing the new capability function. But, missing is the training on how to attract swarms since most of his apiaries were still empty. Skills such as buying swarms, collecting swarms and creating and buying of queen bees in order to swarm his empty apiaries, were all absent [cf. sub-section, 5.4.2 ; Cramp, 2008]. On **2E** the apiarist FCS 9, **FN** said:

I started beekeeping in 2015 after having realised that maize cropping was being affected by droughts and I had to look around for other alternatives [cf. sub-section 5.3.3]. I found apiary and fishpond farming being better alternatives...I was later trained in...I have 20 apiaries...We were taught that bees are like a donor, they supply you with everything ...We were taught....not to be afraid of bees they are like your brother or sister in law...

Thus **2E** trainings helped FCS 9, **FN** establish herself as an apiarist while absenting maize crop farming that had recently been prone to the risks of climate change induced droughts. While the trainings absented the old apiaries and the myth that women cannot be good beekeepers, still to be absented was how to separate and capture queen bees in order to swarm empty hives or how to capture a swarm [cf. sub-section, 5.4.2; Cramp, 2008]. The apiarists complained of empty hives and they blamed veld fires for the absence of bees from some of their apiaries.

➤ **Personal and collective agency on absenting aquaculture practice**

As for **2E** FCS 9, **FN** on aquaculture as an alternative to maize crop farming said on personal and collective agency on aquaculture:

The local MP paid for our aquaculture training, ... in 2015. Five women were assisted in this training [cf. sub-section, 5.5.1]....We learnt...fishpond farming...We feed the fish [Tilapia] ... chicken droppings ...I was also motivated...I said to myself, if people in Beitbridge [a much drier region] are keeping fish, why I can't do it here, a region with plenty of streams and ponds?

To absent maize crop farming, FCS 9, **FN** embarked on aquaculture, the knowledge of which was co-created during training. The co-creation process that led to absenting maize crop farming with aquaculture was enabled through watching videos of aquaculturalists in much

drier provinces of the country and this was good motivation for the farmer to consider the new innovation. The training was also paid for by the local politician and this was a social conversion factor for the conversion to the new capability set of aquaculture. On personal and collective agency, in order to embark on aquaculture as an alternative to crop farming and not as a hobby, FCS 9, **FN** said she was motivated by seeing a video where people from a drier region in the country were actually keeping fish. Thus absencing absence at 2E was non-linear but could take different dimensions.

➤ **Personal and collective agency on absencing poor health**

On individual and collective agency in absencing poor health [capability] and poor nutrition [capability], the community-based farmers appreciated learning of healthy farming through the Field Days as **VM**, **TM**², **LM**³ and **FN** had this to say on health as a capability:

VM: I have collected some garlic bulbs [cf. section 5.3.1]...Garlic helps reduce my cardiac problems and reduces my high blood pressure to acceptable grade levels... last time there was *Rapoko*...,which is also nutritious and good for our health.... **TM**²...We like practising organic farming ...The product is healthy to our bodies... Look, even small children complain of painful swollen legs....but we suspect it is associated with the foods that we eat which are contaminated with chemicals and synthetic fertilisers [cf. sub-section 5.3.5]...FCS 8, **LM**³...Even today (2017) we still supply the local market...people who are asthmatic and those with heart problems and the general public who just love honey [cf. sub-sections 5.4.2 and 6.10.5]. FCS 9, **FN**: We learnt from training that fish as white meat is good for people's health...conditions no longer allow them to eat red meat, fish is good for them...[cf. sub-section 5.5.2].

The capability for health and that of nutrition [cf. Sen, 1993] was appreciated by the community based farmers as indicated above. The farmers managed to link the different products of fish, garlic, *rapoko* and honey, with their health status [cf. sub-section 2.4.4 on self-perceived morbidity and subsection 2.2.9 on inductive reasoning].

➤ **Personal and collective agency on absencing marketing practice**

On absencing ills from and on the markets FCS 3, **LN** said,

I also learnt to change our practice from the market itself, ... through... a series of rejections of our products from the market [cf. sub-section 5.3.2] ... More problems could be noted and we continued correcting and so that is how we learnt this new way of doing farming, market mode...The changing climate was also a big teacher as we had to adapt to the shifting seasons...

Through a series of rejections from the market, the youths learnt how to change their practice to meet the market standards. Each product brought up new knowledge through conflicts, dissonance and corrections were used to absent poor marketing practice. The market though

provided dissonance as products were rejected for various weaknesses, the youths accepted the complaints and absented the product defects by reflecting back on the knowledge of liquid manure use. This resulted in bigger and better products that were acceptable at the market. The changing climate at 1M resulted in absenting rain-fed farming through reflections on different types of irrigation, flood and the inverted bottle drip [cf. sub-section 6.2.4]. According to FCS 3, **LN**, collective agency as absenting markets was practiced through trainings. Collective agency, often ended up withn conflicts from the type of education shared with extension service and donor agencies:

At times we get education on farming business...but we do not get the knowledge on the markets where to send our products and how to enter into such markets [cf. sub-section 5.3.3]...The communal farmers wasted time on a crop that never brought in any returns ...Since they had abandoned their staple food crop [maize] expecting some cash [to buy maize] from the garlic crop, cash that never came by...communal farmers were left with many tonnes...of round nuts after being trained into that, but did not get the knowledge on markets....

By adapting to alternative crops to maize crop farming [garlic, bananas, apiculture, aquaculture, dendrology, horticulture, *rapoko*, ground nuts], the farmers hoped to dispose of these for cash to buy maize, their staple food. So, knowledge of markets become a central capability set for the new livelihood functionings, for food security and for climate change adaptation as shown by FCS, **LN** above. Collective education and agency seemed to have brought up tensions as at times, it ended up impoverishing the communal farmers who upon being introduced to cash crop farming, often abandoned their staple food cropping, maize, but never got the cash in return. In the absence of a market to sell their crops, the community based farmers were often financially worse off than before and were often left exposed to the risk of food insecurity. On absenting marketing practices, at **2E** the farmers learnt from tensions from the market itself as well as learning from colleagues as shown below:

FCS 7, **LM**²: Urban market does not just buy any product they look at the quality first...[cf. sub-section 5.4.2]...But, the rejection help in teaching us where we might be lacking especially in terms of standards that are demanded... and the quality of honey they demand. That made us improve...On quality production and contracts **TM**¹ emphasised: In whatever you do, aim for quality products [cf. sub-section 6.6]. What draws us back is the issue of contractual agreements...We therefore need to work hard so that we meet the demands of the market and those of the contracts...On production upon signing contract, FCS 10, **JC**...The tree nursery project by the youth had many challenges especially from marketing...I reflected...I needed to start by recognising the market, sign genuine contracts then resume production [cf. sub-sections 6.5.1].

The educational knowledge on markets, a social conversion factor, is not always learnt from books but also through dissonance when the market rejects products on account of poor standards. FCS 7, **LM**² thus learnt through conflict and dissonance as his honey was often rejected by the market. He did not give up but had to conform to the standards. The issue of markets is historically rooted as far back as 1903 [cf. Kramer, 1977] and it seems the tensions still exist and confused the small-scale farmers as noted by FCS 8, **LM**³ below:

I have 111 apiaries and 64 are fully swarmed...today we sell to a Harare market... So, it confuses us when one buyer says the market [Harare] is flooded and yet another says they [Harare market] actually need more [cf. sub-section **5.4.3**].

7.2.3 3L (Third level) concerned with Totality, Reflexivity, Internal Relations (knowledge of the implications of our choices for ourselves, others and the more-than human world (knowledge of what should be))

On reflexivity and valuing for transformation at **3L** [cf. sub-section **2.2.3**], the research evidence is categorised into two, crop farming and non-crop farming and is abstracted below.

➤ On laminated totality and reflexivity: Crop farming

FCS 2, **BC**: We have been taken by the winds of change...But, we know our old maize seed variety (OPV) gives better mealie-meal and is resistant to diseases...[cf. sub-sections **5.2.2**; **6.1.1**]

FCS 2, **BC** reflected on the winds of change as these were responsible for his appreciation of a change in the type of maize seed from a long season variety to a short season variety as recommended by research and as adaptation to climate change. FCS 2, **BC** also reviewed that he still see value in the old long season maize seed variety that was currently constrained by climate change induced droughts. FCS 2, **BC** did not see value in the new short season variety that has been on the market as an adaptive mechanism to droughts. From his OPV, FCS 2, **BC** was disempowered by climate change from what he valued. This is the case of alienation [cf. sub-section **2.2.3**; Lotz-Sisitka, 2016] and not a move towards transformation from **3L**. On organic farming, FCS 3, **LN** reflected on a transformative trajectory as he and the other youths valued their practice as shown below:

FCS 3, **LN**: We are committed to the local organic standards which bar us from using artificial fertilisers, heavy chemicals and where possible, we avoid hybrid seed [cf. sub-section **5.2.2**]...We are our own monitors [cf. sub-section **6.1.6**]...don't need someone to keep checking on us whether or not we are still practising organic farming year in year out, it is now part of us... On tensions from markets and how they reacted
FCS 3, **LN**: The marketing journey has been bumpy [cf. sub-sections **5.7.3**;

6.3.3]...We worked through liquid manure and we drastically improved on quantity, quality and size in 2016...

Despite all the tensions faced by the youths in organic farming, they reflected on the ills and tried to absent them. For a capability function that they valued, organic farming, they did everything within their means until they managed to break into an industrial market and more, sending their products for laboratory testing. Thus the youths reflected on collective and personal agency and the value of healthy organic foods and healthy lives and the health of the soils, in following organic standards without external monitoring at all, on the upward move towards transformation at **4D**. FCS 10, **VC** on personal agency and reflexivity said:

Through observing the shifting rainfall patterns in the 1980s when we experienced major droughts in the country, it was no longer reasonable to farm the long season maize varieties (OPV) [cf. sub-section **6.1.1**; **7.2.1**]...The shifting seasons [climate change] actually forced us [referring to family since decisions to make changes in the family field is done collectively, **Layer 2** reflexivity] to adapt to new seed varieties.

A personal and collective reflection on the environmental conversion factors [climate change] and on individual agency after valuing the newly researched short seasoned maize seed varieties, FCS 10, **VC** [son to **BC** and also a dendrologist was commenting on conservation farming that his father engaged with, during a group discussion at the homestead of **BC** in 2014] adapted to, and so he transformed. On transfactuality, FCS 10, **VC**, noted climate change as a global phenomenon that he could not change but he had to adapt to new seed varieties and new capability sets and achieved functionings as advised by research and government policies. On collective reflexivity and the value for perennial agriculture FCS 10, **VC** reflected and said:

People have attained education, formally and informally, we have come to realise that it is unprofitable to waste a certain time of the year (off-season) being idle when the soils and water are available...We say, 'let us utilise the soils throughout the year [cf. sub-section **6.1.4**]...We appreciate all this help [government and partners' free seed and fertiliser input distribution to all farmers]...but we have been left exposed [cf. sub-section **5.2.3** on **co-creation or reframing**]. We just rely on government... and without that we cannot survive...Rather, we want the basic means to produce, water supply to be afforded at homestead level so that we can plant crops throughout the year, buy our own seeds and fertilisers if we want to...our people will be enabled to revert back to our OPV as our main field crop without problems [water related constraints].

Knowledge co-creation, a social conversion factor created tension and became a disabling factor. When the farmers still valued their OPV, they were taken by winds of change because of the absence of water harvesting techniques. The move towards the short season maize seed

variety was more of an alienation [cf. sub-section **2.2.3**; Lotz-Sisitka, 2016] and not transformation since FCS 10, **VC** claimed that he was still being deprived of the freedom of choice of the seed crop and farming practice that he really values. On experiments and valuing of a practice towards transformation at **3L**, FCS 1, **VS** said this on her fertility trenches:

Every morning when I wake up to do my field observation at 0500hrs, I would be surprised to see most of my crop, healthy-green from morning until 1000hrs when it showed signs of moisture stress [cf. sub-section **6.2.5**]...I observed again around 1700hrs the crop was green again...I concluded that my crop was benefitting from the moisture that had been retained in the maize stalks in the (fertility) trenches for a period more than I had expected.

The above evidence might show a deep appreciation of a practice such that FCS 1, **VS** had to keep a record of the condition of the crop as she tried to link the moisture content retained in the fertility trenches and the condition of the maize crop. Such inductive reasoning that the fertility trenches indeed benefitted her maize crop, was good for transformation at **4D**. FCS 1, **VS** also appreciated the limitations of her new capability in absencing long dry spells when she said:

But had the rains not come in February, then my crop was never going to survive [cf. sub-section **5.2.3**]...The maize stalks are good but they might not be good for a very long dry spell and that is why I keep reflecting on the need for a water reservoir...Only if I could have a steady water supply...or the plastic tanks. ...On raised ridges as adaptation to flooding and water logging conditions, FCS 1, **VS** kept reflecting [recursive reflectivity] when she said I did not come out of my field throughout this rain season. I reflected back to our old ways of draining off wetlands by ridging instead of furrowing as is the case with my fertility trenches.

FCS 1, **VS** reflected as an individual [Layer 1 reflexivity] and concluded that while the fertility trenches and the burying of maize stalks were a good innovation, this could not sustain long dry spells and so she still contemplated better water harvesting mechanisms such as a built up reservoir or a raised plastic tank. On recursive reflexivity at **3L** Laminated Totality, FCS 1, **VS** said:

I kept asking *Gogo Hildah* how she got it right and she explained again and again, that she was digging trenches, burying maize stalks and would add cow dung manure into the trenches and leave the ingredients to rot [cf. sub-section **6.1.4**]... I went back home and continued to think over it as I also shared my thoughts with my daughter... The following day, we started the trenches, because we did not have good maize stalks...we started by filling the trenches with humus... and top soils from the forests.

The reflexive, valuing and appreciation process was recursive as FCS 1, **VS** repeatedly asked the old woman how she did it. There was co-creation of the practice as the old woman shared

the knowledge with FCS 1, **VS** without giving up. FCS 1, **VS** later reflected with family at home [reflexivity Layer 2] as she also reflected on self [reflexivity Layer 1] when she compared her age with that of the old woman and wondered why she was starving when the old woman had absented famine. She also reflected on her capability and noted the absence of maize stalks due to the 2012 poor harvest but reflected with her daughter that she could still embark on this new innovation but using humus and top soil from the forest, and so she transformed through this reflexive and recursive process at **3L**. FCS 3, **MM** reflected on the new adaptation and capability functioning of organic farming which was being constrained by the type of soil enrichment, compost manure and so they absented composts. FCS 3, **MM** had this to say:

...the light-sandy soils of 2007,...we enriched the soils through composts but these were not nourishing the soils enough to our satisfaction...We reflected on what our expert then **GC**...taught us about liquid manure...[sub-section **5.1.3**]...and this was the ‘miracle-water’ that took us to competitive levels in 2016-2017 and to agro-industrial market in 2018...So with liquid manure and irrigation, we fully moved from being rain-fed subsistence to small scale market based farmers...[cf. sub-section **5.3.1**]...we realised our dream to move towards organic farming and a three crop cycle...

Upon collective reflection on the new practice after absenting impact of droughts, the youths noted constraints from their new capability functioning which they had to absent again, giving the reflexivity process a layered totality. On knowledge of what should be, the youths reflected that there would not be irrigation farming without a sustainable water supply and so they needed a water pump to enable farming throughout the year. On reflecting on challenges that youths faced at the demonstration site, FCS 4, **SM²** had this to say on his adapted new type of market based gardening:

But we, through reflecting on the challenges of marketing..., that the youths faced at the demonstration site, decided to go for modern market-based crops such as cauliflower, beetroot, lettuce and spinach [cf. sub-section **5.3.1**]. Learning for transformation was through understanding challenges faced by others. [On learning through advising others and generating new knowledges and approaches], FCS 4, **SM²**: As a marketing strategy, can you...try to target a group of people with the knowledge of organic products? The rich maybe for a start...a group of people with the money and who also value their health and eating habits [cf. sub-section **6.2.4** on re-framing. FCS 4, **SM²** reframed the marketing strategy from challenges that he learnt from FCS 3, **LN**].

➤ **On laminated totality and reflexivity: Non-crop farming-apiary**

FCS 7, **LM**² reflected on how he adapted apiary as an alternative to maize crop farming which had been negatively impacted by climate change induced droughts. He had this to say on how he came to value the new capability for transformation into the functioning of commercial apiary:

Today I thank the donor community...for encouraging the Top-Kenyan Bar that is what we are using as new technology in apiary bee-hive making [cf. sub-section **5.4.1**]... FCS 9, **FN** ...I also do practise apiary farming and I learnt of this from FCS 8, **LM**³ during a Field Day... I reflected on the possibility of api-culture after appreciating the number and quality of apiaries at FCS 8, **LM**³ ...111 with 64 fully swarmed ... I was really moved...

The knowledge on apiary as an adaptation to climate change and the newly adapted top-Kenyan T-bar type of apiaries had been co-created through training offered by the donor community and government. But the farmer had to personally reflect and then value it and then adapt. The process of appreciation in FCS 9, **FN** included observing the number of swarmed apiaries that a fellow villager had, FCS 8, **LM**³, 64. The comment, 'I was really moved' shows deep reflexivity and appreciation which was the basis for adapting the new practice. The trajectory at **3L**, Laminated Totalities, involved personal reflexivity, collective reflexivity and at times tensions from the market. Thus on laminated totality FCS 9, **FN** collectively learnt with others during the Field Days but moreover, she learnt through personal reflection and appreciation when she saw 64 swarmed apiaries at FCS 8, **LM**³'s Field Day. At **3L**, valuing, reflection and the move towards transformation, FCS 8, **LM**³ said:

My advice to the other young adults is that we need more apiary farmers as the market is just too big and we cannot even meet the demands of 30 tonnes per year [sub-section **5.4.2**]...apiary has the capacity to reduce domestic violence...With ... availability of honey..., families always have cash at hand and hence less social stress and less domestic violence especially those emanating from financial stress...We encourage farmers even the youths here, to hire out apiaries to crop farmers for the pollination of...crops. I am happy to see more farmers into apiary.

As an established apiarist, FCS 8, **LM**³ now wants to advise other farmers to combine efforts with him in order to meet the demands of the market of 30 tonnes of honey. He reflected on his own capacity and appreciated that he could not meet the demand of 30 tonnes through his own efforts, but had to combine the efforts with others. His comment, 'I am happy to see more farmers into apiary...', shows absence of jealousy and an appreciation that he wants more farmers to join him in apiary farming. In order for the farmers to appreciate apiary as a business, FCS 8 **LM**³ also linked apiary with absented domestic based violence [DBV]. He used inductive reasoning by reflecting that once economic poverty is absented through apiary

farming then the incidence of DBV would also decrease. Reflecting upon self and the environment and reflecting on how other communities were doing aquaculture, despite environmental conversion factors that could have been ills against aquaculture, FCS 9, **FN** had this to say on Laminated Totalities:

Our region...[region 1] still has streams and ponds in most of our gardens [wetlands]...In fact in my own garden are three ponds...What was absent was the training on fishpond farming and not fishery as a hobby...[cf. sub-section 5.5.3]...but I do not know where to get the fingerlings yet if I need them...[cf. sub-section 5.5.4]...where to sell the fish once I want to take the new practice as a business...We were not taught how to market the product...except that we can sell to our local communities.

On Laminated Totalities, FCS 9, **FN** reflected that her region was much wetter and cooler as compared to Beitbridge [cf. sub-section 5.5.2], and yet people in Beitbridge were keeping fish; why not her too? FCS 9, **FN** got motivated when she realised that she actually had three ponds in her garden. The ponds were good commodity or inputs for the functioning of aquaculture. Absent in her knowledge was the appreciation that Tilapia Fish actually thrived in warm water temperature [cf. sub-section 5.5.2] and not in cooler water temperatures as is the case in her ponds from region 1 where the trout fish would thrive better [cf. WRC, 2010]. The reflexive process was laminated in that FCS 9, **FN** had to reflect on her commodity or inputs and then be motivated by watching a video on how other community based farmers in a drier region were actually practising aqua-culture. She adapted to what she saw. But she still wondered how to absent markets including where to buy the fingerlings, making the process at **3L** recursive. On recursive reflexivity farmer agent, **MNA** reflected on how she as extension, also learnt from the farmers and how farmers seemed to be appreciating conservation farming:

I learnt of water harvesting [cf. sub-section 6.1.4] and use of reservoirs that supply water for irrigation in this project... [at a Field Day]...When one sees water,... others can perceive ... market gardening ...In this project water is extracted from a tiny stream into reservoirs, a process that does not disturb the smooth flow of the stream... I learnt one important thing in life, if you want something then you have to sacrifice the little you have in order to have your dream come true...but see how much energy the farmer spent on terracing?...Is there anyone who can confirm any form of soil erosion here?...But, the steep gradient is also a blessing in disguise as it is naturally good for irrigation, the water reservoirs as you can see are in the upper gradient, feeding irrigation water down gradient...

At **3L Totality** **MNA** reflected on a number of things she wanted to take home as a farmer agent. She reflected on the **actual** [cf. subsection 3.4.3] as the youths absented the ills of soil erosion by constructing terraces and absenting impact of drought by irrigation through

converting a small stream into the capability function of water harvesting and flood irrigation. To show her appreciation and reflection of absencing soil erosion **MNA** challenged the participants with the question, 'Is there anyone who can confirm any form of soil erosion?'

➤ **On laminated totality and reflexivity: Non-crop farming-dendrology**

FCS 10, **VC**, a dendrologist reflected as an individual, on alternatives that were at his exposure in the village before he finally transformed to dendrology where he is specialising in fruit trees, ornamental trees, flowers, shrubs and herbs. He said:

The journey towards this new production [referring to dendrology] was long [cf. Plate 5.6]. It was full of reflections...on the various projects that were being done in this village on exotic tree seedling production, on apiary, on aquaculture, on maize crops, on conservation farming [cf. sub-section 5.6.2]...Upon reflection together with my wife....we settled on tree seedlings production as our best capability option under climate change and a harsh economic hardship...we ... reflected that maize crop should not be the only means that we should have for our survival. We ... also reflected that trees pay much better than maize crop. As a result we buy our maize needs from the proceeds that we get from the tree seedlings sales...Upon further reflection, I noted that we could not all produce gum trees...I thought of diversifying into fruit trees, hedges and flowers that have a ready market from schools, hospitals and so on. [cf. sub-section 3.4.3]

The reflexive process at **3L** for FCS 10, **VC** was recursive. He reflected on the economic hardship that affected the country as well as on frequent droughts. He reflected on the different options that were at his disposal in order to absent economic poverty and droughts that were affecting maize the staple food, thereby bringing hunger and famine in families. The reflexivity process was at individual level [Layer 1] and at family level as he had to consult his wife at home [Layer 2]. Valuing, reflection and reviewing of options was not an individual process but a recursive one that involved the family (nucleated) and the big family at times. In the case story of FCS 10, **VC**, climate change and harsh economic hardship and poor remuneration also evoked the agency to reflect on alternative income sources, fruit tree production (2015 onwards). FCS 10, **VC** weighed on different options and so he settled for fruit tree production as his transformed agency, **4D**. The other dendrologist, FCS 11, **JC** noted a recursive process that started way back in 2008, before he finally transformed to the new capability. He said:

The road towards dendrology, tree seedling production, was not straightforward...[cf. subsection 3.4.3] but one full of reflections, sharing of ideas, personal experience and so on...[cf. Plate 5.7]...I reflected on the advantages and disadvantages of joining such a project...We reflected back at home as a family and we saw that this [tree seedling production] was our best income generating project opportunity since 2008

was marred by economic challenges and jobs were difficult to get after all...We accepted to join in the project...

FCS 11, **JC** learnt of the new practice, dendrology after individual and family reflexivity. He personally reflected on how to absent unemployment and so he considered the new project in dendrology being a better option and he accepted joining the project. He also reflected together with his family and they agreed that the project was the best. FCS 11, is one of the two remaining farmers practising dendrology at a commercial scale. He is contracted by tobacco companies [cf. sub-section 5.6.1; section 6.4] to supply them tree seedlings. Through a recursive reflective process that involved self and family and learning from and absencing the constraints that the youths faced in dendrology, FCS 11, **JC** finally transformed from **3L** to **4D**. Learning from the third other was one reflection that the apiary farmers used in the recursive process. The youths, FCS 3 **LN**, learnt from apiarist FCS 8, **LM**³. FCS 3 **LN**, said:

We learnt of the insect pollination of crops from FCS 8, **LM**³ [cf. sub-section 6.1.6; Plate 6.1.] and from books [apiary training manuals]. We tested insect pollination ... We failed to work during the day due to stings and so we quickly removed the apiaries and sent them behind the trees...

While the use of bees to pollinate crops has been used in many parts of the world, Zimbabwe included, knowledge and precautionary clothing and measures on when and how to work with the bees was not clear to the community-based farmers. On reflexivity, this was in-process [cf. sub-section 3.4.3] since the youths experimented and discovered that they could not transform to **4D** in the new innovation since they needed to re-experiment as the bees were stinging them, making it difficult to work in the crop field. They did this and succeeded in 2018 by placing the apiaries at the edge of the crop field and not at the centre [cf. subsection 5.1.3].

7.2.4 4D (fourth dimension) concerned with Transformative Agency, Human Emancipation (knowledge of what real change can be achieved in context (knowledge of what can be)).

This sub-section looks at the evidence on **4D** how the farmers transformed from the two main climate change adaptive capabilities of education on crop and non-crop farming.

FCS 3, **LN**...We are now our own monitors we don't need someone to keep checking on us whether or not we are still practising organic farming year in year out, it is now part of us... [cf. sub-sections 5.2.2; 6.1.6]

The abstract above reflected that the youths claimed to have reached transformation [**4D**] and not alienation [cf. sub-section 2.2.3; Lotz-Sisitka, 2016, on alienation] in a move towards

organic farming practice. The statement that the youths do not need any monitor, might show that organic farming, to them, is an achieved functioning coming from within and not a result of alienation (cf. sub-section 2.2.3; Lotz-Sisitka, 2016, on alienation). Education on irrigation as a capability for the functions of perennial farming knowledge, knowledge for and on market based farming, food security as well as the basic capability of nutrition, were achieved after a reflexive and recursive process. On irrigation as an achieved functioning at **4D**, the youths liked to claim that they valued how they converted a small spring to perennial irrigation:

FCS 3, **LN**...The spring [cf. Plate **5.2** Photo 1] has been flowing for over a century as we gathered from oral history...[cf. sub-section **5.3.1**]... FCS 3, **OD** ... Irrigation enabled market based agriculture as we now produce organic horticultural products throughout the year which we sell to ... I am happy, we are now part of the pricing system [sections **5.7.3**; **6.3.6**]...They also phone us to check if we are coming to the market and with what quantities... They also wait for our truck to arrive in the morning before the prices are determined [cf. sub-section **5.7.3**] ...Agro industries need raw materials and it is our duty as farmers to produce such in bulky for the development of the agro-industry...

The trajectory towards transformation was long, recursive, reflective, reflexive and full of reframing and negotiations whenever there were tensions or dissonance faced by the youths. The youths reflected on a new capability function of flood irrigation based on extracting water from a small spring. Transformation at **4D** [cf. subsection **3.4.3**; Figure **7.1**], the youths led by FCS 3, **LN** reflected that they attained transformation in terms of organic practice as adaptation to climate change and a livelihood. Organic farming is good for people's health, a new capability for different other functions that are related to a healthy person. The comment , 'We are our own monitors' could be a reflection of the value that the youths put into organic farming, the value for health, value for soil enrichment and for mitigating to climate change. Organic farming absences sythetic fertilisers that vapourise and possibly destroy the ozone layer and contribute to global warming and subsequently to climate change [cf. sub-section **6.1.4**]. Upon all refections and knowledge co-created the youths came to conclude that they valued organic farming without being coerced to do so and so they transformed. To support their claim on the absence of sythetic fertilisers and heavy chemicals and value for the use of organic manure, the youths sent soils for manure analysis comparing soils that were from a field that used synthetic fertilisers, heavy chemicals and pesticides and theirs which they claimed to be organic. The results seemed to point that the youths' claims on the laboratory tested organic parameters, were true [cf. Table **8.3**]. Thus through individual and collective

agency, the youths internally came to appreciate and became part of organic farming practices with little external influence from the policy on standards. Moreover, their products were canned by one of the agro-industries in 2018 for further laboratory tests [cf. Table 8.1].

But, at times **4D** was more of alienation than transformation [cf. sub-section 2.2.3; Lotz-Sisitka, 2016]. FCS 3, **MM** reflecting on alienation that led to the abandonment of the tree nurseries, said:

Since we had gained experience in producing gum tree seedling, we thought that was going to be our advantage... each year the goal posts kept changing [cf. sub-section 6.3.5]... One year you are told we are taking indigenous trees ..., the following year you try the indigenous trees then you are told we take exotic... Finally those of us who had soldiered on, producing tree seedlings from this village, reflected and folded-up the projects since our products were all condemned.[cf. sub-section 5.6.3].

Not all of the projects studied in the youths led to transformation; the youths were disempowered by some socio-economic structures from practising the functioning of dendrology. Such disempowering structures were historical [cf. Kramer, 1997]. They constrained youth's dendrology function in 2014 leading to them concentrating on organic farming. The youths could not proceed to **4D** from **3L**.

On transformation [**4D**] FCS 1, **VS** whose trajectory was recursive and reflective, evidence showed that she transformed through the new functionings of fertility trenches, from food insecurity, from hardly 20 kilograms in 2012, to maize crop yield of four tonnes in 2016-July 2017.. FCS 1, **VS** said:

...this year 2016-2017 I expect... to get... four tonnes of maize and that is for our family consumption here and for relatives in towns [cf. sub-section 5.2.3]... But I am happy, I weaned myself from food insecurity, begging bowl [*kungokumbira chikafu*] and moved to food security and now other villagers are now coming to learn from me....[cf. sub-sections 6.1.2]. We were lost when we used poor methods with frustrating harvests... now we are happy with the new methods with good and encouraging harvests. You get enough food and enough [money] to send children to school, that is what we appreciate from this farming practice [fertility trenches]... That is my wish. We no longer want to rely on seasonal farming [rainfed] we waste much time during off season...

VS reflected on her new capability functioning which was now being valued by others and so she had transformed from a basket case to food security at **4D** – consider her comment: I weaned myself... FCS 1, **VS**'s practice could also be in-process at **3L** and not **4D**. Her above comment sums her wish well, 'We no longer want to rely on seasonal farming [rainfed] we

waste much time during off season... [cf. sub-section 7.2.4]. To add to transformation, FCS 1, **VS** sees her fertility trenches having the functioning of bringing development to the rural transport network if it were embraced by many of her fellow community-based farmers and practiced under a sustainable water supply:

... You see, with availability of water, and with more people doing this type of farming (practice), then the transport system [cf. sub-section 6.1.6]...to the market will improve as there will be more (transport) companies operating.....ferrying our agricultural products to the urban open market. Even our neglected road will be repaired when it becomes busy and productive...

At **4D** FCS 1, **VS** envisaged potential conglomerates centred on her transformed functionings, a situation where her practice could draw transport companies and other developmental agents who are associated with agriculture such as companies who are into organic fertiliser as possibilities to bring rural development. Her fertility trenches practice could be a germ cell for rural development. Transformation from the non-crop farmers, dendrologists and apiarists had this to say:

FCS 8, **LM**³...The Harare buyers want 30 tonnes [honey products] from us so the more we are the better... As an individual I can just supply 200 kg so we want many farmers to join us [cf. sub-section 6.5.3] ... But with more apiary farmers we will try... I wasted time in formal employment, it was not worth the time I spent [cf. sub-section 6.5.2]... I am now fully employed as an apiary farmer..., we send our children to school and so we are now a happy family as we can now afford to survive independent of formal employment...[cf. sub-section 5.4.2]. We continue to get trained by our local extension service.

FCS 8, **LM**³ transformed through a reflexive, recursive and reflective process, reflecting on drought and economic hardships that he absented using apiary farming. At **4D** he realised that he could not feed a very big market but he reflected on more farmers to be part of his transformed venture. For the dendrologist FCS 11, **JC** on transformation into his new capability of market based dendrology had this to say:

By 2015-2016 we got much bigger contracts with the tobacco companies themselves and that demanded a larger piece of land, more water supply, more labour since tree seedling production is labour intensive [cf. sub-section 5.6.1],... I also moved from doing things at a small scale to a large scale... from funding the project using personal and family resources to accessing bank loans as a way of being recognised.

FCS 11 **JC** absented transport constraints by buying his own truck to ferry products to the market and so he transformed. FCS 11, **JC** at **4D** managed to get good contracts from reputable companies and he also accessed bank loans. FCS 10, **VC** upon reflection on real change, said:

The tree business venture has helped us a lot...We also produce moringa tree seedlings [cf. sub-section **5.6.2**]...Moringa is in high demand in the country for its medicinal values and high protein levels...We also produce the bottle brush tree... bottle brush tree also attracts bees and so it is on demand from beekeepers... More, some Harare buyers took some of our mango seedling-samples to Z for a possible export market... I am now fully registered and recognised as a legal producer of fruit tree seedlings in this country [sub-section **5.7.1**]... I managed to register my citrus tree seedling company with the Zimbabwe Revenue Authority (ZIMRA) under the name...[cf. sub-section **6.4.6**].

For transformation FCS **10**, **VC**, moved from subsistence crop farming to dendrology and he managed to register a small private company, **4D**. Through a recursive, reflexive and reflective process he managed to absent food insecurity from maize crop farming, now prone to droughts, through dendrology. His market extended from local to urban and now has the potential to export.

7.3 CONCLUSION

This chapter looked at the last research question: 4). ‘What generative mechanisms shape the social learning and the conversion of resources into new functionings and capabilities associated with adaptive farming practices?’

The insights gained from critical realism as an analytical tool included the identification of the generative mechanisms like existing cultural and historical structures, political structures, current innovations, droughts and socio-economic conditions. These were noted at **1M** as shown in Figure **7.1**. The noted absences at 1M were absented at **2E**. As for droughts, the existing absences were absented through water harvesting techniques and small scale innovations for irrigation, fertility trenches, mulch, inverted bottle drip, diversion furrows, conservation basins, syphoning, flood irrigation, use of large plastic tanks as water conservation techniques as well as the use of water pumps [fuel powered and solar powered] to power irrigation, as new capability sets and achieved functionings.

For irrigation to absent droughts, there were various commodity or inputs that included gradient also referred to as an environmental conversion factor [for the power of gravity]. The community based farmers through a reflexivity process at **3L** Laminated totality reflected and valued the trainings before any form of transformative agency could take place. As for training on absencing the impact of droughts, for examaple FCS **1**, **VS**, reflected by herself on why young as she was, she could fail to feed herself. The reflexive process was recursive as FCS **1**, **VS** reflected together with an elderly member of the community and with

her daughter at home. She finally accepted the innovation [fertility trenches] with some modifications. She transformed from being a bowl begging case, **1M**, when she used to harvest a few kilograms of maize that hardly lasted her a month to a harvest of more than four tonnes between 2012 and 2017, **4D**. On absenting economic structures and droughts, the communal farmers learnt of alternatives to droughts such as apiary, dendrology and aquaculture. Upon reflecting on harsh economic hardships for example, FCS 10, **VC**, FCS 11, **JC**, FCS 6, **LM²** and FCS 7, **LM³** transformed from subsistence farming, **1M**, to recognised new functionings at **4D**. All eleven case stories reflected on their current capabilities, the absences noted and how these were absented through trainings and learning from others and learning from markets. The farmers reflected as individuals and as collective agency in order to realise the new functionings in market based farming, food security, alternative to cropping and irrigation, that is from **1M** to **4D**. Therefore the chapter gained insights from using CR in the analysis and also added value to the grounded insights gained from the analysis of capabilities and social learning.

CHAPTER EIGHT

REFLECTIONS, SUMMARY AND CONTRIBUTIONS

8.1 INTRODUCTION

Critical realism endorses situations that necessitate “knowledge integration” for purposes of producing particular results, which may be applied at a particular level [cf. Bhaskar et al., 2010, p. 19], for example, in community-based farmers. The **RRREI(C)** model is applied to explain, describe or analyse complex phenomena in the social world [ibid, 2010]; it is the basis for all scientific knowledge [cf. Bhaskar, 1993; 2016]. The basis for practitioners in the field of environment and sustainability education is to use the **RRREI(C)** schema for learning and research purposes [cf. sub-section 2.2.7; Sabai, 2016]. This chapter looks at the reflections through knowledge integration and generation, summary of the study and looking at the research contributions. The chapter thus gives insights on what the thesis gained from using CR’s **RRREI(C)** model in analysis. The chapter also added to the grounded insights gained from the analysis of capabilities theory and social learning process. The chapter also shows that the analysis from CR, capabilities and social learning process do complement each other.

8.2.1 Resolution (R^1)

Resolution is a level where the participants after describing relevant component parts of a process were able to compare or relate the descriptions to infer causal factors that trigger those processes or predict possible outcomes [cf. sub-section 2.2.7; Sabai, 2016]. Reflecting on government and donor policies FCS 10, **VC**, resolved that:

Government policies such as the shift towards provision of free seed and fertilisers... meant that people had to practise farming using the same seed variety for the same region and the same village. [cf. sub-section 5.2.1 and sub-section 7.2.1]

FCS 10, **VC** as a community-based farmer in this study, thus, resolved that the shift towards uniform distribution of conventional seeds within a region and village, were a result of a government policy. While the government policy was aimed at absencing food insecurity and hunger at village and national level, the uniform distribution of seeds and fertilisers at the same time was often uniformly constrained by droughts and pests thereby leading to food insecurity at a large scale. This often resulted in whole communities’ crops succumbing to similar post-harvest pests such as weevils at a very large scale usually leading to food

insecurity at a large scale [cf. sub-section, **7.2.1** FCS 10, **VC**]. FCS 10, **VC** resolved that it was going to be good for the government to absent the impact of droughts by first giving people knowledge [education as a capability] and skills on water harvesting [**T¹** in my **T⁰⁰** model], before distributing seeds and fertilisers to farmers living within unpredictable rainfall patterns which often resulted in crop failure [cf. sub-sections **5.2.3**; **5.7.3**; **7.2.3**]. **VC** also resolved that:

Through observing the shifting rainfall patterns in the 1980s...experienced major droughts in the country, it was no longer reasonable to use the long season maize varieties (OPV). ...shifting seasons forced us adapt to new seed varieties. Seed houses too introduced short-season varieties in response to reduced rainfall season. [cf. sub-sections **5.2.1** and **7.2.1**]

FCS 10, **VC** resolved that the shifting seasons [climate variability] meant that the farmers had to adapt to short season varieties and abandon their long season variety (OPV). FCS 10, **VC** also resolved that the shifting rain season with onset rains now in December [shifting later from mid-October] meant it was now profitable for farmers to embark on winter cropping [cf. sub-section **5.2.1**]:

We observe and come to the calculations that, we sometimes have a few more months into the rain season...to last around April, then we plant bean crop...short season crop, whilst we utilise the still continued rain season...we have come to realise that it is unprofitable to waste a certain time of the year, idle. [cf. sub-sections **5.2.1**; **6.1.4**]

From apiculture, an alternative to crop farming FCS 7, **LM²** resolved that selling honey to the urban market was a better option than selling honey to the local market where prices were often negotiated downwards or at times the product was exchanged with other products when money was scarce [cf. sub-sections **5.4.1** and **7.2.1**]. FCS 8, **LM³**, another apiarist, realised that the community-based apiarists were still far from meeting the capacity to supply the over 30 tonnes of honey and honey products required by the urban market and so he appealed to more farmers to join him in the new capability set and achieved functionings, apiary:

The Harare buyers want 30 tonnes [honey products] from us so the more we are the better... As an individual I can just supply 200kg so we want many farmers to join us. [cf. subsection **6.5.3**; **7.2.4**]... But with more apiary farmers we will try ... I wasted time in formal employment ... I am now fully employed as an apiary farmer..., [cf. sub-section **7.2.4**]

Thus after observing his own capacity of 200kg per honey harvest against the 30 tonnes that the urban market wanted, FCS 8, **LM³** resolved to mobilise more farmers so that they try to

meet the new market demands. In addition, he was happy with his new achieved functionings of market oriented apiculture, a transformation from subsistence maize crop farming.

8.2.2 Re-description (R²)

Re-description can be described as where one describes relevant component parts of a process in a way that makes them relevant or theoretically significant [cf. sub-section, 2.2.9]. Re-description is a component part of the events, processes or data that may be compared, contrasted or related by participants at a deeper level. FCS 3, LN said:

Luckily in this demonstration site, we have 'irrigation' facility and liquid manure as new innovations. We plant our OPV ... during the dry period of September and we harvest it by March after five months, ready for our peas winter crop. [cf. sub-section 7.2.1]

By absenting the impact of droughts the youths reintroduced OPV, a long season seed variety which is now thriving under irrigation. The reintroduction of OPV into the main crop field and not in wetlands as was the case with FCS 2, BC, has been redefined by the presence of water for irrigation at the demonstration site. Irrigation in this case liberated the youthful farmers to plant a crop of their choice, the one that they valued most but had been constrained by climate change induced droughts. FCS 1, VS also redescribed soil fertility enhancement, as a process towards conservation farming which she had learnt from Gogo Hildah. She said:

In this new practice...I dig trenches as you can see and bury all the maize stalks. I also collect humus and grass from the forests and bury them too in order to supplement on manure... These decompose, provide manure and retain moisture for my crops. [cf. sub-sections 5.2.1 and 7.2.1]

Whilst FCS 1, VS learnt of fertility trenches where maize stalks and cow dung were the main sources of manure nutrients, she redescribed the process by collecting humus from the forest in the absence of cow dung. The humus worked well but it took a long time to decompose [cf. sub-section 5.2.3]. On redescription FCS 9, FN said this as she redefined food security:

In the 2014-2015 season, the rains came a bit late... and so I reflected on... aquaculture... just like apiary, that I also do, aquaculture is also good for us...Rainfall is tricky nowadays and you need to have another farming type. [cf. sub-sections 5.5.1 and 7.2.1]

By observing the changing rain seasons and frequent droughts, FCS 9, FN redescribed farming as an activity that does not have to be restricted to maize crop farming only, but aquaculture and apiary too as alternatives. With alternatives to maize crop farming as new

capability sets and achieved functionings, when market oriented, one could get money to buy maize meal, the staple food. FCS 3, **MM** redescribed soil enrichment as follows:

Granny advised that we start with small grain, *rapoko*, for it enriches the soils and does not need artificial fertilisers and is drought resistant too. [cf. sub-sections **5.2.1**; **6.1.1**]

As other knowledges, FCS 3, **MM** redefined soil enrichment from the usual use of artificial fertilisers to the use of small grains like rapoko. While small grain was good, absent was soil enrichment through compost, mulch, dung and liquid manure. But, FCS 3, **LN** also had this to say on the failure by small grains, mulch and compost to enrich soils and improve on crop size and quality as he further redefined soil enrichment mechanisms:

We reflected on what our expert then, **GC**...taught us about liquid manure application between 2010 and 2012... and this was the ‘miracle-water’ that took us to competitive levels in 2016-2017 season [cf. sub-sections **5.3.1**; **7.2.3**]... Thus from infertile sandy-light soils... to health soils ... and from non-harvests... to recognised products for the agro-industrial market ... in 2018 [cf. sub-section **5.3.1**]

The youths redescribed what they perceived as soil enrichment by looking at the soil appearance and at the product, which at one time, was not competitive and so they reflected on the use of liquid manure which they later perceived as the miracle water that they valued for soil enrichment. The redescription process was a result of observation of the soil appearance and the appearance of the product so as to determine if the soils were rich or not. In addition, after self-perceived soil enrichment, the youths redefined soil enrichment by engaging the observed morbidity of the soils through soil manure analysis under laboratory conditions [cf. Table **8.3**]. On redescribing soil enrichment, FCS 10, **VC** had this to say on the new capability functioning of conservation basins:

Nowadays we do conservation farming where cow dung manure is concentrated in a single hole... unlike the old methods where manure were spread on the soil surface near or around the crop... We also learnt from extension service to reuse the same hole several times since it has enough nutrients... [cf. sub-section **7.2.2**.]

FCS 10, **VC** learnt of soil enrichment from extension, redefining the application of manure from the traditional spreading of manure over the field to concentration in a single hole which they reused since it retained nutrients over time.

8.2.3 Retrodiction (R³)

Retrodiction has been defined as explaining the natural and social events by making inferences back to mechanisms that are capable of producing them [cf. sub-section **2.2.9**;

Sabai, 2016, p. 186]. Similarly retrodiction is defined as the process of explaining the events by postulating [and identifying] ‘mechanisms which are capable of producing them’ [cf. Sayer, 1992, p. 107]. Retrodiction is a thought operation involving a reconstruction of the basic conditions for anything to be what it is, or, to put it differently, it is by reasoning we can obtain knowledge of what properties are required for a phenomenon to exist [cf. Sayer, 1992]. Reflecting on generative mechanisms that led to irrigation farming, FCS 6, **JM²** said:

So I can say climate change and harsh economic challenges... also taught me to think of new ways of farming including irrigation so as to raise income... [cf. sub-section 5.3.2]

The absence of reliable rainfall under rain-fed farming generated the agency for irrigation farming. More FCS 6, **JM²** reflected on the absence of employment and concluded that irrigation farming could absent food insecurity, droughts and unemployment. On generative mechanisms. FCS 2, **BC** had this to say:

We have been taken by the winds of change, we left our old practice (OPV) and have been taught...to plant the modern seed varieties which is prone to diseases... But, we know our old maize seed variety (OPV) gives better mealie-meal and is resistant to diseases. [cf. sub-sections 5.2.2; 6.1.1; 7.2.2 and 7.2.3]

In this case FCS 2, **BC** showed that he was constrained by droughts which he failed to absent and so he accepted the short season maize crop variety as he reduced his OPV to a garden crop. But he still valued his OPV which he claimed resisted diseases and provided a better mealie-meal than the researched upon short season variety. So he preferred to call climate change and the change brought in through trainings by government and partners in the shift to the new capability set and achieved functionings, the ‘winds of change’. FCS 10, **VC** retrodictively reflected on why the government’s free seed and fertiliser distribution disabled them, when he said:

We appreciate all this help... but we have been left exposed... We just rely on government... and without that we cannot survive. Rather, we want the basic means to produce, water supply... so that we can plant crops throughout the year, buy our own seeds and fertilisers if we want to ... our people will be enabled to revert back to our OPV as our main field crop without problems. [cf. sub-sections 5.2.3 and 7.2.3]

FCS 10, **VC** still valued the OPV but also felt constrained by climate change and the free distribution of seed and fertilisers which at times reduced each region to a uniform seed variety and ultimately regional food insecurity in the event of regional droughts. In the event of a pest outbreak, the whole region would be affected. He reflected on the absence of water harvesting capabilities as the main constraint for the community-based farmers. Receiving

free seeds and fertilisers in the absence of water harvesting and irrigation means the government effort goes to waste due to climate change induced droughts. FCS 10, **VC**, claimed that once the farmer starts absencing the impact of drought then the government effort in free seed and fertilisers would result in sustainable harvests [**T**¹ in my **T**⁰⁰ model]. An organic farmer **TM**² retrodictively reflected on the relationship between the foods that people eat and the possible observed poor health of children and adults, when she said:

We like practising organic farming ... The product is healthy to our bodies... Look, even small children complain of painful swollen legs ... but we suspect it is associated with the foods that we eat which are contaminated with chemicals and synthetic fertilisers. [cf. subsections **5.3.5** and **7.2.2**]

The community-based organic farmers observed a trend of poor health [capability] in children and adults and this they attributed to foods that are contaminated with chemicals at production level; such poor health is likely to be absent in foods that are organically produced. The community-based farmers see the close relationship between organic or natural foods and good health, while poor health is associated with foods that are produced under artificial mechanisms. This health awareness knowledge seems to be absent from the urban markets since they prefer products that are produced under artificial mechanisms over the organic ones. **WM** [climate change activist] advocated for a public awareness campaign [informal learning] through the media [cf. sub-section, **6.3.6**]. On the view that the market does not want to promote small-scale producers, the youths complained about why they did not get more accurate information on what exactly the market wanted. FCS 3, **MM** had this to say about tension from such a social conversion factor they claimed was meant to disable the youthful farmers:

- . ..But each year the goal-posts kept changing... One year you are told we are taking indigenous tree seedlings when you had exotic tree seedlings, the following year you try to produce the indigenous tree seedlings, then you are told we take exotic or a specific indigenous tree which you had not heard of in time...The following year you then attempt to do both the indigenous and the exotic... at the same space and well in time and the exotic trees get diseased in the process. [cf. sub-sections **5.6.3**; **6.3.5**; **6.5.4**].

The youths reflected on why the market was never clear as to exactly what they were supposed to do and concluded that the market never wanted them in that new capability functioning. All these tensions were meant to discourage them. Upon further reflection on the imposed structural ills, the youths abandoned the practice of dendrology in 2014. In addition, the community-based farmers in this study reflected that transport constraints were used as a

mechanism to push them out of their newly achieved capability functionings. FCS 11, **JC** speculated on why the youths abandoned the new capability of dendrology in 2014:

But we also learnt that most of the agents be they government or non-government are very supportive... at the inception of the project but there are always hurdles at the marketing stage of the project... Day one, the truck doesn't appear, day two, it doesn't, day three it doesn't again... Day 7 may be, when almost 30-40% of the tree seedlings are now lost, the big truck finally comes, condemn the 30% and takes only 70%, if you are lucky. This was a common pattern that made most farmers abandon the project. [cf. sub-section **5.6.3**]

The villagers reflected that transport constraints were being used to disable their new achieved functionings so that they fell from **4D** back to **1M** [cf. Figure **7.1** downward arrow]. Although they reflected that this was structurally designed to push them out of their new capability sets and achieved functionings, there was little they could do since they were constrained by transport difficulties which they were yet to absent. In this regard poverty remained the major disabler of the youths' capabilities [cf. Sen, 1993]. On absencing unemployment, the youths used this retrodictive reasoning on some of the generative mechanisms on unemployment:

FCS 3, **OD**: Agro-industries need raw materials, and it is our duty as farmers to produce such in bulk for the development of the agro-industry...Agro-industry in return will offer us the youths and university graduates jobs...if we don't produce then industries might remain shut down and as youths we don't get the jobs at all. [cf. sub-section **7.2.4**]

By interacting with agro-industry through this thesis, youths came to realise the link between job creation and the community-based farmers' production of raw materials for the agro-industry. However the youths reflected that the quantities that agro-industry required for operations was just beyond their capacity. Thus, more players were needed including engaging the universities' community engagement and whole institution approach of the gap [cf. section **1.2** and sub-section **1.6.1**]. In trying to link new farming education capabilities and rural transport development, FCS 1, **VS** had this to say retrodictively as she reflected on poor roads in the village:

You see, with availability of water, and with more people doing this type of farming..., then the transport system ...to the market will improve as there will be more... companies operating...ferrying our agricultural products to the urban open market. Even our neglected road network will be repaired when it becomes busy and productive... [cf. section **7.2.4**]

FCS 1, **VS** could link her practice as a causal mechanism for rural development including road network and infrastructure. Production is hereby perceived as having the power to

develop road network as more companies come to ferry products to the market. On the link between conservation farming and organic practices to a cleaner environment, the farmer agent **CM¹** had this to say:

When people use artificial fertiliser where the rains are scarce, there are gases that are associated with our... fertilisers and those gases... rise into the air...disturbing part of the air called ozone layer. [cf. sub-section **6.1.4**]

The knowledge shared between the farmer agent and the community based farmers was quite technical as the farmer agent managed to educate the farmers on the causes of climate change by linking the use of some artificial fertilisers to the destruction of the ozone layer. Moreover, he linked absents the use of synthetic fertilisers through conservation farming to a mechanism that absents further destruction of the ozone layer as a way of protecting the earth from extreme weather conditions including droughts. Organic and conservation farming, according to the above quotation, might qualify as not just adaptation to, but also mitigation to climate change, if mitigation to climate change includes aspects of reducing harmful gases into the atmosphere [cf. sub-section **2.4.5**; IPCC, **2014**]. Technically if organic farming absents the addition of harmful gases into the atmosphere, just as hydro-power, solar power and wind power, absents the addition of harmful gases from fossil fuel, then there is need for a relook at the contribution of organic farming towards the climate change mitigation equation.

8.2.4 Elimination (E)

In terms of eliminating alternative expressions and explanations that suggest existence of confounding mechanisms [cf. subsection **2.2.9**], FCS 10, **VC** reflected:

Our rains are erratic... But we...reflected that maize crop should not be the only means that we should have for our survival [sub-section **7.2.3**]. We ... also reflected that trees pay much better than maize crop. As a result we buy our maize needs from the proceeds that we get from the tree seedlings sales.

FCS 10, **VC** eliminated other options like rain-fed farming since they are less resilient to climate change. **VC** finally opted for dendrology and produced fruit trees, shrubs, herbs, ornamental shrubs and flowers instead of getting trapped into maize crop production as the only capability for food security. FCS 10, **VC** used the income from sales from his dendrology practice, to buy his maize needs. So, FCS 10, **VC** still sees maize as his staple food but now he gets maize after absents the impact of droughts and adapting to non-maize

crop farming, on a market mode, dendrology. On eliminating poor farming methods, FCS 1, **VS** said:

We were lost when we used poor farming methods... with frustrating harvests, now we are happy with the new methods with good and encouraging harvests [cf. sub-section 7.2.4] ... But I am happy, I weaned myself from food insecurity, begging bowl... and moved towards food security and now other villagers are coming to learn from me.

FCS 1, **VS** eliminated poor farming methods when she reflected on fertility trenches as water harvesting and soil enrichment innovations. Through eliminating or absented temporary droughts and moisture shortage, the new water harvesting technique, though at a micro-scale, has resulted in FCS 1, **VS** realising a maize crop harvest of four tonnes in 2017 up from zero tonnes in 2012. She eliminated her old poor farming practice [c.f sub-sections 5.1.1; 5.2.3 and sections 6.11; 7.2.4].

8.2.5 Identification (I)

Identification has been explained as identifying correct generative mechanisms from those considered [sub-section 2.2.9]. FCS 10, **VC** identified the underlying mechanism on why the community-based farmers were disabled from being self-reliant as the following:

We were therefore socialised in such a way that when we grow up we had to look for jobs in towns preferably [cf. section 5.6.1]...We were never socialised into being self-employed beings...I sat down and reflected on other sources of income apart from formal employment...I thought of diversifying into fruit trees, hedges and flowers that have a ready market from schools, hospitals and so on... [cf. section 7.2.3]

The moment FCS 10, **VC** identified the absence, he absented it and thus he transformed to become a sustainable and registered fruit tree producer and exporter by 2018.

8.2.6 Correction (C)

FCS 3, **MM** reflected that learning was a recursive process that thrives on correcting one's frame of knowledge construction by accepting suggestions from others and so conformity rather than dissonance was important to farmers' transformative social learning:

We accepted to be corrected and once we corrected the noted mistakes then we recalled the group [cf. section 7.2.2]...to show our appreciation of the corrected problem...Yes, we did that with FCS 1, **VS** who had noted the absence of mulch in our crops...FCS 3, **LN**: More problems could be noted and we continue correcting and so, that is how we learnt this new way of doing farming, market mode [cf. sub-sections 5.3.3 and 7.2.2]

Corrections that were supposed to be made, were noted by the market on the quality of crop products, as the products from the research participants were rejected [cf. sub-section **5.1.3**]. For example, the youths, continued reworking and correcting the constraints noted by the market in order to come up with a better quality product that was acceptable by the market and more by the industrial market in 2018 [cf. sub-section **7.2.2**]. Also FCS 7, **LM**² on corrections [cf. sub-section **5.4.2**] noted how he accepted to be corrected by the Harare market which often demanded a certain quality from his apiary products. FCS 3, **LN** sent some of their products for canning [cf. sub-section **5.3.1**; Plate **5.9** last photo] and later for laboratory tests and for soil tests at the university; this was another way of correcting ills identified in the product and in the soils. Corrections thus were at times determined by laboratory tests as the farmers queried their own self-perceived morbidity and tried to verify the claimed health of crop and soil parameters, using the observed morbidity, laboratory tests, in order to correct ills in the product and in the soils.

8.3 INDUCTIVE REASONING AND RELATIONSHIPS

On inductive reasoning [cf. sub-section **5.2.1**, related events, observed correlations then come up with a theory or conclusion], FCS 1, **VS** said:

What I noticed was that every morning when I wake up to do my field observation at 0500hrs, I would be surprised to see most of my crop, healthy-green from morning until 1000hrs when it showed signs of moisture stress...When I observed again around 1700hrs the crop was evergreen again...I concluded that my crop was benefitting from the moisture that had been retained in the maize stalks in the...trenches. [cf. sub-sections **5.2.3**; **6.1.5** and **7.2.3**]...I reflected that my fertility trenches are good but would not stand prolonged droughts....

On inductive reasoning FCS 1, **VS** reasoned that her observed green maize crop at 0500hrs and at 1700hrs was a result of the moisture retained in the buried maize stalks [which had a spongy characteristic that retained moisture] and humus in the trenches. Although **VS**'s claim could have been the norm with any maize crop under temporary drought conditions, her reflection that this took a longer period than she expected, made her conclude that the fertility trenches accounted for the evergreen crops during the temporary drought. It was when FCS 1, **VS** reflected on her experiment and came to conclude that the fertility trenches really worked, that she accepted this new innovation as her valued being and doing. **VS** was also quick to note that her new capability set and achieved functionings of fertility trenches remained a temporary stop gap measure as it could not stand either a meteorological or a hydrological drought and so she still wants to absent the impacts of such types of droughts by having a

sustainable water harvesting mechanism. FCS 1, **VS** on inductive reasoning [related events, observed correlations then come up with a theory or conclusion], also observed that the use of humus and fertility trenches increased production. Humus and trenches increased maize production and so water harvesting and soil enrichment increased productivity. Therefore the theory here was that buried maize stalks, maize cobs and humus in fertility trenches, preserves and conserves moisture and saves maize crops from temporary droughts and thus increases the maize crop yield [zero tonnes in 2012 to four tonnes in 2017]:

I continue to observe that whenever I use the new method, the maize output continues to increase, and so trenches and humus are good for maize crop output and I enjoy continuing with this method as it is working for me... [*Takainonokera tichigara mumatown*], we left farming until old age while we wasted time staying in urban areas. [cf. sub-section **5.1.1**].

From the experiment and observations on the condition of her maize crop, FCS 1, **VS** concluded that buried maize stalks could have resulted in absencing temporary drought. FCS 3, **LN** also inductively noted how rocky the marketing journey was for the community-based farmers. The youths were structurally disempowered by external forces, the market included. This dates back to 1903 cf. Kramer, 1977]. **LN** had this to say:

...but we do not get the knowledge on the markets where to send our products [cf. sub-sections **5.3.3**; **7.2.2**]... each year the goal posts kept changing [cf. sub-section **6.3.5**]... We tried to negotiate on why not alerting us in the beginning of the year on which tree seedlings the government and the donor agents were interested in and at what price. That information was not always available to us...

FCS 3, **LN**, concluded that whenever the community-based farmers were introduced to a market-based project, they would be disempowered at the marketing stage from what they would have started to value doing and being and hence they were left impoverished. Thus the community based farmers concluded they were supposed to remain at a subsistence level despite any market oriented projects being introduced by the government and donor agents. Therefore it could be concluded that funded projects that lacked wholesome education on marketing and markets, were meant to disempower the people's freedoms and capabilities to function. The farmers were aware of that, but they were disabled by poverty. FCS 1, **VC** inductively noted the absence of water harvesting techniques as a disempowering generative mechanism that made them remain non-being [**1M**]. **VC** had this to say:

We appreciate all this help... but we have been left exposed. We just rely on government... and without that we cannot survive. Rather, we want the basic means

to produce, water supply to be afforded at homestead level so that we can plant crops throughout the year, buy our own seeds and fertilisers if we want to ... [cf. subsections 5.2.3 and 7.2.3]

While the government and donors made efforts to give the farmers free handouts, seeds and fertilisers included, the farmers viewed this as ultimately disempowering since their dependence on handouts was made perpetual in the absence of water harvesting mechanisms which they needed in order to absent the impact of droughts, which affected any harvests from the free seed they might get [cf. T^1].

8.4 REFLECTIONS

Figure 8.1 was further developed from Figure 3.2 and it gave some reflections on social the learning process that resulted from research evidence as discussed in this study.

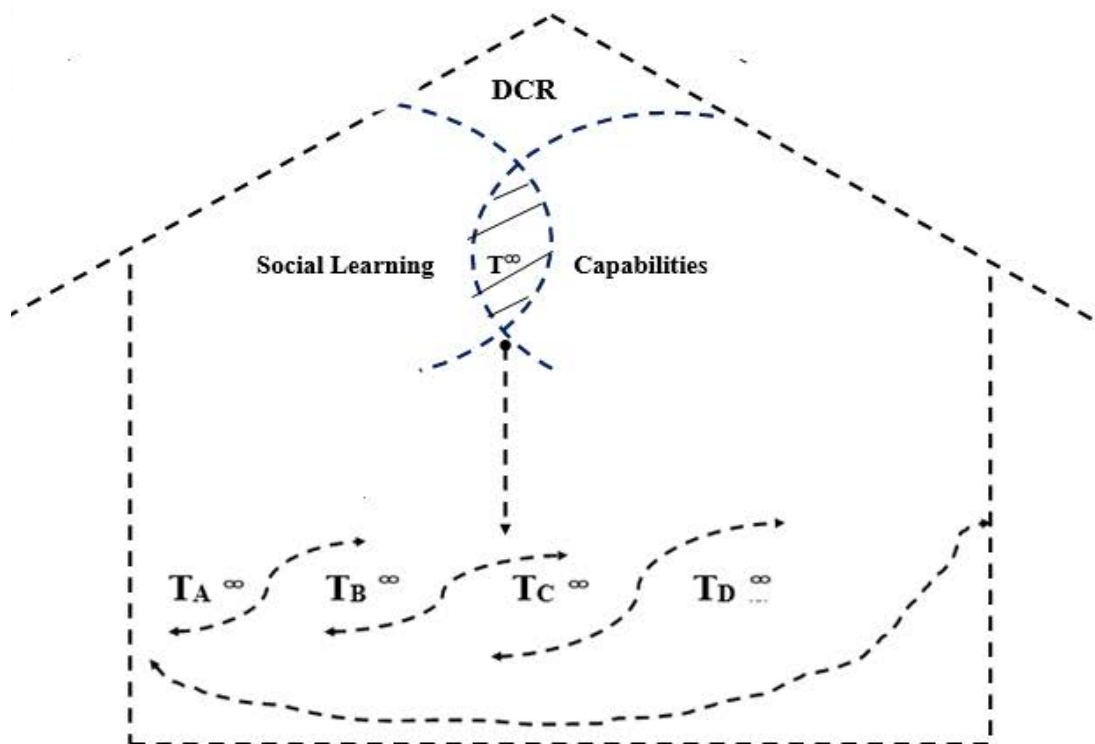


Figure 8.1: Inter-relationships and social learning process

Source: Author

In Figure 8.1, T_A^{00} shows community based farmers' transformative social learning process in crop farming capabilities such as market oriented organic and conservation farming as well as in market oriented non-crop farming such as apiary, dendrology and aquaculture. This is what is indicated in Level I labelled T_A . The transformative social learning process at **A** is

infinite [T_A^{00}] as there are many dimensions to transformative social learning at **A** [crop or non-crop farming level]. Farmers learn through reflective, recursive and reflexive processes starting at Layer 1 with learning about the basics such as water harvesting techniques like diversion furrows [cf. FCS 5, **SS**; sub-section **5.15**], fertility trenches [cf. FCS 1, **VS**; sub-section, **5.1.1**], conservation basins [cf. FCS 2, **BC**; sub-section, **5.1.2**], mulching [cf. FCS 3, **LN**; sub-section **4.3.3**], building up water reservoirs [cf. FCS 3, **LN**; sub-section, **2.6.1**] and mounted plastic tanks [cf. FCS 6, **JM**²; sub-section **5.1.6**]. Learning at Layer 1 takes place when the individual reflects on what is and what is not in her/his life? This is what s/he wants to absent or to continue doing in order to transform. Reflection on the practice at T_A can also be at Layer 2, which is at family level, either nuclear or extended or big family levels. This brings about co-creation of knowledge and collective decisions and agency, when the family members consult each other before a major shift or adaptation is accepted. At Layer 3, transformative social learning takes place when the farmers learnt with others in the community [cf. FCS 1, **VS**; sub-section **5.2.2**, learning from Gogo Hildah]. Thus transformative social learning at Layer 1 [at production level] takes a multi-level and infinite approach. Social learning does not end for it to be transformative, it is infinite even at the level of production. It is at T_A^{00} that the farmers also learn from the community of practice that includes farmer agents like extension service, forestry extension, climate change activists and learning from the market including the industry. Learning at this level is to ensure quality and quantity of products. T_A^{00} is thus directly linked to T_B^{00} [agro-industry] or there is an overlap between the knowledge learnt at T_A^{00} [the community based farmer and her/his community of practice at production level] and that at T_B^{00} [agro-industry] – social learning knowledges do overlap when agro-industry learns something from the farmers and extension services at the same time as they learn from the agro-industry. There is also considerable learning at the agro-industry level with learning from its own agronomists' research, workshops and its own communities of practice, but in addition, there is learning from the farmers and farmer agents as **TM**³ notes:

Why would we risk giving someone a contract... who has an unreliable water source?... We advise you to go and think of ways of harvesting and harnessing water if you want to be part of our contract farming project... We are always learning in this process, every contract is unique with its own set of challenges [cf. sub-section **6.4.4**]... An extension officer who works hard in the community, making the people productive and sending products to the market, the market will not ignore the brains behind the good products. ...That is how most agro-companies manage to recruit good agronomists.

While transformative social learning at **T_B** is infinite, as it is at **T_A**, it begins at **T¹** not **T²**; that is why the agro-industry starts by advocating for water harvesting and emphasising that they give contracts to people with evidence of water sources. This seems to be an absence from the government and non-governmental organisations or even private input distributors, who according to the evidence as claimed from this thesis, seem to start at **T²** and not **T¹** as done by the agro-industry. Industry appears also to have learnt from the community and extension services, as evidenced in **TM³**'s comment: "we are always learning..." To show the overlap in knowledge, industry also learns from extension services as noted by **AK¹**:

At times in group-work like this, we need to iron out the issue of communication channels... In some projects, the corporate world likes to deal directly with the farmer and the extension officer gets information from the bottom, and, at times the information might have been distorted...**TM³** [in response]: We are not here to disrupt your relations or your learning structures with your farmers, but we are here to make sure your goals are achievable in harmony with your existing frameworks. [cf. subsection **6.4.4**]

The above suggests that learning at **T_B** might be infinite but it starts at **T¹**. The T-infinite model, Figure **8.1**, does not simply end with co-creation of knowledges but provision of products. After learning at **T_A⁰⁰** the farmers provides products at **T_B⁰⁰**. The products at **T_A** are infinite as well as those processed at **T_B**. **T_B⁰⁰** overlaps with **T_C⁰⁰** as was the case between **T_A⁰⁰** and **T_B⁰⁰**. **T_B** learns with others while processing the many products acquired from **T_A**. **T_B⁰⁰** then overlaps in knowledge and products with **T_C⁰⁰** who, most likely is the local markets. **T_C** overlaps with **T_D** and shares infinite knowledges and products at regional market systems and more on the international market. As shown in Figure **8.1**, when fully learnt and trained, **T_A** will one day have a direct link with **T_D**.

But, for the trajectory in Figure **8.1** to happen, there is also an overlap of theories where dialectical critical realism underlabours and identifies and helps in absencing the absences in the farmers' capabilities and social learning process. The capabilities' conversion factors help in explaining the pedagogic processes in the six moments of the social learning pedagogy. Where the three concepts [theories] intersect, is what I consider to be the zone of infinite transformative social learning. The thesis therefore assumed that the community-based farmer at **T_A⁰⁰** produces products which could feed into the local industry **T_B⁰⁰** and the products feed the local markets at **T_C⁰⁰** and the exports at **T_D⁰⁰**. Thus, if the community based

farmer at T_A^{00} is idle then the local industry remains operating at low capacity. If the community-based farmer is active then more jobs would be created in the local industry and more products for the local, regional and international markets. Therefore the transformative social learning trajectory in this study follows a T-infinite approach meaning: *Ukufunda akupheli* (iSindebele), *kufunda takumani* (Tonga), *Uguda ahufheli* (Venda), *Kgoruta akguyeli* (Sotho), *Funda akutopela* (Kalanga), *Kudzidza hakuperi* (Shona), learning never ends (English), but should start at T^1 .

➤ The epistemic and ontologic reflections

The major epistemic and ontologic reflections are based on the evidence that the community-based farmers began to question the type of knowledge capability that they were getting which they claimed was disempowering them. FCS 10, VC questioned the government and its partners' logic of giving inputs every year without empowering the people in water harvesting techniques first so as to absent the impacts of droughts which affect production (hence the inputs often go to waste if there are droughts):

We appreciate all this help... we have been left exposed... Rather, we want the basic means to produce, water supply to be afforded at homestead level so that we can plant crops throughout the year, buy our own seeds and fertilisers if we want to...[cf. subsections 5.2.3; 7.2.3]

Instead of simply receiving the free seed and fertilisers the farmers were questioning that epistemology of absencing food insecurity as it is constrained year after year by droughts. Rather, the farmers were reflecting at starting at T^1 , water harvesting. The farmers also challenged the positivist ontology and epistemology of scientific testing as the only way of generating knowledge on organic standards when the youths were able to claim through self-perceived morbidity that the soils where they produced products were organic and so were the products. FCS 3, LN and the youths sent the soils and the products for laboratory tests [cf. Tables 8.1, 8.2 and 8.3] to verify their self-perceived knowledge.

Thus, the farmers claimed that their epistemology and ontology of organic parameters should be embraced as other knowledges by the scientific world in an 'ecologies of knowledges' approach [cf. De Sousa Santos, 2007]. This thesis might have contributed towards identifying the need for a whole institution approach where different faculties in the university come to work together on community engagement. To open up such synergy, the agro-industry studied in this thesis, canned the community-based farmer's product and the university saw

an opportunity to improve university-community engagement by helping the community to test the canned product for nutritional parameters [cf. Table **8.1**] and test the soils for manure analysis [cf. Table **8.3**] [Faculty of Science-Chemistry Department and The Faculty of Agriculture-Soil Science Department]. Thus the learning pedagogy from the farmers also found its way into the education curriculum within the Faculty of Education, Department of Science Design and Technology [DSDTE].

In its theoretical reflection, this thesis noted that dialectical critical realism's MELD schema and RRREI(C) are two tools that were used to analyse the farmers' social learning process. Dialectical critical realism identified the absences and the generative mechanisms in farmers' capabilities and also provided the lens to absent the ills for the farmers to transform. The capabilities theory and social learning theories could not have done this fully without dialectical critical realism.

This thesis has reflected on the intertwined link amongst the three: critical realism, social learning process and the capabilities theory as they are applied in education. Education as a capability enables different other functionings like new knowledges on markets and innovations needed for improved production. The thesis tried to identify individual and collective agency as well as the different conversion factors found to play an important role in the social learning trajectory. Decisions for transformation were shared collectively by the family and extended family as well as the local community and communities beyond. Decisions were not only based on individual agency. Social learning in this thesis has been reflexive, recursive and reflective and was laminated [happens at different layers]. Moreover, social learning was observed to be non-linear as also noted in literature [cf. Wals, 2007]. But unlike in literature, social learning in this thesis did not always happen in dissonance and where dissonance existed, sometimes no learning happened and no transformation as the practice had to be abandoned [cf. sub-section **8.2.3**; the youths abandoning dendrology in 2014].

Social learning did not always result in transformation as has been noted in this thesis where after learning about market based mode of production, some of the community-based farmers were disempowered in the process and were left impoverished and in a worse situation than before [cf. sub-section **5.6.3** on the different cases where communities were disempowered]. Transformation at **4D** seems to have remained a continuous process but was reached by FCS

1, **VS** who between 2012 and 2017 managed to transform from food insecurity of zero tonnes in 2012 to four tonnes of maize crop in 2017 after converting to fertility trenches for soil enrichment as well as a temporary rain water harvesting innovation [cf. sections **5.1.1** and **8.3**]. FCS 1, **VS** still needs to sustainably absent the impacts of drought through a more robust rain water or underground water harvesting technique. Thus, although **VS** thought she had transformed, there were other constraints that could still make her fall back to **1M**. FCS 10, **VC**, despite having managed to register a company and break into the export market, still needs to absent the impacts of droughts through a sustainable water harvesting mechanism from his protected well [cf. sub-section **5.6.1**, ...we still need to buy a plastic tank as a reservoir where we pump up the water from the well and then into the field]. While FCS 10, **VC** seemed to have moved towards transformation at **4D**, he still relied on begging for free commodity capabilities, the plastic pots as his inputs [cf. sub-section **5.6.1**]. This might indicate that FCS 10, **VC** is yet to operate his dendrology business as a self-funding new capability set and achieved functionings. The case of market based products in all the case stories in this research also showed that transformation at **4D** was a continuous and recursive process as each case story had to continue facing and absencing new ills even at **4D**. Thus whilst FCS 10 and 11 were happy to have transformed into some kind of commercial dendrology functionings, both were yet to absent input shortages through purchasing these from shops rather than relying on free supplies which could give a sense of false business project sustainability at **4D**.

The community-based farmers learnt of new practices but they all had to reflect on their own capability commodities to guide them on how to adapt. FCS 1, **VS**, for example, learnt of fertility trenches where maize stalks and maize cobs and cow-dung were buried, but she opted for burying humus in her trenches in the absence of maize stalks, cobs and cow-dung [cf. sub-section **8.2.2**]. FCS 10, **VC** learnt of dendrology from FCS 3, **LN** and the youths, but upon reflection, he opted for fruit tree nursery production as an alternative to maize crop farming as compared to the exotic trees that the youths produced and they became disempowered. FCS 6, **JM²** observed the use of one plastic water reservoir from FCS 4, **SM²**, but upon reflection with extended family, FCS 6, **JM²** opted for ten such water reservoirs instead of a single plastic tank as was the case observed from FCS 4, **SM²**. Whilst FCS 3, **LN** and the youths opted for peas as their winter crop, FCS 5, **SS** opted for winter wheat which he valued doing. Therefore the shared knowledge was on a concept but the

implementation of that concept was dependent on one's capabilities and the commodities one had. I also noted the link between my own work as a university lecturer and community engagement through scaling the GAP and ESD [cf. sections 1.1; 5.3.1 and 8.3]. As community engagement under Education 5.0 [cf. sections 1.2], this thesis opened up the link for more than three faculties to work together under the whole institution approach of the GAP as they directly and indirectly linked with the thesis project community studied. Figure 8.2 shows the link between my university and community engagement from this study.

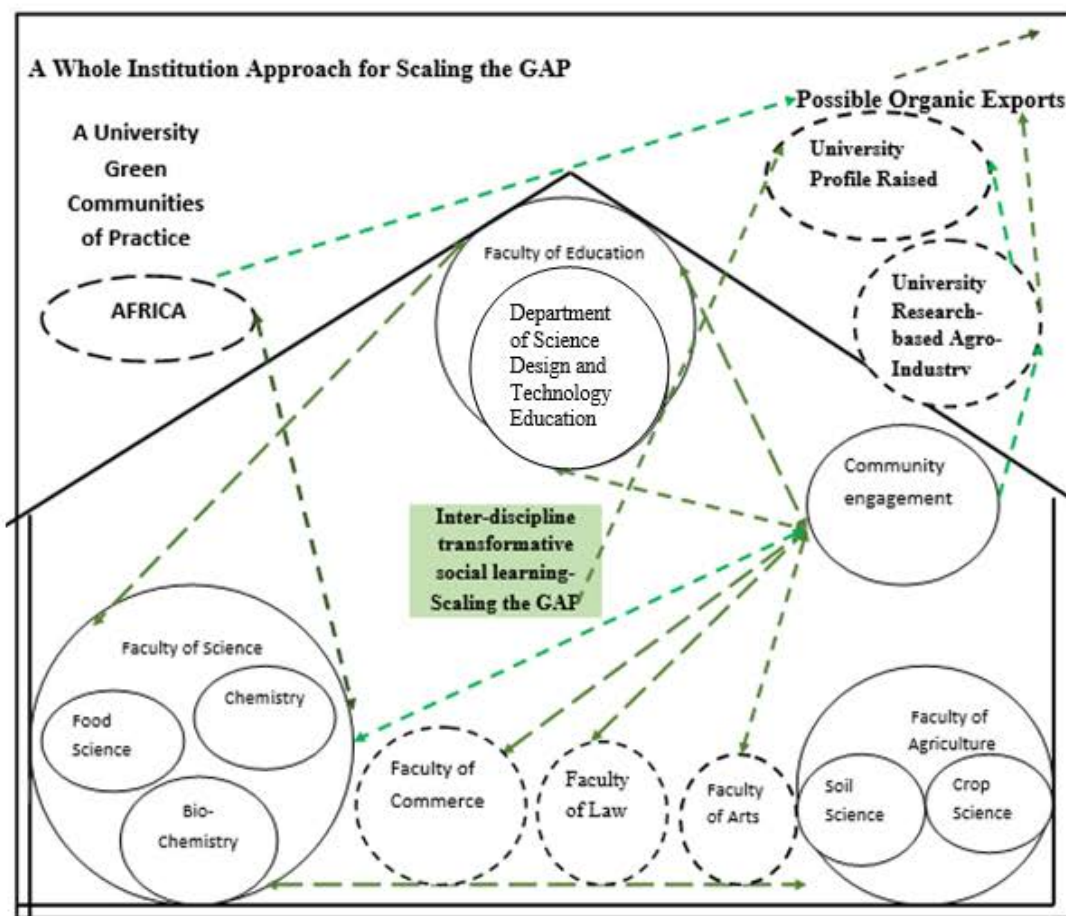


Figure 8.2: University community engagement and testing against organic standards

Figure 8.2 is derived from empirical evidence from the study. The researcher from the Department of Science Design and Technology Education (DSDTE) assisted the thesis project community to get their products for laboratory testing from the Faculty of Science (cf. section 4.3 researcher position). The soils from the project site were laboratory tested from the Faculty of Agriculture for manure analysis and this was funded by the Faculty of Education as part of education 5.0 community engagement. Samples of fresh peas from the project site were also tested against heavy metals from the national standards association.

Thus the Faculty of Agriculture contributed to the whole institution approach through soils testing while the Faculty of Science contributed through testing the products for nutritional components, the Faculty of Law is envisaged to work on educating the farmers on contract farming whilst the Faculty of Arts, was envisaged to work on water harvesting issues. The product after being certified to be organic is envisaged for local and regional markets. Table 8.1 shows the nutritional data analysis from the project site.

Table 8.1 Nutritional data of Green Feast peas claimed to be organically produced

Sample Identity	Parameter	Result Obtained
Canned Peas	Moisture content (g/100g)	78.88
	Crude protein (g/100g)	0.68
	Crude fat (g/100g)	0.56
	Total Ash content (g/100g)	0.52
	Available Carbohydrates(g/100g)	10.65
	Crude Fibre(g/100g)	5.35
	Energy (KJ) (g/100g)	266.86
	Potassium (mg/100g)	170.21
	Calcium (mg/100g)	36.82
	Iron (mg/100g)	1.88
	Zinc (mg/100g)	0.77

The 2018 Report Read: Following is a table of preliminary results of nutritional factors, (product in sauce mother liquor), of peas claimed to be an organic product. The Green Feast Peas tested is a very healthy food, low in saturated fat, cholesterol and sodium; parameters that highly associated with cardiovascular diseases. It is also a good source of protein, a wide array of vitamins and minerals and dietary fibre. The results obtained were not very different from the standard nutritional benchmarks. Test results from the standards association of the country against the presence of heavy metals are shown in Table 8.2.

Table 8.2 Test Results for Heavy Metals

PARAMETER	RESULTS	Instrument/ Test Method Used
	Fresh Peas	
Arsenic (as As), mg/kg	None Detected	ICP-OES
Cadmium (as Cd), mg/kg	None Detected	
Chromium (as Cr), mg/kg	None Detected	
Lead (as Pb), mg/kg	None Detected	ICP-OES

None detected = result<0.001ppm

The tests for heavy metals from the fresh peas crop showed that none of the tested heavy metals were detected at <0.001parts per million (ppm). The metals tested by the standards association of the country as shown in Table **8.2** were arsenic, cadmium, chromium and lead [cf. subsection **2.4.5**]. The laboratory tests showed absence of the four heavy toxic metals from the peas crop that was produced by the community-based farmer FCS 3, **LN**. This might suggest that the product was produced under organic conditions that were friendly to the environment and free from toxins. Literature also shows that the four heavy metals tested could be harmful to people's health and to some extent, to the environment [cf. sub-section **2.4.5**]. The soils that the community-based farmers claimed to be organic were also taken for laboratory tests for pH value and manure analysis comparing the organic soils and soils that were taken from a field within the same geographical space where heavy chemicals, fertilisers and pesticides were applied and the results are shown in Table **8.3**.

Table 8.3 Manure Analysis Report

Parameter	Inorganic Manure	Organic Manure
pH (1:10)	6.1	7.2
Organic matter %	1.62	3.83
Nitrogen %	0.21	0.53
Potassium mg/kg	355.17	326.92
Zinc mg/kg	12.24	22.27
Manganese mg/kg	84.79	255.00
Copper mg/kg	8.28	16.67
Nickel mg/kg	15.51	11.00
Iron mg/kg	7765.32	7335.00
Phosphorus mg/kg	499.79	2613.21

In this thesis the community-based farmers, though poor and relatively uneducated (formally), questioned positivism as the only epistemology for determining organic products by sending soils from their field for laboratory tests which they, for years have been claiming to be organic but lacked scientific proof. In terms of Table **8.3**, soils were taken from the same geographical area and the pH from the FCS 3, was **7.2** as compared to **6.1** from the inorganic field within the same geographical space. The pH of **6.1** indicates acidic soils which was not the case with the organic soils at pH **7.2**. In terms of organic matter, it was 1.62% from the inorganic crop field soils compares less favourably than 3.83% from the organic crop field soils. While the percentages might look small, this might have indicated some good efforts from the youths. The thesis thus attempted to develop some organic

standards that might include qualitative and quantitative aspects that could be acceptable at regional and international levels. Therefore each university faculty and department as shown in Figure 8.2 were carefully chosen for their capabilities in the community engagement project and their contribution to the university innovation hub.

8.5 REFLECTIONS FROM THE SOCIAL LEARNING NEXUS

The Before Harvest Field and Demonstration Day meetings [Field Days], Kramer (1997) was the main platform where the farmers exhibited their capabilities [valued beings and doings] and achieved new functionings that they learnt [cf. Sen, 1993; Robeyns, 2005] through the social learning pedagogic process [cf. Wals, 2007]. The five basic capabilities noted by Sen are not exhaustive [cf. Nussbaum, 2000; 2003] and this thesis came up with many other different capability sets. Figure 8.3 summarises the farmers' capability sets and the respective social learning and pedagogic process nexus.

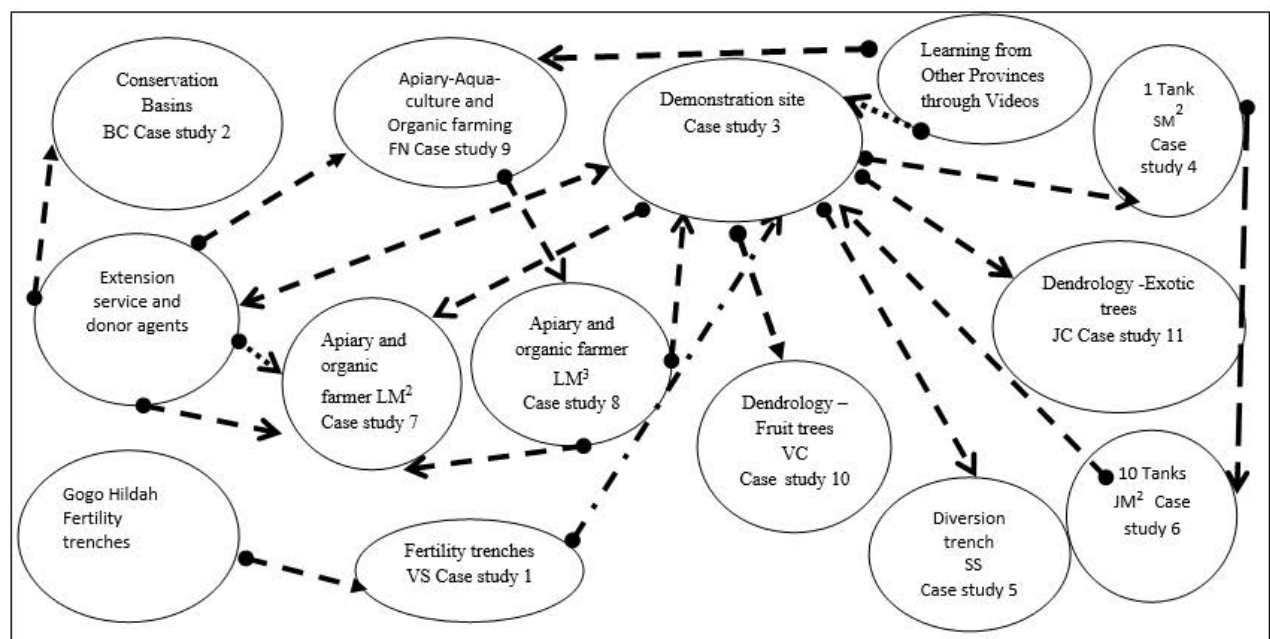


Figure 8.3: Elaborating on the T-infinite Model in the Social Learning Process

In Figure 8.3 there is no single nuclei or centre of knowledge or learning source. The small black circle shows the source of each knowledge while the arrowhead shows flow of knowledge and the destination of the new generated knowledge. The demonstration site [cf. FCS, 3 LN and the youths] has been noted as part of the learning platform source for

dendrology for FCS 10, **VC** and FCS 11, **JC**. The demonstration site provided a learning platform for organic farming for FCS 7, **LM**², extension service [double arrow as knowledge was shared from extension service to farmers and vice versa from the farmers' practice]. The site also provided knowledge on water syphoning to FCS 5, **SS** as an innovation in irrigation techniques. The demonstration site was a knowledge source where FCS 4, **SM**² learnt of water conservation [from a small stream], market gardening and flood irrigation, but after reflecting on the knowledge, he opted for a 5 000-litre plastic container instead of cement built tanks that he had learnt of from the demonstration site. The youths at the demonstration site also looked elsewhere for knowledge, they learnt of market gardening at a large scale from FCS 6, **JM**². The youths also learnt of water syphoning and the use of the inverted bottle irrigation from other provinces through watching videos and this is shown by a circle at other provinces with knowledge flowing according to the arrow pointing towards the demonstration site. The youths from the demonstration site also learnt of insect pollination of pea crops from FCS 8, **LM**³, from a neighbouring village and from books. The youths at the demonstration site learnt about mulch and fertility trenches from FCS 1, **VS** who had learnt but modified the practice from Gogo Hildah. In terms of apiary FCS 7, **LM**² learnt from family, extension services and from experienced FCS 8, **LM**³. FCS 9, **FN** learnt of apiary farming from extension service, training in other provinces and from more experienced FCS 8, **LM**³. FCS 9, **FN** learnt of aquaculture from extension services and training within the province and through videos from other provinces. Regarding conservation basins, FCS 2, **BC** learnt from extension services only. FCS 6, **JM**² learnt of water harvesting from underground into plastic tanks, a mechanism he modified from a single tank to ten, from FCS 4, **SM**². Therefore the social learning process and pathway was multi-nucleated, reflective and recursive as knowledge generation did not flow in one direction only.

8.6 CONCLUSION

This chapter looked at the RRREI(C) schema of knowledge integration as a way of recapturing the knowledge generation processes. The chapter also gave a summary of the research evidence reflections on the interrelationships between the two theories, critical realism and capabilities as well as the social learning process in knowledge generation. The chapter then summarised the project activities in a multi-nuclei framework and knowledge flow [Figure 8.3] where knowledge generation was non-linear and multi-directional. The next chapter looks at the recommendations and provides a general conclusion to the thesis.

CHAPTER NINE

RECOMMENDATIONS AND CONCLUSION

9.1 INTRODUCTION

This chapter provides recommendations based on empirical evidence from the community-based farmers and other participants in the community of practice. The recommendations are also derived from the reflections and are also designed to cover knowledge contribution to theory and practice. Further recommendations are also found in the following categories: extension and other farmer agents, the university community-engagement as well as the university curriculum with reference to climate change adaptation and associated education and innovations. Also considered in this chapter were the theoretical contributions to the capabilities theory, social learning process and critical realism theory.

9.2 RECOMMENDATIONS ON SUPPORTING FARMERS' SOCIAL LEARNING FOR ADAPTIVE CROP AND NON-CROP FARMING PRACTICES

A recap of the research evidence as summarised in this chapter, demonstrated that crop and non-crop farmers learnt from each other and from experts through the before harvest field and demonstration days [Field Days]. The social learning process as observed in this study, was non-linear but cyclic, reflexive, recursive and knowledge sources were multi-nucleated. After observing a practice, the farmers reflected first as individuals [Layer 1 reflection], then went home and reflected with family and extended (big) family [Layer 2 reflection], experimented on the new practice, addressing possible dissonance issues emanating from different perceptions on the new practice, called community for a Field Day [Layer 3 reflection] where collective reflection was done on the new practice. Apart from learning through practice on the Field Days, the community-based farmers also learnt through non-formal education during trainings offered by government and partners. Moreover, the farmers learnt through reflecting on personal formal education at school, as a latent conversion factor. In addition, the farmers learnt from informal learning as accessed through multi-media, videos and social networks and this included knowledge from other districts and provinces. Thus, the social learning process in this study took a multi-nucleated cyclic nexus approach. Crop farmers' recommendations are as follows:

- FCS 1, **VS**’ maize production yield increased from zero tonnes in 2012 [non-being/non-existent] to four tonnes by 2017 [being] which she attributed to adapted fertility trenches. FCS 1, **VS** managed to reflect from **T¹** which was absented the impact of temporary droughts and absented poor soil fertility through learning from another community farmer and now she has absented hunger, can afford to buy her own seed when she wants to, **T²**. The study thus recommends that it would be good for extension service and the donor agencies to share other knowledges on ex-field and in-field water harvesting techniques with targeted farmers like FCS 1, **VS** so that all farming activities starts at **T¹**. The study also recommends that the government might reconsider its policy on free distribution of seeds and artificial fertilisers to all farmers, but rather, do a needs assessment first on an individual farmer basis. More government might want to consider giving the farmers the knowledge for water harvesting alongside the traditional inputs distribution. The free seed and fertiliser distribution could be on a farmer to farmer basis since farmers do have different capabilities and commodities. If funds from government, the donor community and other partners were made available, this study could recommend the drilling of a borehole at FCS 1, **VS**’ field in order for her to realise the dream of perennial farming. Due to the geographical position of **VS**’s field (a watershed), sinking a borehole at her field would benefit other farmers in this thesis who reside on either side of the watershed as follows: FCS; 2; 3; 4; 5; 7; 9 and FCS, 10.
- FCS 2, **BC** liked to continue using the OPV maize seed variety which is a long season variety that has been constrained by the winds of change [climate change, government policies and research]. FCS 2, **BC**’s new functionings on conservation farming were constrained by agricultural [short term] and meteorological [long term] droughts and subsequently, climate change hence the study recommends the sinking of a borehole at FCS 1, **VS**’ field would help FCS 2, **BC** practice OPV maize crop farming. The youths FCS 3, embarked on a market mode of farming in horticultural crops from 2012 and got recognised as ‘beings’ by the urban market from the year 2016. The thesis recommends for the youths, that the government and donor agencies might want to share knowledge of the value chain with farmers during trainings. The knowledge from field preparation, growing and harvesting of crop, packaging, marketing, storage [including post-harvest processing at district level] and processing,

depending on the crop type, could be shared with the young farmers. FCS 5, **SS** is one of the very few winter crop community-based farmers in this study. He was constrained by small quantities of crops. To absent the absence of large quantities, the study recommends that community-based farmers like **SS**, **LN**, **JM²** and **SM²** who practise perennial irrigation farming, could benefit more when extension service as well as the non-governmental organisations share knowledge on permaculture and mixed crop farming in particular in order to maximise on quantity-output per unit area. FCS 6, **JM²** was constrained by the absence of flood irrigation which was a function recommended by one agro-industry for the tomato crop on contract. The agro-industry only contracted farmers with drip irrigation. To absent the absence of drip irrigation as recommended by agro-industry² for the production of tomatoes for industrial raw materials, the study recommends that FCS 6, **JM²** and the other community-based farmers with irrigation, might benefit from sharing knowledge of and funding for drip irrigation which is already available from one donor agents on a credit facility basis within the province. Farmers lack the knowledge on where and how to access information and where to access the credit facility and such knowledge sharing could be facilitated by the extension services and donor agents.

Recommendations for non-crop farming practices

- FCS 7, **LM²** shifted from rain-fed farming to small-scale irrigation organic farming as a result of observed climate change and he shifted from apiary as a hobby to apiary as a market oriented farming and as an alternative to maize crop farming. Organic farming reduces the use of chemicals which makes it good for bees as they collect pollen from non-pollutant sources. However, FCS 7, **LM²** is constrained by poor apiary colonisation since out of 46 apiaries only six are swarmed. To absent the absence of swarming, the study recommends that extension service could share education on how to create queen bees, how to catch swarms, and where to buy queen bees in order to improve swarming of the empty apiaries in the community. The Environmental Management Agency (EMA), Agritex and related agencies might want to continue with awareness campaigns against uncontrolled veld fires which drive away bees and burn down the beehives. FCS 8, **LM³** another apiarist who practiced a market mode of agriculture, was often constrained by the market which demanded 30 tonnes per harvest from a farmer who produced just 200 kilograms. The study

therefore recommends that the Environmental Management Agency (EMA) and related agencies continue awareness campaigns on apiary in order to increase the number of apiary farmers in the community and thus the lucrative urban markets and beyond could be harnessed. But more the farmers might want to be trained in the processing of honey products in situ and be trained in other apiary functionings like hiring out bees to plantations.

- FCS 9, FN shifted from rain-fed farming in 2015 into apiary, organic and aquaculture. She currently practised the three new functionings at subsistence level. Her constraints were the absence of markets for aquaculture if she wanted to farm commercially. To absent the absence of aquaculture markets and apiary markets for FN, extension service could add, within their training programmes, named markets and marketing strategies and not only dwell on establishing the projects, leaving the farmer stranded with the end product hoping to find markets which are difficult to identify as a farmer alone. On aquaculture it would be good for extension service and the donor community to think of considering post harvesting processing of fish in situ as livelihood for the aqua-farmers.

Recommendations for Farmers in dendrology

- FCS 10, **VC** is the only community-based farmer in this study who managed to legally register his farming activities of dendrology where he specialised in fruit-tree, shrubs and herbs. FCS 10, **VC** is constrained by quantities as he hoped to supply the export market which demands large volumes. The study recommends that FCS 10, **VC** might need further training from the extension services and other donors on packaging for his tree-seedlings especially the non-fibrous mango seedlings that he intends to export. He also needed education on contracts and how to access loans from banks since he already has a company so that he do not have to rely on begging for free capability commodities such as plastic pots. Poverty was still a disabler of his dendrology capabilities. Contractual issues could best be handled by the Faculty of Law in a whole institution approach. FCS 11, **JC** like **VC** is a dendrologist and he specialises in exotic tree seedlings for marketing to commercial tobacco farmers. He is the only one in this study who accessed bank loans and managed to buy a truck for his achieved functionings of producing and transporting products from his dendrology new functionings. **JC**'s new capability set was constrained by a leaf-disease that

affected his tree seedlings in 2014. The study recommends that Connex consider working closely with small-scale farmers in training on tree seedling-disease identification and treatment. Farmers like **JC** are doing much to replenish the forests of the country and so research could engage even small-scale farmers like **JC** in order to absent the leaf related disease. **JC** might benefit more from government support and education on running his new achieved functionings as a sustainable business.

Recommendations to the University

- The university innovation hub could identify champion farmers such as the youths and other farmers in this study, to work with and to help protect them under contract farming models. The university could start the small scale experiments of processing the different organic products from the community-engagement under the whole institution approach, starting with the community-based farmers' products in this thesis, such as honey, organic horticultural products, cooking oil, fish and other collectables which are easily accessible. The university, together with the standards association of the country, could help in improving the organic standards [both self-perceived and observed morbidity of the soils and that of the products] including the standards on the environment where collectables like honey, mushrooms, fruits, herbs and shrubs are found. The university might also want to consider processing fish products in the innovation and research hub as part of its wider community engagement and farmer capability enhancement as lessons from the thesis after the youths managed to get their peas crop canned.

Recommendations to extension service

- Extension service and the donor agencies, might want to target sharing knowledge on how to legalise the farming activities through company registration processes, training on contract farming and collective farming practices where the farmers produce one crop as individuals but market as a group in order to meet the large tonnage of raw materials needed by agro-industries. The Zimbabwean government and extension service in particular could consider up-scaling farmers' capabilities from 'champion' farmers such as, FCS 3, **LN** and the youths, FCS 6, **JM²**, FCS 4, **SM²**, FCS 7, **LM²** and FCS 8, **LM³**, who have the pre-requisite commodities such as small scale

irrigation mechanisms, land, modern apiaries for the achieved functionings of market based production for selected agro-industries and for job creation of other youths at point of source and at the end point, the industry. The study showed the possible existence of a link that could be between the community-based farmers and agro-industries, provided both parties are clear on contracts, quantity and standards of products.

9.3 RECOMMENDATIONS FOR FURTHER EDUCATIONAL RESEARCH

- The research recommends that other educational researchers could further study transformative farmers' social learning as a catalyst for community or rural infrastructural development (transport, telecommunication, internet etc). This is an assumption from FCS 1, VS that when provided with irrigation at homestead level [T¹] and when properly linked with reliable markets, the community-based farmers could, as claimed by VS, induce infrastructure development in the community such as transport network.
- The concept of latent conversion factors might need a follow-up in capability studies in education.
- Researchers might want to further study the concept of farmers' social learning and collective agency and productivity as compared to individual agency and productivity. This was an assumption set by the youths that transformative farmers' social learning could enable the community farmers to sustain agro-industry through farmers' collective agency and collective supply of the same product to industry.
- Critical realist researchers might want to consider testing the MELDARA schema in a similar community based farmers' social learning context since this study was restricted to the MELD schema.
- Other social learning researchers could consider studying other generative mechanisms that constrain the small-scale farmers apart from those studied in this thesis like climate change induced droughts, socio-economic and political structures and so on.

- In addition, researchers in education for sustainable development could consider social learning for both crop and non-crop farmers in post-harvest processing including drying and canning, in order to understand the constraints the farmers engage with in their trajectory towards breaking into the food processing capability set.
- Local universities could consider attaching students on small-scale projects which offer learning platforms.
- More research could be done on the GAP especially looking into how small scale farmers' achieved functionings could be embraced as measures for the global achievement of the SGDs.

9.4 LIMITATIONS OF THE STUDY

I reflected in Chapter One that as a multiple case study this thesis could not be generalised to all community-based farmers in the village of study or elsewhere. I also reflected through the study's theoretical framework that critical realism as the underlabourer for social learning process and the capabilities theory could not wholly explain how the community-based farmers could fully engage with learning about the global marketing systems such as the neo-liberal economy (social conversion factor) as this indirectly affected their local functionings. Political structures, be they local or global, historical or contemporary, do influence local events and mechanisms to liberate the community-based farmers from stresses. Ills from political structures as generative mechanisms were not fully engaged with using the two theories chosen in this study, critical realism and capabilities. But, this study might have provided some insights on what constrains community based farmers' capabilities and agency in order to absent similar ill elsewhere. Poverty as noted in the capabilities literature remained a disabler of the community based farmers' capabilities in this study.

9.5 FINAL REFLECTIONS AND CONTRIBUTIONS OF THE STUDY

This research might have contributed to the general understanding of the underlying generative mechanisms as enablers or constrainers to shaping social learning and people's measurable functionings in the context of education for sustainable development and the global action programme (GAP). To reduce constraints like absence of sustainable farming

techniques, the community-based farmers through social learning, reflected as individuals and collectively as a community on adaptive practices. Upon reflexive and recursive processes, the farmers managed to exercise their agency to transform to new capability sets like apiary, dendrology, business partnerships and aqua-culture as alternatives to maize crop farming. The farmers in this study also transformed to new functionings such as irrigation and market based production as a result of the realised individual and collective agency.

9.5.1 Theoretical Contribution

The study reflected that the farmers' social learning processes were multi-nuclei, reflective and reflexive. The farmers reflected on their capability sets (valued beings and doings), the available commodities or inputs such as water, slope, soil and knowledges in order to convert these to achievable functionings and to adapt to climate change risks and vulnerabilities. Dialectic critical realism interlocks with social learning trajectory and capabilities at 2E when absenting absence through identifying the conversion factors such as individual knowledge, skills and characteristics; physical factors such as soils, slope, streams, climate change (droughts and floods) and social such as culture, policies and political structures, into the various achievable functionings such as new farming techniques and alternatives to maize cropping. At **3L** laminated totalities, the community-based farmers experimented as individuals and collectively (social learning) in their communities of practice, reflected and valued the results of the experiments in order to adapt to the new transformed functionings (4D) such as syphoning of water for flood irrigation, inverted bottle drip irrigation, divergence trenches, conservation basins, use of liquid manure and fertility trenches as shown in this study as new capability sets and achieved functionings.

Reflexivity in critical realism and social learning was not a one-time event and neither was it restricted to one geographical space as farmers reflected as individuals and as families and as a community as they experienced and engaged with a practice at their individual fields and at other farms during Field Days and with far away provinces through videos and social networks. For **VS** it took five years to transform from zero maize crop harvest to four tonnes. **FN** wanted to engage with aquaculture and apiary, a new functioning she had practised since 2015. **JM²** had also worked his new practice since 2015. The youths reflected with the community at different levels while they transformed from conventional farming to organic farming practice. The youths also enhanced soil health in the process, a move from light-

sandy to darker loam soils as part of their new achieved functionings. The trajectory followed by the youths could also be viewed as cyclic, reflexive and recursive as they liked to link their community based functionings with laboratory tests. The theoretical contributions have therefore been based on the links between critical realism, social learning process and capabilities theory and approach. Farmers learnt better when they identified their capabilities and the means, also called the commodities or inputs at 1M. The farmers had to absent the absences observed as ills at 2E through social learning during Field Days and workshops under the communities of practice as a model of the social learning pedagogy.

The farmers continued reflecting at **3L** at different levels [individual, family, community] and transformed at **4D**. Other epistemologies were engaged as the youths proved that their self-perceived morbidity of soils and crops could be triangulated with the observed morbidity of soils and crops through laboratory testing. For transformative social learning as T-infinite and for it to take place, the study observed that the process could be a product of identifying and absencing ills or constraints [dialectical critical realism], a product of social learning and also a product of the farmers' conversion factors. Thus when community-based farmers absent ills through learning from others and with others, they do so when they identify their own individual capabilities and agency and the different disabling constraining factors. This happens at different levels, the individual, the communal, industrial and so on. Learning is a reflexive, reflective and recursive process that is multi-layered from Layer 1 (individual), Layer 2 (the immediate family), Layer 3 (extended or big family), Layer 4 (reflexivity with industry) and so on. The study also had both epistemological and ontological implications as the community-based farmers started to question positivism as the only benchmark for organic standards by sending their own 'organic' products for laboratory tests, a capability set that was traditionally the privilege of the elite.

9.5.2 Field-based Contributions

From the field, the community-based farmers reflected that they wanted to practice their agency transforming from old farming practices, rain-fed, to irrigation and non-crop farming. They wanted to engage directly with industry but they lacked the capacity to supply industry. Tensions as capability deprivation came from their relationship with extensions service. Extension services seemed to lack the appreciation of the knowledges that came from farmers (non-being). Such tensions seemed to restrict the community-based farmers to subsistence

levels when extension was not keen to see the farmers engage in contract farming. The community-based farmers preferred to learn through Field Days, through dissonance and through accepting and modifying other farmers' innovations. Farmers also learnt from the market as was the case with FCS 3, LM², LM³ and WM.

Therefore for social learning to take place, the community-based farmers learnt with and from others through reflecting on the practice and through identifying their capabilities, and absencing ills. The research process was practical by nature since the community-based farmers learnt as they engaged with their practices. Workshops and training were targeted for projects that aimed at more than knowledge generation but knowledge to transform the farmers' practices and well-being. Crop and soil laboratory tests were new achieved functionings coming from the rural poor as they thrived to contribute their voices towards organic standards. This was one technical contribution from this thesis study. The T-infinite model might also be one major contribution from this thesis.

9.6 CONCLUSION

The findings from this thesis reflected that social learning in this study was a reflective, recursive and reflexive process that constrained and enabled the community-based farmers' capabilities and agency in different ways. The social learning and pedagogic process involved a multi-sectoral approach. The community-based farmers, both crop and non-crop, attempted to move from non-being to transformation and agency, being [**1M** to **4D**] through long winding trajectories that were characterised by structurally and politically determined generative mechanisms that were at times not easy to absent. Ills such as the impacts of droughts were absented at **2E** through training and through other social learning pedagogic practices during field demonstrations. When this happens before production starts, a situation I liked to call **T¹** in my **T⁰⁰** framework then ill could be better managed than when farmers learnt of ill at harvest during field days. Review and reflectivity was shown at **3L** (Laminated Totality) and the praxis was accepted as transformation at **4D**. Without a sustainable **T¹** the farmers were likely to move downwards from **4D** back to **1M**.

The study, though at a small scale, could point towards global policy implications as the farmers attained food security and healthy food under organic farming practices (Sustainable Development Goals 2 and 3). The study might also have had implications for SDG 1 through improved income from market gardening and alternatives to maize crop farming such as

income oriented apiary and dendrology. The quality transformative social learning that farmers engaged with could be assessed as SDG 4. The shift by the community based farmers from subsistence farming to a practice that was commercialised and marked by laboratory tests and value addition of products could be viewed as a move towards SDG 9. By engaging in sustainable farming practices such as conservation and organic, the community-based farmers attempted to address SDG 12. Moreover, the whole farming practices in this thesis were adaptations to climate change (SDG 13). Finally to address the research question, the thesis concluded that the 11 farmer case stories learnt of new adaptive practices through social learning which was reflective, reflexive and recursive, but often led to transformation. Overall, however, poverty remained one of the major disablers of these farmers' capabilities.

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Personal communications (Face to face and Zoom talk)

Lotz-Sisitka, H. (2012-2019). Murray and Roberts Chair of Environmental Education, Faculty of Education, Rhodes University, Grahamstown, 18 February, 2019.

LIST OF APPENDICES

1. Letter of introduction into the community of the study



RHODES UNIVERSITY

Grahamstown • 6140 • South Africa

Environmental Learning Research Centre
Tel: +27 (0) 46 603 8390
Fax: +27 (0) 46 622 8028
PO Box 94, Grahamstown, 6140
E-mail: elrc@ru.ac.za

18 October 2013
Dear Sir / Madam

PERMISSION TO CONDUCT RESEARCH

This letter serves to introduce Mr Crispin Dirwai, a registered PhD scholar at Rhodes University, South Africa (Student Number G12D0002). Mr Dirwai is undertaking research into social learning in rural farming communities in the context of climate change. The Rhodes University Higher Degrees Committee has approved Mr Dirwai's proposal and research design and he is now ready to undertake his fieldwork.

The research design Mr Dirwai intends to use will allow farmers and other stakeholders to reflect on their farming practices and food security in climate change risks and help to explore ways to adapt to climate change. The research will be conducted with due attention to research ethics protocols and farmers and others involved in the research will be asked for consent to participate in the research at individual level. The study will also respect their wish to withdraw from the research should they want to. The research methods will include observations accompanied with photographic-documentation, detailed interviews and focus group discussions.

I therefore kindly ask you to allow Mr Dirwai access to conduct his research in your organisational or community context.

Please do not hesitate to contact me should you require further information.

Yours sincerely,

Professor Heila Lotz-Sisitka
Murray & Roberts Chair of Environmental Education
Research Supervisor

2

Ethical clearance in the village of study



RHODES UNIVERSITY

Faculty of Education: Environmental Education (EE)

PhD Project: *Climate Change Education*

Title of Project

Exploring social learning within the context of community-based farming: Implications for farmers' agency and capabilities.

Dirwai Crispen (G12d0002)

To the Kraal Head

RE: Permission to Carry-out a PhD Research Study in Muchena Village

My name is Dirwai Crispen a PhD Rhodes University student who is carrying out a research study entitled: **Exploring social learning within the context of community-based farming: Implications for farmers' agency and capabilities.** During the data collection process, which might take more than a year of visiting your village, I do hereby ask for your permission to interview and observe eleven of your rural farmers in the village during Field visits and Field days. The eleven are involved in climate change adaptive crop farming and non-crop farming practices such as apiary (bee-keeping), dendrology (tree and shrub nurseries) and aqua-culture (fish-pond farming). I shall be talking to the eleven farmers as individuals and talking to them in small focus groups. For my research evidence, I do hereby ask for your permission to take photos and videos of the crop and non-crop environments as well as the individual farmers themselves as they work in their fields and as they learn from each other during the agriculture Field days throughout the study. In order for me to use the farmers' photos and videos in my study, I will also ask for written consent from each of the eleven targeted farmers. The results of the research, apart from being academic, are envisaged to help the rural farmers appreciate new climate change adaptive practices for food security, and, to appreciate appropriate organic farming standards for the purported health of the people and that of the soils in the village. As the custodian of culture, the people, the crop fields and surrounding environs, as well as the custodian of ethical issues in this village, may you please show by written consent that I can freely carryout my study. And, if you observe a breach of culture and that of ethical issues, by myself, during my study in your village, you are free to immediately stop the data collection process.

Yes ☒ ----- No -----

Name of Kraal Head (optional) Abraham ----- Signature AM ----- Date 15/11/13

3 Research Instruments

Interview and Observation Guide (Farmers' Case Stories)



RHODES UNIVERSITY

Faculty of Education: Environmental Education-(EE) PhD Project

Area of study: Climate Change Education

Title of Project: Exploring social learning within the context of community-based farming: Implications for farmers' agency and capabilities.

G12D0002: Dirwai Crispen

Farmer's Case Story

RE: Permission to Interview and Observe Target Crop and Non-Crop Farmers in Muchena Village

My name is Dirwai Crispen a PhD Rhodes University student-who is carrying out a research study entitled: Exploring social learning within the context of community-based farming: Implications for farmers' agency and capabilities. I have chosen you to be part of my research study because of your climate change adaptive practice in: crop farming/apiary/dendrology/aquaculture (researcher to tick the most appropriate). During the data collection process, which might take more than a year of visiting you, I do hereby ask for your permission to interview, observe, take photos and videos of you whilst you work and learn during Field visits and Field days. However, your actual names will be replaced with codes to protect your identity. At any given time of my study and visits, if you feel you are no longer interested to be part of the study, you are free to opt out of this study. If you agree to participate then you can sign for your consent:

Yes-----No-----

Name of Farmer (optional) Lloyd Signature L

Permission to be recorded L.N

16/11/13

1. What are the current farming practices and the types of resources that you are currently using and what were they like before? Researcher to observe, document and take photos of the practice and verify if it is/are compatible with climate change adaptation/s.
3. What factors made you to shift from old to new practices and do you enjoy the practice as compared to the old? Researcher to observe, probe and document evidence that might indicate whether or not the farmer enjoys the new farming practice (achieved capability).
4. How do you learn this new farming practice? Researcher to probe all learning platforms used to share information, where and when. Researcher to take part in observing the learning process whenever present.
5. What about markets? Do you market your products and where? How do you learn about markets and what are the challenges faced when marketing your products? Researcher to observe probe any marketing activities. Researcher also advises the farmer that he will carry-out multiple visits cross-checking on any updates on the major questions asked.

Thank you-Ndatenda-Mwazvita

Unstructured (open ended) Interview Guide: Farmers' Case Stories



Faculty of Education: Environmental Education (EE)
PhD Project

Area of study: *Climate Change Education*

Title of Project: Exploring social learning within the context of community-based farming:
Implications for farmers' agency and capabilities.

G12D0002: Dirwai Crispen

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Yes-----No-----

Name of Farmer (optional)-----Signature-----Date-----

Permission to Record Detained Interview. (Signature)-----

1. Tell me about the type of farming practices in the early 1980s, the resources that were used and the rainfall patterns experienced in this village? *Researcher to probe all farming activities.*
2. What about the current crops and no-cropping activities that you practice today? When did you change and what were the reasons behind? What resources are involved and how do you source them?
3. How do you learn these current farming practices and what do they say about these current farming practices during trainings and social learning sessions? *Researcher to probe on the methodologies used and the type of knowledge shared. Researcher to probe all who are involved in knowledge generation for the new farming practices.*
4. Do you enjoy practicing your current farming practices? If not tell me why and if yes, tell me why you say so too.
5. How are the social learning interactions in your community groupings (*a climate responsive community of practice involving multiple stakeholders*) currently supporting you as communal farmers to learn new adaptive farming practices? (*Researcher to probe issues of climate change adaptation and green agriculture economy and which stakeholders do emphasise on that and what exactly they say and what they miss which remain absent in the farmer trainings. Researcher also to probe the roles of the different farmer agents and climate change activities as they influence farmer activities*).
6. How do the learning processes and practices promote or constrain your ability to shift from old practices to new practices (*conversion factors: personal, social and environmental*).

7. How do the learning processes promote or constraint the process of turning resources into new functionings (*valued beings and doings*) as achieved capabilities that respond to socio-ecological climate variability and longer term climate change induced risks amongst farmers?

11. What generative mechanisms (*any archival information, documents, policies, standards and training documents*) shape the social learning and the conversion of resources into new functionings and capabilities associated with adaptive farming practices?

Are there any comments on how you want to share knowledge with other farmers on the new practices? Please feel free to say out your mind for the benefit of the community-----

-----**Thank you Ndatenda-Mwazvita**

4. Transcriptions

1. November 2011 to May 2012: A social learning trajectory through intergenerational knowledge transfer.

ED, Old female demonstrator on organic farming: This is how we used to do it (broad casting small grains in soils) in our old days. We mixed the small grain with soil or sand. We used to do this dry planting sometime in September as rains used to come in early October, today we do it in November expecting rains this month.

The old female demonstrator happens to come and help the young organic farmers learn traditional farming practices whilst trying to add soil fertility by organic means (converting the soils from the use of artificial fertilisers to organic manure). The young organic farmers put the practice into action, the agriculture extension officers come and monitor as well as promote the organic practice. If the practice is approved by experts then a much bigger Field Day or a before harvest event is called for where the entire villages will come to learn from the new practice. Organic farmers are keystone to this thesis and project (November 2011 focus).

FCS 3, MM Female youth: [To ED the old female organic demonstrator]. Why do you mix the small grains with soil?

ED, Old female demonstrator on organic farming: For good spreading of the seed and crop. If you don't mix with soil chances are high the crop will be heaped in one space upon generation. To avoid such heaping on a particular space, we mix the grain with sand to encourage good spread and spacing of plants.

FCS 3, MM Female youth: And how do you cover the seed and why?

ED, Old female demonstrator on organic farming: Yes we can use a hoe to cover the seed from insects, ants or even from birds. (*demonstrating on the broadcast method*). Before people came up with the linear method of small grain production, we used to do the broadcasting method. But the soils must be thinly spread to avoid overburdening the seed.

FCS 3, LN: Youth Leader in the project. Referring to the broadcasting method was that not a poor method as some could germinate even outside the field?

FCS 7, LM² Male Teacher: Yes it had disadvantages but since we are hereby experimenting on the two processes, linear and broadcasting, we should be able to study the germination rate, weeding process and the harvest, from these two methods used. We can also use the results when teaching our children in class.

FCS 3, MM: Female youth. So that is how you used to cover the seed? Those unfortunate seeds found under your feet were they ever going to germinate?

Chorus answer (*younger members laughing*): Why not, once it rains all the seeds will germinate. [N.B from literature, reviewed on small grains, there is plenty of potential on the world market especially those countries that take small grains for stock feeds. Here knowledge is generated through discussions; even younger members of the community had ready answers to some of their cohort' questions. Environmental conversion factor-slope or gradient which propagates gravitational force for possible drip or sprinkler use at this demonstration center, a factor that is not present in all

homesteads, even when the rains delay the small grains were still watered under small scale irrigation. A factor that was also considered in the all stakeholders meeting with the Agro-based industry. Dry planting was done on 1/11/11 and harvesting was done on 11/05/12].

11/05/12 Harvesting small grains 3 members present, FCS 3, MM and AK² and ED the old demonstrator.

ED, Old female demonstrator on organic farming: *Demonstrating on rapoko harvesting rapoko techniques:* We use a knife to harvest the small grain. We take the large open basket (*dengu*) and put in the harvest, once the open basket is full then we put in a 90 kg bag and once that is full we send home. We used to process communally (*nhimbe*) where a group of people assemble at one homestead with beaters hitting the finger millet until all grain is separated from the plant. Once it is done we apply the winnowing process (*pressure gradient method*). The chuff will be blown by the wind whilst the grains will fall directly in a container. We use a winnowing basket (*tsero or rusero*) for that. We further process it into mealie-mill using the grinding stones (*huyo*).

N.B literature has noted that this traditional way of processing finger millet or rapoko means the nutritional value of the crop is maintained unlike when modern milling is done.

CD: Are there any advantages in the small grains over the conventional maize crop?

ED, Old female demonstrator on organic farming: Conventional maize crop is better. Rapoko is difficult to harvest.

N.B During interviews with **FCS 2, BC (VH¹)** the issue of culture where *mhunga* is not a permissible crop in Mutasa district (*unoripa netere*) If you plant this crop the only way to appease the spirits of this land is for you to emigrate. You see how dangerous a crop that is in this area. Planting such a crop is like wishing for droughts. Whilst culture prohibits the cultivation of *mhunga*, literature has noted that this is a more nutritious crop with much bigger markets outside Africa

ED, Old female demonstrator on organic farming: However rapoko is good for it does not easily succumb to weevils like maize. You don't apply artificial fertilisers on rapoko production neither do you need pesticides on storage. You save money.

CD: How do you store rapoko?

ED, Old female demonstrator on organic farming: We put in a grain silo (*dura*) it can take ages before it is attacked by weevils unlike maize. Maize easily gets attacked and that is why we use chemicals in the silos to drive away weevils from maize. Rapoko is difficult to weed unlike maize and so people don't like it. The harvesting process is tiresome as it is very manual and taxing where traditional beaters are used. The beating process only separates the grain from the plant then you use (*mortar and pestle*) to separate the grain from the sheath then the winnowing process to remove the chaff and lastly grinding it with stone grinders into mealie-mill, that is a difficult process altogether.

N.B taking back to literature, all over the SADC countries, small grains are poorly marketed, even though they fetch a better value structurally people are accustomed to maize production and it can be a culture difficult to break.

CD: Do people like practicing small grain farming? What about issues of health, can you talk about rapoko and the sick. (As a new capability the new functioning also has challenges as shown below)

ED, Old female demonstrator on organic farming: We recommend porridge from rapoko for the sick. It is good for their health.

CD: What about the modern grinding mills, can these process rapoko too?

ED, Old female demonstrator on organic farming: Yes nowadays it is easy to process rapoko using the modern day mills.

(N.B. Absence is the link between the small grains and inside and outside markets, that is a possibility of a missed capability, also one of the three pillars of ESD-the economic aspect, also emphasised in the organic training under climate change adaptation is also missing).

CD: What about relish, is it possible to take rapoko (*sadza*) with any relish?

ED, Old female demonstrator on organic farming: Yes but is favourable with chicken stew, beans or beef stew and not good with other traditional vegies.

CD: After that demonstration in November last year (2011) how many people in Muchena village have embarked on rapoko cropping?

ED, Old female demonstrator on organic farming: Very few people have planted rapoko this year. They say it is difficult to weed that is why they did not embark on it.

FCS 3, **BD** [June 2017] As a grandson to **ED**, I also learnt a lot from my grandmother. I learnt of how to grind the small grains into a mealie-meal. Today (2017) my family cannot experience starvation. Today I am now empowered with the skill to [process rapoko into mealie-meal without processing it through the hammer miller] sustain my own family when there is no money for hammer milling. I also learnt a lot from my grandmother especially how to grind the small grains into a mealie-meal. Today (2017), I cannot starve because I don't have money to pay for hammer millers to process my small grains, I do it by myself.'

N.B The question remains why the people dislike rapoko but prefer maize that is affected by climate change and often (they) do not realise any harvest at all? Thus the issue of structures as people were oriented into maize cropping, and other cash crops like tobacco and cotton and now it might be difficult without rebranding rapoko, for people to accept it.

Lessons: From the field demonstration that the 15 members learnt included how to plant rapoko (finger millet). Even though several advantages were noted, very few community members went back and do the practice. Rapoko they said it is difficult to weed and harvest (more according to literature it is not commercially marketed). One community member not in this sample had this to say in the year 2013, on the small grains:

'I will never risk attempting small grains again! They say, they fetch much better than maize (price), but where is the market? I had 25x50kg bags and that was massive but I struggled to get a viable market, I tried hospitals and they said they only take products from reputable producers, the same was said by hotels and departmental stores. How can we become reputable if we are not supported?'

15/05/12 Processing of small grains by the youths: A skill demonstration

FCS 3, MM. (processing rapoko in mortar and pistil) we pound the rapoko in mortar using the pistil. After that we winnow and then send to a grinding mill.

CD [13 July 2017]: How did you learn about the production, harvesting and processing of small grains such as rapoko? (pedagogic trajectory)

FCS 3, **MM** [on 13 July 2017]. We learnt from grandmother a lot of things. She taught us that small grains are drought resistant. That small grains are good for their nutritional (capability of health and nutrition) values especially for the terminally sick. Grandmother taught us that of the old methods of sowing small grains and the new method is about putting the grains in lines along across the contour as this ensured a uniform spacing between the lines and it has an aesthetic value too. Grandparent **ED**, *Old female demonstrator on organic farming*, also taught us how they did it in old days. In grandmother's days they used beaters on a prepared ground but nowadays we pounce in a mortar then winnow and send for grinding mill.

CD: How long does it take to fill a 20kg container?

FCS 3, MM: This is a very fast process, depending on the size of the grains. If there is enough wind, then it is fast to separate the grains from chaff and the process is even faster.

N.B Understanding pressure gradient is an important conversion factor to facilitate in the processing of rapoko.

FCS 3, BD: (Male grinding rapoko into mealie-meal). I help my wife prepare the mealie-meal since we do not have money to send for the grinding mill.

CD: Who taught you the skill of stone grinding rapoko into mealie-meal?

FCS 3, BD (male youth): Grandmother **ED**, *Old female demonstrator on organic farming*, taught me this full process. In times of scarcity without cash, children will not starve but we prepare a meal through this traditional food processing technique.

FCS 3, MM (female youth): From this processed mealie-meal we can make porridge or thick porridge (sadza). If we want *mahewu* (*maghewu*), we first ferment the seed (*N.B a process that has been noted in literature as possibly poisonous*).

CD: How do you test for quality of finished product?

FCS 3, BD (male youth): Through filling between the fingers. If it feels smooth then it can be good for food preparation, if it is coarse or rough then it still needs more time in the 'mill'. Grand mother taught me these techniques.

ED, *Old female demonstrator on organic farming (monitoring the grinding process)*. He can still observe by sight without feeling with fingers that the processed meal now dropping onto a capturing device is smooth and not rough.

FCS 3, **MM**: [10 October 2017]. Today we now know from the knowledge that we gained from grandmother, knowledge shared with other farmers and knowledge that we gained from the extension service through the field demonstrations, that small grains are good for our health. We now have massive knowledge for every stage of production and processing of small grains like rapoko. Knowledge such as field preparation that is sowing, weeding, harvesting, pounding, grinding to knowledge on how to prepare a meal from small grains. We also learnt of the best types of relish that suits the small grain meal [referring to *sadza/pup/nzima* or thick porridge].

CD: As a summary, what can you say about the knowledge that you gained from Grandmother, **ED**?

FCS 3, **MM**. While we learnt a lot from grandmother on the production of small grains, the process from planting stage into weeding, harvesting, shelling, stone grinding into a mealie-meal, is laborious and not easy as compared to taking maize to a hammer miller as we are used today. The small grains are good but they too have some challenges. Small grains cannot be taken alongside any relish such as vegies as is the case with maize meal and as a result they remain unpopular amongst people in this village. We know of a colleague too, in another village, who had 25 bags [25x50kgs =1250=1.25tonnes] of small grains and he got stuck with them. He tried to market them at hospitals so that he could get the means to buy maize, our staple food, but they did not buy, he tried supermarkets and they too did not buy and so he ended up exchanging it with maize as barter trade with those who produced traditional brew. From such experiences, even when we want to produce small grains in bulk we have to think twice! Remember our staple food is maize meal and when we produce small grains, we do it in the hope that we will sell them and buy our staple food, maize meal. By practising organic agriculture, we hoped this was going to solve the problem of pests since we are testing the use of traditional methods to control some of these pests.

CD: Thank you do you have any other insights to share?

FCS 3, **MM**: Sure! So after reflecting on the poor sandy soils of 2007 we embarked on organic farming, starting with soil enrichment using small grain. We wanted to the new farming practice throughout the year. But we needed water for irrigation. And so we continued reflecting amongst ourselves and consulting the community leadership on ways to sustainably harvest water from the nearby spring without causing it to dry up. At first the community leadership ruled out a fuel powered water pump but recommended a manual bush pump. But without machinery, it was so difficult to fill-up the two cement and brick-built water reservoirs upgradient using human power. Thus still, we further reflected on the water issue with the community elders and so we tried to have a temporary small earth built pond that had to be constructed some distance away from the main community water point as a water harvesting point for water extraction by fuel powered pump into the built up reservoirs.

6th October 2012 Field Day at the youths demonstration site

Children's poems during Field Day

ChdPoem1: The organic farmer

She befriended the hoe, she sourced knowledge from her community, and she got resources from her surroundings. The organic 'green' product is here for all of us to see. This is now our inheritance. Let's take this knowledge over to the next generation. Stop complaining, oh you farmer, be productive on the land, Plant in time, seek knowledge from others, let's always protect our surroundings in the farming process. To refuse yourself inherited knowledge is like denying that you have a 'Totem', Thank you. (*Poem written by Mr Lovemore Manhanga, St Georges Primary School Penhalonga, a practicing organic farmer (6 October, 2010)*)

ChdPoem2: Organic farming knowledge

Organic farming is 'the' farming, no two ways about it (*hapana chitsotsi apa*). If you till the soils you harvest 'money', No two ways about it. Get food and money, to 'kill' hunger, handle the how well, Learn from others in order for you to be successful in farming. If you listen to the weather advice (radio and television) you won't miss production. Thank you. (*Poem written by Mr Lovemore Manhanga, St Georges Primary School Penhalonga, a practicing organic farmer (6 October, 2012)*)

ChdPoem3: Knowledge is power

Knowledge is power, today we witness how locally available resources are utilised. We have witnessed how to protect our resources through good farming practices (conservation-terracing as observed during a field day). We have witnessed how water has been harnessed and fully utilised. We learnt about irrigation skills with green crops during this very dry period, we have learnt of natural and nutritious food production, non-genetically modified. Now let's share this knowledge with many others back home. This farming practice has opened a new era, we salute you (*organic*) farmers. Thank you. (*Poem written by Mr Lovemore Manhanga, St Georges Primary School Penhalonga, a practicing organic farmer (6 October, 2012)*)

Field day 1 in the PhD data collection process 6 October 2012

CM¹ *a farmer agent specialised in crop science: (Keynote address by Agritex to farmers, teachers, school children, kraal-heads, as CoP).* My name is Agritex Officer **CM¹**. I am standing in for the supervisor Mrs. **MNA** (*the farmer agent who is responsible for the district*) who could not make it today. First I am so impressed by the poems that (ten) children have recited. I, together with many of you, must have learnt a lot from the poems. The children have just reflected that teachers are moving with time on environmental education. You are actually supporting our cause as Agritex. The children made my task easier as they said most of what I wanted to say. However, I am going to add a few more points before we go to observe the actual product and learn more from the practice. I want to appeal to all farmers here present to continue working with your Agritex officers, so that you share knowledge on best farming practices. When people use artificial fertiliser when the rains are scarce, there are gases that are associated with our fertilisers [ammonium nitrate] and those gases from these fertilisers, rise into the air, [beyond the atmosphere] disturbing part of the air called ozone layer. Apart from reducing the destruction of the ozone layer, manure helps in making up the soil structure it provides the binding network to soil materials for it to be called rich and productive soil. On the cultural methods that we can use to control pests, rotation of crops and mixed farming where we plant onion and garlic within the same space with your crops is good. Let me talk of conservation. The farming practice here is called conservation farming. Why do I say so? This is farming that conserves the soils, there is massive terracing that was done, there mulching of crops to conserve moisture, there is manuring of soils through composts. Try to compare this field with that of farmers who are still applying synthetic fertilisers, you will observe that the soils here are much richer than those where synthetic fertilisers are applied. At the end of the day fertiliser infested soils will quickly 'gets tired'. Manure supported soils will remain strong for a long time. We encourage all farmers to use the cultural method that we find here, use of manure. Organic food is for our health as was said by one farmer here present. [on spacing for pea crop]. Peas have a tendency of 'nesting' and you need to spread them apart hence there is need to leave a walkable gap after every 4 rows. Well let me elaborate on the old type of farming that we now want to abandon. Long time ago people used to practice shifting cultivation as a way of resuscitating soil fertility. People used to slash, burn, plough, shift after a few year and repeat the process at another plot whilst the first plot lay fallow. Nowadays where is that land to waste? Remain on where you are and try to improve the soils to take you for generations, practice conservation, put manure in the conservation holes, and make composts for your soils to remain healthy. Here we have witnessed intensive agriculture, farming on a very small piece of land but with very high yields. How many onion plants have you observed, try to divide by 3 to get how many dollars our organic farmer can get from a market. Let us all utilise the very small portions that we have in order to survive.

FCS 4, SM² (*after the Agritex demonstration on the unearthing of onion bulb process*). Why do we have to do that process?

CM¹ *a farmer agent specialised in crop science:* This is to reduce continuous bulbing. We earth them to encourage bulbing and we unearth to discourage that process. Not all markets want very huge bulbed onions. To maximize on market you have to unearth.

VM: *Organic farmer.* We are happy with this Field Day. I have collected some garlic bulbs from this field. Garlic helps reduce my cardiac problems and reduces my high blood pressure to acceptable levels. From this field, we have learnt a lot, last time there was rapoko (small grain), which is also nutritious and good for our health. I am also encouraging other farmers that let us continue doing conservation farming.

TM²: [organic farmer during a Field Tour at the youth project, July 2015, speaking on the new capability of organic farming and nutrition under irrigation]. We like practising organic farming through digging basins [conservation basins]. We do not apply artificial fertilisers nor do we apply chemicals on our plants. As a result, our products are good for our health. Look, even small children complain of painful swollen legs. We don't know the source of such health problems but we suspect it is associated with the foods that we eat which are contaminated with chemicals and synthetic fertilisers. Contaminated foods cause illnesses.

VH², EM: (*Village Head²*) I actually wondered, this time of the year, during the hot sun of October, to get an invitation on an organic onion project. I came only to prove if it is true that people can do viable farming when the rains are nowhere near. Where and how do they get the water? Now I have the answers, it is possible to farm throughout the year as long as you have water. I have learnt a lot about the water harvesting techniques and the conservation techniques that are used here. With water reservoirs this conservation (organic) farming can be made possible in my entire village.

Learning through workshops: Training in Agroforestry 15-05-13

Organic farmers, teachers, children, community leadership gather at St Georges Primary school to learn about ESD from the forestry agent (30-05-12 and 15-05-13). What is it that they learnt? In workshop training 1 the flip charts were used to show the knowledge generated from the participating audience including the village head and one kraal head. Questions were asked by the Forestry agent about the importance of trees (fruit, the indigenous and exotic) to the local community, factors that needed to be considered for the best location and best soil to start a good tree project.

TM¹ Forestry extension (Connex) (*late*): Long time people used to farm on several pieces of land. Leave this piece fallow for ten to 15 years, embark on yet another whilst the latter recovers in fertility. Today, this is no longer possible because of population pressure on the land. We now have to protect the little space that we have from soil erosion (*gukuravhu*), lets plant trees **30+ participants:** Provided information on the advantages of trees to human life and the environment. The need to plant many trees of different kinds, ways to combat soil erosion.

TM¹ Forestry extension (Connex) (*late*): But we cannot just produce trees to replenish the degraded environments, we also have to benefit. Trees are a source of livelihood. You can survive on tree production. I want to challenge you to use the knowledge that we have shared here and go and produce trees that we can help to market. In whatever you do aim for quality products. Gone are the days when you just produce something expecting it to be bought by anyone out there?

FCS 9, FN: (*summarised the days' workshop and quickly compiled a song and songs to do with the Thesis are on video*) 'Here in Muchena village, we have been given yet another chance to plant trees!'

Workshop 2 from the same Forestry Agent (15-05-13)

TM¹ Forestry extension (Connex) (*late*): (workshop2): We did our training in May 2012 and I hope the products that we trained in are here for all of us to see. Now I have come to share with you about the markets and contracts for the tree products. There has been massive deforestation in the country and at time our tobacco farmers are the culprits. The government enacted a law to make sure all tobacco growers do have evidence of a woodlot or a tree nursery to that effect. We look forward to tobacco companies that they come to our rescue and buy the tree seedlings that we have produced. What draws us back is the issue of contractual agreements. You might not be familiar with contracts, these are the legal documents that you sign upon agreeing that you will supply so many tree seedlings of such quality and on such a date. This is important for you to understand as you move from mere subsistence tree producers to commercial. We therefore need to work hard so that we meet the demands of the market and the contracts. Each working at her homestead but you have to coordinate yourselves so that you plant at the same time, maintain the quality we have talked about, send the number of your tree seedlings to a central point, let's say here at school. The school will give our Forestry offices the total number of tree seedlings from this village. Our office then coordinates with the tobacco companies so that the tree seedlings are collected as one bulk consignment from the village. Each of you will be paid according to the number you have supplied.

FCS 9, FN: (*summarised the days' workshop and quickly compiled a song, all songs linked to the Thesis are on video*) 'When-ever you see **TM¹** coming into this village, it is all because we agreed as Muchena village to work with him.'

Demonstrations on New Practice by the youths at the demonstration site 14-05-13

FCS 3, SM¹: *Female youth*, This is our compost, we learnt about compost making from Agritex officers, Ms **NN** (*a farmer agent who specialised in animal husbandry*), Mrs **PN** (*farmer agent responsible for the community under study*), Mrs **MG** and Mrs **MD**. We also had an idea of the new ways of compost making from our member **FCS 3, KM**. **FCS 3, KM** watched some videos on compost making at the University of Zimbabwe in Harare and these were from other organic farmers in South Africa. **FCS 3, KM** shared with us the practice that he learnt from those videos and today we have completely shifted to that new practice of compost making technique.

CD: How did you use to do composts before **FCS 3, KM** brought in the new practice?

FCS 3, MM: *Female youth*. We used to dig pits, let the materials decompose then we later 'mined' the materials out of the pit.

CD: How do you do it today?

FCS 3, MM: *Female youth*. Today we prepare above the ground composts, measuring 2x2x2m (length, width and height). We put brown materials at the bottom then green materials from our harvested peas crop, then manure from the chicken droppings. By the way we keep 200 chickens to help fundraise for our project. We continued alternating, browns, greens, manure, and we water the compost heap daily when we water our crops, to fasten the decomposition process. Compost is therefore the source of manure that we apply to our crops.

FCS 3, SM¹: *Female youth*, Had we but enough manure, we would have hoped to have two or even three more compost heaps as of today.

CD: How do you intend to overcome the problem of manure shortage?

FCS 3, SM¹: *Female youth*. If we raise enough from the current product, our current onion crop can take us through to buying a few goats or even a cow. This will ease our manure crisis. Goat and cattle dung, will supplement the chicken droppings that we already utilise. Buying manure from neighbours with cattle 'eats' into our profits.

(N.B availability of cattle can be noted as a good socio-economic conversion factor to people's functioning of organic farming).

Focus Group Discussion with 4 rural farmers and an agriculture extension officer

CD: My name is **CD** a PhD student at Rhodes working in the organic project here in Muchena village. I would like to hold a discussion on the path that you have taken so far in organic farming in this village, if you are free to participate then we can continue. The discussion is captured on video if that is fine with you. If that is not fine with any of you, you are free to opt out at any time within the discussion. *(Letter of introduction and consent forms were signed by the 4 present)*

FCS 3, LN: *(Youth Leader at the demonstration site)*. My name is **LN**. I am a practicing organic farmer here in Muchena village.

FCS 3, SM¹: *Female youth*. My name is **SM¹** I practice organic farming here in Muchena village.

FCS 3, MM: My name is **FCS 3, MM** Female youth, I practice organic farming here in Muchena village, near Penhalonga, Manicaland in Zimbabwe.

NN *a farmer agent who specialised in animal husbandry* I am Ms **NN** Agritex Officer specialised in animal husbandry. I work here in Muchena village ward 26 (*Nyasukwa*).

CD: When exactly did you start practicing organic farming in this village?

FCS 3, MM: *Female youth*, January 2009 to be specific after we had embarked on a tree nursery raising project in 2008.

CD: Why did you start this project?

FCS 3, MM: *Female youth*, It was our wish to do so. People in this village complain that if you practice farming without fertilisers it is a waste of time and so we wanted to experiment on that. Secondly we had a running project on tree nurseries, you know tree seedlings are a seasonal venture and instead of waiting for the rain season in order to start another tree nursery, it was imperative to go for an all season project to supplement the tree one. From then we have enjoyed the practice. All that we produce since January 2009 is organic.

FCS 3, LN: *Youth Leader*, Also there are now many pests which are difficult to control and this can be a result of the very high temperatures nowadays and practicing organic we thought was going to solve the problem since we are testing use of traditional methods to control some of the pests.

CD: How is this new farming type different from the old farming type that people used to practice in this village?

FCS 3, LN: *Youth Leader.* Before 2009 we waited for rains to come, plant a crop and wait to harvest. Today we plant crops throughout the year, beans, peas, onion, veggies, butternuts, pumpkins, tomatoes and garlic. We don't just practise organic horticulture, we also plant maize crops (OPV) under organic conditions and under small-scale irrigation [a new mode of production]. We don't buy the seed but we use our traditional OPV- Hickory-King-[Hakiri-king in local language] that we acquired from our village head FCS 2, **BC**. We learnt from elders like FCS 2, **BC**, that this type of maize crop is similar to the then SR52 and requires a lot of water, long season variety [evidence of transfactuality]. In the absence of long rainy seasons such as the erratic rains and frequent droughts as a result of climate change we are experiencing today, people can't plant the traditional maize variety, a high rainfall seed variety. Luckily in this demonstration site, we have 'irrigation' facility and liquid manure. We plant our OPV during the dry period of September [under small scale irrigation] and we harvest by March after 5 months, ready for our peas winter crop. I can also add that the rains in some cases, never came until we lost the crop to droughts. Now with irrigation, we have realised that today (2015), we plant crops throughout the year and long season maize variety (OPV) in particular since we can water throughout the year.

FCS 3, MM: *Female youth.* We have learnt to practice crop rotation. So after reflecting on the poor sandy soils of 2007 as I noted before we opted for the small grain and then moved into organic farming. With a fuel powered water pump in place we realised our dream to move towards organic farming and towards a three crop cycle. For the peas-crop, we had to fill in the manure in small trenches and not basins this time. The product was not competitive at the market we reflected on liquid manure, a technique we learnt from GC.

CD: How do you learn of these new practices?

FCS 3, LN: *Youth Leader* Our Agritex officers are our main source of education and we also learn from each other as we interact during field days.

FCS 3, MM: *Female youths.* Mainly Mrs **PN** and Ms **NN** here present.

CD: *(To PN is the farmer agent responsible for the village).* How do you share knowledge of farming practices with the farmers in this Muchena village?

NN *(a farmer agent who specialised in animal husbandry).* We work as a team, *(mentions 3 other Agritex officers)*, if a farmer identifies a problem which s/he needs solved, we go to the farmer's field and attend to that problem. For example the organic farmers called for a compost session, and we teamed up and went to help solve the compost problem by taking up in the building of the compost to completion. In that way our farmers learn together with us. We share knowledge but it is the farmer mainly who identifies a problem. After the compost making process we had a field day in September and the organic crop that we show-cased to the village was great. The village was shocked as people thought it was the artificial fertilisers only that was good for crops.

(N.B this is a shift from the literature where extension work was not directly linked to farmer's needs, see literature). Still absent is the economic aspect of the learning process. People are producing but if they produce without gaining financially is not motivating enough to take the farmer back into the field).

CD: What resources do you use in organic farming?

NN *(a farmer agent who specialised in animal husbandry).* We use compost manure; we also use dung and chicken and goat droppings. We also practice rotation of crops.

CD: How do you learn about marketing of your crops? *(Market is envisaged to be a disabler or enabler of capabilities and functionings)*

FCS 3, SM¹: *Female youth.* We were taught how to farm as business by **CM²** a donor farmer agent. Now take a sample of our produce to the market, **S, O, T** and if they favour our product then we come and pack larger quantities. We have receipts as evidence of what we sale. For our organic garlic crop, we packaged some samples in black plastic bags and the packaging was automatically condemned by the market. But during the reconnaissance for the same market, such conditions were never stated. Once we had managed the packaging issue correctly, there came the quality and quantity issue. To fight that, we had to buy a suspended scale that could measure up to 20kg so that we would do our weighing at home and go to the market with the exact or slightly above quantities. More, with the

right weighting, quantities, quality and correct packaging, there came the hurdle of registration. This VAT system was something that we had little idea about at that time (2013). So we resorted to sending our peas products to the open market (urban) where such conditions were not in place.

FCS 3, LN: Youth Leader. We trained between 27th to the 31st of May 2013 in farming as business. We learn about new ways of farming in the marketing aspect. We learnt of record keeping.

N.B The issue is if farmers were taught about farming business, keeping records and so on, why is it that the rural farmers continue struggling to sustain their lives? What sort of knowledge do farmers get? Is that what they want? Or want to have? I can link this to structure and agency relationship, capabilities and conversion factors and the issue of absence? I crosschecked on what another farmer had this to say: 'In my community donors encouraged over 1000 farmers to grow garlic. After harvesting we were all moving in town with bags of garlic and there was no one to buy from the many of us, at the mean time we had abandoned our traditional maize crops hoping to get cash from garlic, the cash that never came our way and we ended up without food to eat.'

FCS 3, LN: Male leader. We learnt about the need for budgeting first before we start production. We learnt that we need to consider our inputs including labour and predict our supposed output, if the crop is not profitable then do not go for it. *(But if they get all this education then why do they still struggle with markets?)*

CD: What about Agritex, what did you learn from this donor-run Agro business workshop?

NN *(a farmer agent who specialised in animal husbandry).* We enjoyed this workshop, for five days our farmers discovered farming business. People used to think business is just about running grocery shop, but not, farming too is a good business. We all learnt a lot from this donor agent. We (Agritex) were also empowered as farmer agents into other approaches to help our farmers learn practices. There was a mixture of writing, documenting, form filling all was made easy by the participatory approach used by the donor agent. Our people could follow proceedings and I hope the education that we (Agritex and rural farmers) got will go a long way to improve our farmers' practices. **CM²** came for this type of workshop on two occasions, first in May and second on 1 -5 July 2023. They chose those practicing organic farming. They talked about the importance of organic farming to people's health. People now want to consume healthy foods without chemicals. The market also is slowing adapting to organic products. Our supervisor also attended on the first day of training. *(I note contradiction with what the market said in the interview with climate smart).*

CD: After the training what benefits did the training yield in terms of marketing.

FCS 3, MM: Female Youth. We started our new project by making a market survey about the product; we went to S, M farm produce and T shops, knowledge that we gained from the trainings. The market promised to take the product if it meets their quality demands, so we embarked on a winter crop, peas which could not be attacked by pests easily because of the cold weather. We collected humus from the bush and from the mounted compost and cow dung, filled up the dug conservation basins. This created a new mode of farming, conservation farming. For peas and onion crops we did not dig basins but we dug small trenches that we filled with compost manure. Apart from basins and small trenches we also applied mulch for moisture preservation. But, still, the product was not competitive at the urban open market. The market complained about the quality. As I noted the other day, by 2013, the humus collected from the bush, composts and cow dung, filled in the conservation basins. For the peas and onion crop we had to fill in the manure in small trenches. We also applied grass mulch for moisture preservation but the crops were not competitive as I noted above.

FCS 3, LN: We experimented on the use of liquid manure. This time we increased the volume from the small watering cans to 200 litre drums. This we did at a proportion of 30% cow dung and 70% water. Liquid manure was our miracle-fertiliser we were looking for as the crop quality and quantity drastically increased.

CD: Thank you very much is there anything else you want to add.

FCS 3, SM¹: *Female Youth* Yes, we also learnt a lot from the market. At first we went to the market with our products in black plastic bags, we were taught this was not good packaging. The procurement manager at Farm produce showed us better packaging that was acceptable at that level of market. I quickly borrowed money to buy the packaging material, repackaged and then submit our consignment, by 12 o'clock, I was paid. That was a great lesson.

FCS 3, LN: *Leader of Youths.* From M farm produce I also learnt that we need to have our own measuring scale. They take products to a specific weight and if you do not weigh your product then it becomes difficult to market it. We (*the organic farmers' group*) bought our project weighting scale immediately after we had been paid for the day's consignment.

15/07/14 Interviews with FCS 3, LN

FCS 3, MM: *Female Youth.* We also attended other trainings where we have been taught about importance of trees to our surroundings and the need to continue planting trees. This was by Forestry Commission. **TM¹** (*late*) was the Forestry extension (*Connex*) I had forgotten, there also came four different donors training us in bee-keeping. They talked about sponsoring bee keeping projects for very big markets in the East. These sounded very good projects. They said they will provide us with the bee extraction gear and other equipment. But, that project, we thought, was more relevant in **Ny** area (*next village known for bee keeping*) where there are plenty bees and gum trees. Here, the bees are scarce. But we accepted the project because we do not want to scare away donors. 'Tomorrow' we will need their help in other projects. If we sound 'impossible', they will not sponsor our village in times of need. So we just accepted the trainings and the projects.

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CM¹: *a farmer agent specialised in crop* Now, I want to call upon the first Climate Smart agent to give her presentation so that we continue learning from others. Over to you Climate Smart.

WM, *climate change activist* Thankyou master of ceremony (**MC**). My name is **WM**. I am so happy with what FCS 3, **LN** and the organic team are doing. I learnt one important thing in your address to the farmers here, when you said nowadays rains are no longer reliable as they used to be in the olden days. Why is it like that, FCS 3, **LN**? We (*two members were present at this CoP workshop*) as Climate Smart team have come to share with you some of the knowledge on why rains are erratic nowadays. There are so many reasons to that, but partly, people are cutting down trees without replacing them. We have come with the gospel, 'Let's plant trees'. We are happy as Climate Smart, to link you as farmers with the market. Tobacco farmers for instance do cure their crops using wood fuel, but where do they get the trees? There is massive deforestation going on. This is a good opportunity for Muchena tree growers. We are going to help you to get linked to that big tobacco market. To link you as organic farmers and tree growers, I have with me a green texta-cash card which is nice to have. The green card is as good as any other ZimSwitch bank card that many of us (general public including majority of those rural farmers) possess. It is a Central Africa Building Society (CABS) card. You can bank and withdraw money from it. The purpose of the card is for direct linkage between you the farmer and the buyers. All monetary transactions, upon sales, will be done through the bank and so you can reduce dangers of thefts when you carry around large sums of money. The purpose of the card is for direct linkage between you the farmer and the buyers. All monetary transactions, upon sales the green texta-card is also good, we will compile a register of organic farmers and other climate smart practitioners into a database. We will use the database for lobbying for workshop funds, linking buyers and producer. Apart from the bank card...we are working towards a possible tree seedling bank. At the bank they will be cared for until the next planting season.

Farmers: *Clapping hands in anticipation to own the green texta-cash card (ten organic farmers bought the cards on that day).*

WM, *climate change activist* The card is also good for record keeping. We will compile a register of organic farmers and other climate smart practitioners into a database. We will use the database for various purposes including lobbying for workshop funds, linking buyers and producers straight from our computers, and many other things. (*N.B it can be argued that the majority of the farmers do have some operational understanding of some of the terms used by the presenter such as database, ZimSwitch card, climate smart and climate change. This is based on two assumptions; that 90% of Zimbabwe are able to read and write and that the majority of the participants are young enough to have underwent four years of secondary education which is basic education in Zimbabwe and if so, they might have come across these terms in one way or another*). Knowledge is power! I also want to thank the university (*University of Zimbabwe through this thesis*) participation in knowledge dissemination through gatherings like this. If we do not educate each other, we will not develop. *N.B emphasis on (ESD) and public awareness.* Our forests are no longer 'clothed', let us clothe our forests

by planting trees, we say 'green' revolution. (*Missing are links between climate change and anthropogenic factors but talk was on what was relevant to the local people*). Do we have bee-keepers in this side of the village, can you show by raising hands? (*Three put up their hands*) Yah, I am interested in you most. For you to get honey there must be a flower somewhere and trees provide the much needed flowers. Bee-keeper need to be organised too. We are busy preparing workshops for you. A lot of workshops are lined up so be organised so that you come up with a common pricing system. The buyers will come and collect the honey in bulk to there is power in working together as a team of producers rather than working as single individual producers. But, more, you should all have the green-texta cash card for easy transactions. Can I have questions or areas that you need further clarifications?

PN *the farmer agent responsible for the village* we have people that were recently resettled and these too are busy clearing land for cultivation, cutting down trees in the process. Does your climate smart education reach those resettled farmers otherwise 5 years from now (2014) you won't even like the degraded view that will be there. You won't even take your car or even ride a bicycle due to gulley erosion. Trees are God given but what people are doing is not good at all.

WM, *climate change activist* Before the end of this gathering, we are going to come up with committees and coordinators to spread the climate smart gospel of tree planting to all the other villages in this community. We are working in conjunction with the Environmental Management Agency (EMA) and Forestry Commission and other government departments that have a say environmental issues. You see, at this field there are a lot of big gum trees. It shows someone must have planted these some time ago (these are the 1982 gum trees I referred to in my conceptual framework chapter). I challenge you today, to plant trees so that your grandchildren will say it was our grandparents who left these trees for us to use. (statement was said at exactly 24:00mins in the DSCF6435 video clip which is 33.19 minutes long). (ESD plus Brandtland, 1987; GAP, 2014). Our climate smart awareness programme is covering the whole of Zimbabwe. Our campaign is not on exotic trees only, these are good for tobacco farmers (*fast growing*), but as you see on our membership registration form, we are promoting fruit and indigenous trees also. All that qualifies into the category of trees, we promote. We want to clothe the country so that our old rainfall pattern is restored. I remember when I was young staying in Honde valley (50km) from Muchena village in the same Mutasa district), my grandmother used to plant maize on the 23rd of October, the seed variety of that time was 52 (SR52). Today all that has changed, let us ask ourselves the question, why? Trees are no more! Those doing sculpturing are also cutting big mature trees that are difficult to replace, is that good? (statement to look for consensus from the participants). We are not saying do not use the tree resources, but quickly replace the one you remove. This is our 'gospel' and you should help us (environmental agents) to spread this gospel to the people.

CM² *Donor Agent* I have been pleased with your presentation especially where you talked about connecting the rural farmers here present with tree markets out there. Besides trees what else do you promote marketing through your networks? (Inter-agency interaction and synergies). We have farmers (*they have been working with*) who are stuck with tonnes of round nuts and do not have a market, what's your advice?

WM, *climate change activist* Climate smart is a branch of the Zimbabwe Commercial Farmers Union. We help the farmer in very aspect, even there are farmers with goats, and we do not hesitate to market them that is our work. (*address was given for further contacts with farmers, only removed on ethical reasons*). We will take down details of where there are and tomorrow will send a team to assess. (*I was reliably informed by climate smart that these were later collected for a Harare market from Mutare district*). We are targeting women in particular, we want to empower women in every aspect and so women come up with viable projects that we as climate smart will help promote. Get registered and be in our database. For us to be able to make 'noise' in higher offices we need a large number of farmers in our database. No preachers ever prepares a sermon for an empty church that will not make sense. I need a large following in my 'church', climate smart.

CM¹: *a farmer agent specialised in crop*. Coming back to our day's lessons. Peas is a winter crop and has to be planted in end march to April so that by June and July, it will be on the market. We also have summer peas varieties but to those farmers who can afford small scale irrigation, the winter option is good. Secondly we encourage farmers to dig holes or trenches, pout manure then plant the

crop. We don't encourage the spreading of manure on top of a crop as was the norm long time ago. Doing such a practice is like trying to baby feed by placing porridge on top of the baby's lips, that baby will not be able to eat isn't it? FCS 3, LN, what spacing did you maintain for your peas crop?

FCS 3, LN: *Leader of Youth.* 7cm between plants and 10cm between rows.

CM¹: *a farmer agent specialised in crop* Good whilst you maintain your 10 cm between row spacing, leave a sizable gap after every four rows to give you chance of walking within your field. Pease have a tendency of 'nesting' and you need to spread them apart hence the need to leave a walkable gap within after every 4 rows. If you do not leave such a space chances are high that during the spreading process you disturb the flowering stage with some flowers fall away, giving you unnecessary loss of crop. We encourage all farmers to use the cultural method that we find here, use of manure. Organic food is good for our health as was said by one farmer here present. There are some potato products in shops which were planted and harvested within 7 days, can that product be good for your health? When people use fertiliser where the rains are scarce, there are gases that are associated with our (AN) fertilisers and those gases from these fertilisers rise into the air (atmosphere) disturbing part of the ar (atmosphere) called ozone layer. Apart from reducing the destruction of the Ozone layer, manure help in making the soil structure. When you hear people saying my soil is 'old' unproductive, it means the network of materials in that soils is now lose. What we mean when we say manure maintains a good soil structure is that it provides the binding network to soil materials for it to be called rich and productive soil. On cultural methods to control pests, the use of onion and garlic is also good when you mix those with your crop. I know one family that almost got 'closed', they sprayed veggies with heavy chemicals but instead of waiting for the recommended 21 days they took part of the crop for a meal after 14 days that was disastrous. Lastly we want to thank the Agritex agent in charge of learning in this CoP for her expert advice, the spacing and quality of crop is good. Thank you.

Field Day 2 of the PhD data collection process Presentation 3 (17-07-14)

Interview at FCS 1, VS (Female Farmer who learnt from other farmers and not Agritex)

CD: [13 July 2017]: What type of farming mode are you practising and what are your major inputs?

[FCS 1, VS is a farmer who was sampled outside the group that benefitted from extension services but participated in a FGD. Her inclusion was important for her unique practice that was not learnt from extension but from other farmers. Farmer agents also discovered this farmer during a Field Day and later asked her if they could select her field for a possible Field Day in 2015 and so I copted her into the social learning group as a late comer with own expertise to contribute. Now that her practices were congruent with organic practices, I copted this farmer in the sample including in the FGD with industry and coded her FCS 1, VS because of her geographical location as the first household into the project site from the main dust road].

FCS 1, VS: In this new practice, I learnt of digging trenches as you can see, and, to bury all the maize stalks. I also learnt of collecting humus and grass from the forests and to bury them in the trenches too, in order to supplement manure. These rot, provide manure and retain moisture for my crops in the season [reflecting an in-field water harvesting technique.

CD: I can say I was impressed with the type of farming that you described during the FGD at the Field and Demonstration Day (FDD) today, and I have come to learn more of your practice right at the field. How did you learn of this practice (fertility trenches).

FCS 1, VS: A friend came here and talked of a field day that was being held at *Gogo Hildah (an older member of society)*. When I reached her place the Field Day goers were yet to arrive *Gogo Hildah* took her time to show me how and what she had done that had warranted a Field Day. She showed me how she dug the trenches, burry the maize cobs and grass. She then explained that crops were planted on top of the fertility trenches and the harvest was great. I was impressed why such an old woman in our community could harvest so much using very simple techniques when younger as I am, starving. Immediately after harvesting, I embarked on the digging of the fertility trenches as I had observed and learnt from *Gogo Hildah (an elderly woman who practices conservation farming)*.

CD: What was your harvest like before you learnt of this farming practice?

FCS 1, VS Just one 50kg bag from the whole hectare. (The picture above shows the size of maize cob that she realised before the new practice)

CD: And what was your harvest like after you learnt of this new farming practice?

FCS 1, VS: The first year I started practicing this type of farming I harvested 20x50 kg bags of maize and last year (2013) I harvested 35x50kg bags. I am impressed. From a starving woman to surplus a woman with surplus food! This year I am predicting 65 of such bags if God is willing (*a common statement amongst locals that only God has the ultimate plan for people's survival, or put it loosely, can be, 'if I am still alive by then'*) to give us the blessings of life and good rains, I think we will develop.

CD: Have you shared this knowledge with other farmers in this village?

FCS 1, VS: (*mentioned 3 farmers not in the sample who benefitted from knowledge sharing with FCS 1, VS*). Three farmers and the youths (FCS 3) came here for a field tour and I hope they benefitted from knowledge sharing with me here. They were impressed and they vowed to copy the practice. I haven't got the chance to go and assess how far they have gone with the practice yet, but I will make a follow up. The three farmers came here and I demonstrated to them how I had learnt from *Gogo Hildah*. I showed how I use grass, leaves, maize cobs to feed the fertility trenches, they were impressed and they vowed to copy the practice. (*I also liked the practice and our organic farmers later came to learn from FCS 1, VS so that they embark on it in 2015*). I emphasised to them that the maize cobs conserved water in the soils and that is good practice in times of low rainfall. When the temperatures are high, moisture content in the soils is conserved by the maize cobs in the trenches. This makes the maize crop grow well with little moisture stress in these days of low rainfall.

CD: Agritex agents, have they been here yet.

FCS 1, VS: They only recognised my practice when I mentioned it during the Field Day. They came, the four of them. They liked my practice and they promised that they will set a date for a Field Day in order for the community to learn from me too. I am happy because I have enough food to take me from one harvest to another. (Food security). This year (2014-15) I hope to send at least a tone to the local market (Grain Marketing Board-GMB). I am confidently looking forward to that. This shows the beauty of farming. We were lost when we used poor methods with frustrating harvests, now we are happy, the new methods with good and encouraging harvests. You get enough food and enough to send children to school, that is what we appreciate from this farming practice. Women are empowered, no need to ask for cash for every item in the house from father of the house (Vid_20140717_172229 time when statement was said: 0404minutes).

CD: What else do you want to say?

FCS 1, VS: I wish to have a reliable water source or the knowledge and means to harvest water then I would also embark on winter cropping as what we have just seen in the organic farming project today. That is my wish. We no longer want to rely on seasonal farming (rainfed) we waste much time during off season. Once we get a good water source, then we reserve it for gardening. We will empower each other together with our neighbours to be productive throughout the year, by so doing we can develop our community. You see, with availability of water, and with more people doing this type of farming, then the transport system will improve as there will be more companies operating our Muchena-Mutare route ferrying products to the market. Even our neglected road will be repaired when it becomes busy and productive. Thankyou.

17-07-14 Field Day 3 of the PhD data collection process

MNA is the farmer agent who is responsible for the district I would like to recognise the presence of the community leadership, FCS 2, **BC (VH¹)**, colleagues in agro-industry, here present, Climate Smart and GIZ and all our Agritex officers here present. I understand there was going to be an agro based industry representative but today I am told he could not make it today. The field day I witness here has several lessons to be learnt. We would have wanted even a million people to be here to witness the lessons I personally learnt by coming here. I learnt of water harvesting and use of reservoirs that supply water for irrigation in this project. When one gets to a water point, one can perceive seeing crocodiles, others can perceive taking a cold bath whilst others think of market gardening. In this project water is extracted from a tiny stream into reservoirs, a process that does not disturb the smooth flow of the stream. I learnt one important thing in life, if you want something then you have to sacrifice the little you have in order to have your dream thing. Let's say the piping that was done in this project might have cost the farmers USD300, try to imagine how many USD300 you have spent on other luxuries instead of buying irrigation pipes? What you value in life is very important in order to gauge where to invest your priorities and finances. In this project the farmers

valued provision of water and irrigation equipment first before other necessities. Secondly, this piece of land is of steep gradient, but see how much energy the farmer spent on terracing? Is there anyone who can confirm any form of erosion here? Indeed no erosion takes place because of the conservational method used here. In other districts we are struggling with people as they are unwilling to dig just simple contour ridges to combat soil erosion but here they prepared this land into an attractive farmland. This shows will power. Historically people were forced by law to make these contour trenches and ridges and because there wasn't enough knowledge why the practice had to be done, people (Black Africans) resisted that. In one village people could go and lie at the district offices that 3 old women have died from the stress of digging contour ridges. The knowledge that the contour ridges were not there to benefit the district administrator (who was White then), but the farmers themselves, was not there in us the Black people. Only a few people came to realise that the quality of soils in the fields was deteriorating as rich and fertile soils were washed away by sheet erosion resulting in poor yields. This was because of the absence of techniques to combat soil erosion such as contour ridges (*Bhaskar's CR-abductive reasoning, people noticed poor yields and connected that to soil erosion and subsequently to absence of contour ridges which was a result of lack of knowledge as people resisted the practice which they thought was political and colonial*). The lesson today is that let us all make contour ridges to benefit our own fields and not to please anyone else. The terraced land here is enough evidence of conservation farming, this place should not have been good for agriculture at all. But, the steep gradient is also a blessing in disguise as it is naturally good for irrigation, the water reservoirs as you can see are in the upper gradient, feeding irrigation water down gradient. Thirdly I learnt of mulching where maize cobs have been used in the process. The mulch decomposed and was dug into the vegetable bed as manure, this has darkened the soils no longer look sandy as is the case in the surrounding places here. At this rate of soil replenishment, this piece of land will be very rich and fertile. How many of us are contributing positively to soil enrichment here present? A few of us are in the tendency of negatively changing the soils, they settle in a rich piece of land, waste it, and think of migrating to yet another rich piece of land, only to repeat the wasting process over and over again. Some fields are actually cut into two because of gully erosion whilst the farmer fails to combat in in time. Fourthly I learnt of farming without fertilisers. These four lessons are exactly the four we teach our farmers about. We tell farmers the world has changed and farmers need to change practices to adapt (suit) to changing world. Some farmers have large herds of cattle but fail to adapt to organic practices, then I start wondering why. The same farmer will cry that the price of fertilisers has gone up and yet he does not utilise the natural fertilisers in her cattle kraal. At this homestead all the four lessons are inclusively found here as a full package. From age 40 and above, people are now suffering from different ailments. Most foods in our supermarkets are not good for people's health. If you want to enjoy life to old age, a healthy old woman, then go foods which are naturally produced, those not produced under fertilisers and heavy chemicals. In much advanced society, if you take your big fertiliser produced veggie bundle and FCS 3, LN stands with his organic and much smaller bindle, they will struggle against each other to take FCS 3, LN's bundle.

CM²: *Donor agent* Thank you for the great keynote address madam supervisor. Standing in for the Donor Agent, I would like to summarise my talk by saying our education to farmers should not just end at food security but farmers have to produce with surplus for sale. Climate Smart promised to get markets for you provided you are organised into formidable farming groups, produce together and market together. Even at my organisation (GIZ) we emphasise during our trainings that as farmers you need to move with changing times. First identify your market before you put seeds into the soils. Knowledge of marketing is quite wide, you need to know what crop is needed but who and when and at what stage of maturity. Peas for instance people eat the fruit itself or the outside skin. You can have a very good pea crop but none can be bought if you are not clear with market demands and standards. This is the type of education that we offer to farmers together with our colleagues in Agritex. Let us be organised so that we move the adaptation process together, by respecting the environment through conservation farming and tree planting whilst we push the economic agenda through farming for food with surplus for located markets. From now CM² and the donor will work closely with Climate Smart. FCS 3, LN remember I still want to see my books so that you show me your calculated net profit or loss, do not just concentrate on farming for food security but go beyond into realising financial benefits of your farming activities. Thank you.

17-07-14: Field Day 3 data collection process

FCS 3, LN: (*Addressing 50+ farmers, Agriculture agents, donor agents and teachers-CoP*). Before we, (*we-includes ten other organic farmers he shares the practice with*) used to wait for rains to fall. Nowadays we are observing changes in rainfall pattern. This 'year' the rains come 'November', the other year, end of December and so on. This used to confuse our farming practice as we were not very sure of what to do at the beginning of each farming season. Without the rains we could not start planning, without money to buy fertilisers, the yields were so poor that we could hardly talk of any harvest at all. We now have water (reservoirs) and so can do cropping three times a year. We practice rotation of crops. We learnt of farming as a business through GIZ training headed by Mr **CM²** and Agritex. From that education we were taught that a farmer should not rely on one aspect of farming but has to diversify. Because of that we do tree nurseries for sale and we also keep 200 chickens where we get cash for our remunerations and manure for our composts. That's the knowledge we gained from GIZ, is being utilised here (GIZ officers were also present on the day). We also learnt to follow a calendar. If I plant my crop today, what will be the market like when I start selling the product? That type of learning was good for our activities here. Through that training we learnt of record keeping. After harvesting you should be able to calculate the net profit or loss. Our practice is purely organic, no fertilisers and no chemicals. We make composts and use traditional methods as pesticides, we use mainly paper. We learnt all these from our older generations and our Agritex officers. We were also taught that we have to look for a market first before embarking on a project. I used the knowledge learnt and went to look for the market at Spar, and Manica produce. Both said they wanted it but Cairns said they are not into peas but tomatoes and beans. I now pause for questions from fellow farmers as we are all learning here.

CM¹: *is a farmer agent specialised in crop* Long time ago people used to practise shifting cultivation as a way of resuscitating soil fertility, on how the Shonas used to prevent erosion of soils. Nowadays where is that land to waste? Today you remain here where you are settled and so you try to improve the soils to take you for generations. Practise conservation farming, put manure in the conservation holes make composts for your soils to remain healthy. Here we have witnessed intensive agriculture, farming on a very small piece of land but with very high yields. Let us all utilise the very small portions that we have in order to survive out of them. Thankyou FCS 3, LN let us get questions from our farmers here present.

FCS 4, SM²: When did you start planting your winter peas crop so that next year I copy the dates and do this similar practice since we have learnt of big markets here?

FCS 3, LN: Our crop is in different stages, the first crop was on 11 April 2014 and that is the crop we are harvesting today (17-07-14), the seed batch was planted on the 23rd of April.

PM: *Organic farmer.* How do you apply manure to your peas crop?

FCS 3, LN: We apply manure in trenches as we plant the crop using a linear approach and once the crop shows signs of manure deficiency, we slightly dig next to the crop and apply more manure.

CM²: *Donor Agent* Eeeh **FCS 3, LN**, we learnt from here that you learnt a lot from the different training programs that take place in this village. It is good that we are all into supporting organic farming in this village, I want to know how many farmers in this segment of the village who have come to learn the practice at this plot and went back to their different homesteads and apply the practice?

FCS 3, LN: We have ten gardeners that are doing this practice. Not all have water reservoirs so they rely on open wells from gardens for watering their crops.

CM²: *Donor Agent* What big lesson have you learnt from this farming you are calling organic as compared to the old farming practices? What's bad about the old practices and what is good about the new practices? I mean the good and the bad of each practice.

FCS 3, LN: I can say the old practice was expensive we needed fertilisers and that is beyond our reach today. Compost is financially cheaper although taxing to prepare. Pests are traditionally controlled and not using heavy chemicals so our soils are protected. Rains are now unreliable and with organic we no longer rely on traditional maize but we also practice small grain cultivation, leafy veggies, tomatoes, onion, garlic, pumpkins, all under irrigation.

CM¹: *Donor Agent* Can the other organic farmers especially those who said they are practicing this farming type, cheap in with their own perceptions?

TM²: *Female organic farmer who appreciates organic foods.* We like to practice organic farming since we do not apply fertilisers and chemicals; the product is healthy to our bodies. The foods with fertilisers that we take today are responsible for most diseases nowadays. Look, even small children complain of painful legs. We don't know the source of such health problems and we think it is associated with the food that we eat which is contaminated with chemicals and fertilisers. Organic in that regard is good, no chemical will be found in 'destroying' our bodies.

CM²: Isn't there another farmer to give us further explanations?

PM: *Organic farmer.* The taste between an organic product and a conventional product are totally different with artificial-fertiliser-produced veggies have plenty of water coming out during cooking, something I do not experience when cooking organic veggies. The tastes are totally different. Organic product is tasteful whilst the fertiliser produced product does not taste that good. When preparing veggies, fertiliser produced ones has plenty of water coming out during cooking something I do not experience when cooking organic veggies.

FCS 3, LN: To add on to that, I have experienced that when I take two bundles of veggies, an organic produced one and a *synthetic* fertiliser produced one, the *synthetic* fertiliser produced one, quickly wilts whilst the organic resists *wilt* much longer. The synthetic fertiliser produced veggies quickly wilts whilst the organic veggies resist moisture loss much longer. I sent our peas crop to the open market. I did not tell the women [buyers] that our product was organic. After two days, our peas crop was still fresh, whilst the synthetic fertiliser produced peas, had started showing signs of wilting. The women asked, 'how come your peas crop still looks fresh as compared to the other ones that we bought from other producers on the same day we bought peas crop from you? We actually, kept both sets of peas crops under similar conditions.' I replied, ours is organic and they asked again, 'what is that?' I then explained. **CM¹:** One more question, has the market been made aware of this type of crop yet?

FCS 3, LN: Practically when I sent our peas crop to the open market in Mutare I did not tell the women (buyers) that our product was organic. After two days when I went to collect payments, our peas crop were still fresh and looked good, whilst the fertiliser produced peas the women had bought and stocked for sale together with our crop, had started showing signs of stress. The women asked, 'how come your crop still looks fresh as compared to this other one that we bought from other customers on the same day we bought a crop from you? We actually, kept both sets of peas crops under similar conditions' I replied, ours is organic and they asked again, 'what is that?' This might suggest that the general public might be lacking a general awareness of what organic products are all about?

CM¹: *Donor Agent.* And what about prizing, do the organic products fetch a higher price than the organic ones?

FCS 3, LN: That is still a big problem. At present we do not have a recognised organic market. We struggle to compete with those who farm using *synthetic* fertilisers. We hope the teachers in schools will help teach children about the good organic products and their advantages to our health, may be children will convince their parents to go for organic products then there will be a long-lasting shift towards organic products with then, a favourable pricing system.

FCS 4, SM²: *Market gardener and teacher by profession.* As a marketing strategy, can you try to target a group of people with the knowledge of organic products? The rich may be for a start, this can be a group of people with the money and who also value their health and eating habits. They might have a better understanding of organic products than the general public.

FCS 3, LN: *Leader of Youths.* We try to reach such people through the big shops we talked about, but unfortunately they are still regarding our products as the same with those produced under synthetic fertilisers.

CM¹: *Donor Agent.* My last contribution, FCS 3, LN can you try to visit the different markets at different stages of crop growth, Some markets might prefer 'baby peas' different purposes whilst others prefer the fully grown peas, some might want the dry organic peas seed and that is a different market altogether. Try to vary your marketing strategies. Can I make an announcement then, next all the organic farmers should bring their fully completed books to the school (St Georges) for evaluation of how the knowledge gained has been applied? This includes **FCS 3, LN** and your team.

CD: To **FCS 4 SM²** on an aside after the Field Day: I was impressed with your contribution. Briefly tell me how you entered into market gardening?

To **FCS 4 SM²**: I started by attending Field Days [2013 and 2014] at the communal demonstration site where I helped the youth in taking photos and videos using my personal phone. I developed interest. I played back these videos at home and reflected on the learnt practice. I discussed this with my family and extended family in the diaspora, whom I also shared the photos and videos of the learnt practice through the internet. They got interested and they supported me by buying a plastic tank with 5,000 liter capacity and a fuel powered water pump.

1-10-14 Climate Change Activist (Key Informant Interview)

CD: Good morning **WM climate change activist** *climate change activist*, we last met at Muchena village on the 17th of July, how has your work with Muchena organic farmers progressed ever since?

WM Climate change activist Indeed we are working with Muchena organic farmers. We are trying by means to link their activities with the relevant buyers. We saw their peas crop in July and we were quite impressed. From there the farmers came into town and we started looking for markets together. We visited **HI Hotel**. At **HI** the procurement management said they only take products only if the farmers meet certain standards. The peas had to be of a set weighting, quality and acceptable quantities per supply. **HI Hotel** also encouraged the farmers to diversify and not restrict production to peas only but veggies, tomatoes, onion and so on and all under organic techniques. Lack of awareness and education about the benefits to people's health and the environment from organic products, is the main problem we get from our uninformed market today. The procurement manager at **K shop**, actually said when people come for shopping we do not have much time to explain to them how each product was produced hence customers rely on their perception of the product that is relying on how the product looks from the outside appearance.

CD: Can I interject a bit? Can you explain more on the weight that the market demanded of organic peas crops.

WM Climate change activist. They did not specify the weight that they said was their hotel benchmark. What the Hotel wanted was to sit down with all the registered organic farmers from Muchena so that they teach one another on the issue of standards. We are yet to make that arrangement and meeting amongst the three stakeholders, the hotel, the farmers and ourselves, Climate Smart. We look forward to such a meeting in the near future. More! We help the farmer in every aspect including marketing all agro-products. There are farmers with goats, we do not hesitate to market them, that is our work. We want to empower women in every aspect, so women come up with viable projects that we as climate smart will help promote. Get registered and be in our database. For us to be able to make 'noise' in higher offices we need a large number of farmers in our database. No preacher ever prepares a sermon for an 'empty church' that will not make sense. I need a large following in my 'church', 'ClimateSmart'

CM²: I have been pleased with your presentation [referring to **WM**] especially where you talked about connecting the rural farmers here present with markets out there. We have farmers who are stuck with tonnes of round nuts and do not have a market, what's your advice?

CD: What about the issue of quality how did this market define quality of peas?

WM Climate change activist I went with peas samples from our Muchena farmers and as expected, the organic peas were slightly smaller than the fertiliser produced peas that they had in stock. The market opted for the product which looked bigger to the eye as far as I observed.

CD: Did you verify with management if the bigger peas products were organically produced or not?

WM Climate change activist WM: Yes, I did check, the peas-crop [in the supermarkets] were not organically produced. We shared knowledge [with the supermarkets] on organic products and their advantages over the much bigger conventionally produced crops, but their argument was that the organic farmers should compete with the inorganic farmers, on size and quantity of products, without that they are likely to lose out. I also went to one **S shop** in town and I discussed with the procurement management staff. **S shop** raised the same concerns as the hotel. The peas product that they had were much bigger than the organic products that I had brought in as samples. Their argument was clear. Customers are not yet educated into organic products. Customers look at size of product and not the quality or contents of the product. That is the problem with our market today. The procurement manager at **S shop** actually said when people come for shopping we do not have much time to explain

how each product was produced hence customers rely on their perception of the product on how it looks from the outside appearance. So, they argued organic farmers are a long way to go in order to compete with nonorganic producers in terms of product size and quality. Once the product is competitive and acceptable the prices were quite good, around USD 3.00 per kg.

CD: What is the way forward then?

WM Climate change activist Public education is needed in our people maybe through the media. The media just needs to refocus, more on productive issues than they focus on social issues as is the case today...Our people like farming but information on weather is sometimes absent from some of our news bulletins and whenever it is available, it is often marred by a musical background much to the frustration of the farmer who can hardly hear anything.... The different shops and hotels also need awareness on what organic production is all about, and, its role in climate change adaptation. This awareness needs to be vigorous since the market and the shops seem to be lagging behind world trends in terms of climate change and in terms of quality food. (*Food security should not just be enough food but quality of food, FAO, 1994; IPCC, 2014*). As Climate smart we have seen this gap in our people and we are now planning all stakeholders' workshops where experts on organic products will spearhead the discussions. We have our local Zimbabwe Organic Promoters and Processors Association (ZOPPA) member here in Mutare and we will be happy if he can join us in such a workshop. Lastly I want to encourage farmers to stop veld fires and plant trees.

(N.B. The lack of education on the need for change in consumer behaviour towards organic products is not restricted to Mutare market only but a similar argument was presented by a group of 13 vegetable growers in one other province near Harare the capital city of Zimbabwe, whom I interviewed in 2014 in a bid to lure them into organic production. I had observed their potential in terms of adequate water supply, rich dark loamy soils, flat land, accessible to a big urban market, large cattle herds with plenty of cow dung manure, and their reputation to regularly provide large truckloads of vegetables to the urban market. what I gathered from them was that, despite the advantages they had towards organic farming, they still applied ammonium nitrate an artificial fertiliser on their vegetable crops and their argument was to make the leaf crop to look 'dark green'. Their argument was, that is what the market wants. The dark greener the product looks the faster it sales on the market. Transfactuality as the farmers perceive that dark green leaves are attractive to the market and yet they are not very healthy to the body).

01-10-14 Field Tour and FGD at Agro-Industry¹

TM³ is the Agro-industry¹ member who features well during the FGDs My name is **TM³**, I work here at Agro-Industry¹. We work with farmers, buying your field products and fruits. With your products (*farmers in general*) we produce products for the local market here in Zimbabwe and for export. We produce jam, sun jam that we grew up with which was also popular at breakfast during old Christmas holidays in our rural areas (joke and people laughed). We also produce baked beans, Cashel valley baked beans. We get most of the raw materials that we use to produce our products from local sources. Some of the Michigan bean product is locally sourced from farmers in Zimbabwe but majority we have to import from Malawi and Ethiopia since our local farmers currently do not have the capacity to supply the quantities that industry require for full scale production. You see if you as our local farmers are failing to produce enough for our consumption, we go out of the country to source for the products. (I argue, why one should degrade the environment if she can realise that there is a big ready market for her crops, she will jealously guard it in order to continue realising the means for survival). (This is ESD). It was going to be good if you our local farmers get enough education to produce more so that we buy from you. This empowers and your families, you will be able to send children to school, seek specialised medication when you are ill or have enough to buy food and clothing through proper farming methods. In the previous years due to economic challenges that affected everyone in the country, we were unable to come to source products from as many farmers as we used to do but now we are able to do that. After this training workshop we expect you to go and start producing this Michigan bean crop that we will be happy to accept as a company. In the old days we used to give farmers the Michigan pea bean (also called white pea bean or hurricane) seed, give them the correct education needed for the full production of the crop. Education was done by our agronomists who used to extension service the farmers. They gave farmers knowledge on when to plant, when to spray, what and which fertilisers to use and how to identify possible diseases that could

affect the end product. In the near future if funds permit, we want that framework to be back in position and we have to start with you here present. Before you bring the bean product to the market, we expect you to sort your product removing all unwanted staff chuff and so forth, that is grading at homestead level. The production of the baked bean product includes several other ingredients most of which come from you farmers. We have tomatoes, onion and so forth, and we expect these to come from you farmers. We buy one or two tonnes of onion after every six months. Tomatoes, yes, but at present we are not taking any as our processing machine is down. We rely on importing tomato paste and that is quite painful as we often see tomatoes at the public market (*Musikawehuku in Mutare*) going to rot, without a proper market whilst we import the same product. This processing machine is very expensive and we need enough money to buy it. Without this machinery running, we don't see how best we can empower the rural farmer or Zimbabweans in general. We have successful stories that we learn from our producer farmers, some say they managed to buy big urban houses, some building houses here in Dangamvura (a local urban suburb in Mutare), all from money they raised through supplying tomatoes to this very company. Some claim to have bought large herds of cattle for beef farming, managed to send children to school up to university completion, all through tomato supplies to this company. Learning of such successful stories from farmers brings satisfaction to us to that we are contributing something good to society through job creation at household level. That is at homestead level, at company level, the more the tomato product is supplied to us the more youths we recruit to come and work in the factories. (Abductive how youths can be involved in ESD, why would youths degrade the environment if they indirectly and directly benefit out of it?).

CD: This is good news. We look forward to the contracts.

TM³: For us to start contract farming in a community, we start by assessing some basic physical factors such as soil type, rainfall type, temperatures and these have to suit the type of product that we want to contract the farmer to produce. Some crops thrive in winter, some in summer. We only engage farmers who display evidence of reliable water source/s so that the crop (on contract) will not suffer from moisture stress. Nowadays rains are erratic, we cannot contract a farmer who practises rain-fed farming. You see if you as our local farmers are failing to produce enough for our industrial consumption, then we go out of the country to source for the products. I still wonder why you as our local farmers still fail to support your agro-industries simply by being productive. It was going to be good if you our local farmers get enough education to produce more so that we buy all products from them. You will be able to send children to school, seek specialised medication when you are ill or have enough to buy food and clothing. You simply require proper farming methods including water harvesting. But before you bring the said product to the market, we expect you to grade your product by removing all unwanted staff that is grading at homestead level. We buy 120 tonnes of bean crop after every six months. Tomatoes yes, but at present we are not taking any as our processing machine is down. We rely on importing tomato puree and that is quite painful as we often see ourselves losing out in forex while tomatoes at the public market are going to rot there. Well, learning of such successful stories from farmers, bring satisfaction to us as we see how best we are contributing to society through job creation at household level and at national level as an industry. Now I hand you over to **CM³** (*a technical advisor at the Agro-Industry¹*) before we get questions and contributions from our farmers.

CM³ *a technical advisor at the Agro-Industry¹* We maintain our international standards (ISO) in the production process and as a result the raw materials that we procure from farmers must be of high quality and of set standards. Before you bring a crop, to our industry, you send to us a sample of that crop for our laboratory tests. We mean we put the bean crop under test examination for bean size, presence of weevils or other after harvest pests, presence of chuff, and evidence of blemishes on the crop itself, moisture content of the crop, and so on. We only accept a product for industrial production if the laboratory tests results are at 98% level as a set benchmark for supplying your crop to this company. You have done well by coming here at least you now know what standards we expect from farmers. It is good to remember that we don't just take in whatever bean product a farmer brings in, we look out for quality in the product. When you produce a crop look out for the things that we have talked about and make sure the crop is dry with a very low moisture content. The Agritex officers here present will help in extension education so that you produce an acceptable crop. Now that we have started learning together, the Agritex officers will help you on the environmentally friendly ways of

production whilst we come in with our experts to look out for our standards benchmarks that we have learnt about today, and you, busy in the production process. A similar process is applied to all other products that we take from farmers, tomatoes, onion and so on.

FCS 3, LN: *Youth Leader* Which tomato type can we plant if we are to supply to this market?

CM³ *a technical advisor at the Agro-Industry¹* Generally take most tomato varieties but less of the local money maker type. The Roussel and Philadelphia are good varieties that we take for industrial production. We want tomato crops that give us enough soup to suit our purposes. Once we work out the conditions of the out-grower scheme that we are exploring today, then we will be in a position to supply you with the seed whose crop we will accept.

PM: *Organic Farmer* Since you said you import the bean variety from outside the country how do we access the seed so that we start local production?

CM³ *a technical advisor at the Agro-Industry¹* We have local seed houses that are into seed production. I am sure you should be able to get it the local varieties and as for the imported varieties local researchers are working on that.

FCS 3, LN: I am still interested in the type of crops that you will accept from us, because often we produce and when we approach the market they say that is not the variety that we want. Which onion variety do you want?

CM³ *a technical advisor at the Agro-Industry¹* We normally take the onion with big bulbs (king onion). Currently we take onion from the small scale irrigation producers around Mutare. Currently we buy at 50c to 60c per-kg.

AK¹: *Agriculture Agent* Can you elaborate on the issue of contract farming. What are your expectations? We need to learn it from you together with our farmers.

TM³: *Agro-Industry¹ member* For us to start contract farming in a community, we start by assessing some basic physical (environmental) factors such as soil type and other environmental factors such as rainfall type, temperatures that have to suit the type of product that we want to contract the farmer to produce. As Agritex Officer that will be your task. Once we agree on a crop then you recommend the relevant and suitable fields. We also have our company agronomists who will also share knowledge with you and your farmers, by so doing we will learn better and come up with a better product. Some crops thrive in winter some in summer and as a result we also want a farmer with a water source so that our crop will not suffer from moisture stress. Nowadays rains are erratic, we cannot rely on a farmer who wants to rely on unreliable rainfall. We also use a trek history of the farming community. If they once entered into contract farming how did they respect the contract? There are some rural farmers once you give those seeds they simply disappear with the seed or even sell the seed, such as we don't re-contract.

FCS 3, LN: What about other natural disasters such as stormy winds, floods or even extreme droughts or frost that can affect the crop under contract farming, how will you deal with that aspect?

TM³: *Agro Industry¹* Natural disasters are an understandable phenomenon especially nowadays it has become even more difficult to prepare for such, as no one seems to understand what is happening with our weather today. But in terms of your extreme droughts, we take precautionary measures before signing the contract with the farmer, why would we risk giving someone a contract project who has unreliable water sources. Most of our crops fall outside our rain-fed staple-food-crop calendar and that means farmers might thrive on harvested water. We advise you to go and think of ways of harvesting and harnessing water if you want to be part of our contract farming project. For those with scarce water sources we recommend smaller and manageable quantities of crops and crops that might not need a lot of water. This is a negotiation process as we don't want the farmers to be a fix by trying to produce sustainably to meet the contract demands with extra for profit making. We are always learning in this process, every contract is unique with its own set of challenges. The good part of our contract is that we will provide our own transport to go and collect the product from the farmer. *(Absence was the issue of insurance in the contract)*

AK¹: As an extension officer, I also want to understand my position in the contract farming scenario. The farmer enters into a contract with you, and I provide knowledge and expertise, the farmer submits the product to you and she gets money. How do I benefit? I just need some clarification. At times in group-work like this, we need to iron out the issue of communication channels. In some projects, the corporate world like you to deal directly with the farmer and the extension officer gets information

from the bottom and at times it might have been distorted. Is it not good for the corporate world to deal with the extension officers and agronomists who will deal with the farmer on the ground? By so doing I can see no conflicts of roles here. **TM³**: [in response]. We are not here to disrupt your relations or your learning structures with your farmers, but we are here to make sure your goals are achievable in harmony with your existing frameworks....We are actually happy that you have accompanied your farmers and have learnt together of our industrial demands...We would not have liked a situation where the farmers were here without you.

TM³: However, if the extension officer is thinking outside the box, then she or he too should ask for a piece of land from government or from her/his local community where s/he can produce own product and develop a demonstration site for the farmers to learn better from him or her. Fortunately we view the extension officer as a government employee trusted by the government to help the people learn better farming practices for the development of society, having said that she or he is paid for that. However, if the extension officer is thinking outside the box, then she or he too should ask for a piece of land where s/he can produce own product. When the farmers will be sending in their products to us, s/he too will send her or his own products. Let me talk of the long term benefits. An extension officer who works hard in the community, making the people productive and sending products to the market, then the market will not ignore the brains behind the good products. That is how most agro-companies manage to recruit good agronomists. Different NGOs who are into agro projects will quickly snatch you out of that community, give you a car so that you spread your knowledge to the entire Zimbabwe and not that small community. Government promotions can also follow only those who work hard in their communities and all those are benefits. This type of learning we are doing today, we also practice it with other communities (*name supplied*) the farmers and their extension officers come into this boardroom and we exchange knowledge, they go back and put the knowledge into practice.

BM: *Organic farmer*. How do you deal with defaulters?

TM³: We deal impose a collective punishment once we encounter a defaulter in your group. If one of you decides to run away with our product or decides to sell the product to other buyers, we recover our costs from the group. It is the group that will deal with the defaulter because the group knows where to locate her or him. The important point is to learn that in contract farming, the contract is signed by a group and not a single individual and so legally the group is responsible for the behaviour of its individual members. In another community here in Manicaland (*name supplied*) the contract farmers named their group, *Simbe ngadzibve*, meaning lazy people should be out of this group. They had encountered the problem of defaulters before and in the next contract all defaulters were removed. For a start try to identify hardworking farmers and will not be difficult to monitor and enter into the contract. More farmers will join your group upon realising the benefits the first group realised. We pay the group a lump sum but each member of the group keeps a record of the quantity of her or his crop that s/he contributed. You do the calculations together and work what each member respectively will earn and remember we also subtract our costs for seed and so on from you. So that is how we deal with defaulters.

AK¹: At times in group work like this, we need to iron out communication channels. In some projects, the corporate world likes to deal directly with the farmer and the extension officer gets information from the bottom and at times it might have been distorted. Is it not good for the corporate world to deal with the extension officer and agronomists who will deal with the farmer on the ground, by so doing I can see no conflicts of roles here. At times you get surprised when your farmers are putting in regalia used to promote a programme when you as the extension officer is not given that recognition to associate yourself with the programme that you are directly involved.

TM³: We are to strengthen or to support your practices together with the farmers that you deal with. We are not there to disrupt your relations or learning structures with your farmers, but we are there to make sure your goals are achievable in harmony with your existing frameworks. We are actually happy that you have accompanied your farmers and have learnt together of our industrial demands. We would not have liked a situation where the farmers were here without you.

Detailed interviews with FCSs during a Field day at the Demonstration Site

[See also **FCS 1**, **VS** in black jersey dancing to a song while **FCS 3**, **LN** is standing near **CD** at the water reservoir] in 2014.

CD: Can you take me through the long journey towards irrigation farming?

FCS 3, LN: The long road towards irrigation started from learning from the spring that is down there [a community water point] that never dries up year-in-year-out. The spring has been flowing for over a century as we gathered from oral history. One of my Aunts who is now late but, used to tell us that she used to drink from this same small spring and water point as far as she remembered. As a point of reference, she would point out drinking from this spring when she was at the age of seven and that was during the First World War [1914 –1918]. As far as she remembered that she drank from the same spring during the Second World War [1939–1945]. So, we can safely confirm that the spring has been flowing for over a century now [1914-2017]. But, to extract water from this century-old spring, we (youths) had to observe some ‘Dos and Don’ts’ or taboos that are associated with the continuous or the discontinuous flow of this spring. We thought of the best way we could use it to water our fields since it was a spring of centuries. The road was a bit long as we reflected with community leaders at different stages. We concluded that it was going to be good on cultural reasons, to extract water from a pond, a small distance away from the water point. We had to dig a pond and protect it, make a platform to put our water pump and started doing work.

CD: That is great to hear. We will continue talking about the trajectory that you took towards small scale irrigation farming, and what about you **FCS 5, SS**. Can you also take me through your story.

FCS 5, SS: My journey through winter wheat farming has been running in the family as I inherited this from my own father (late). My father taught me that winter wheat has to be planted mainly during the first week of May, so that the harvest does not clash with the coming of first summer rains which makes the wheat to rot. To enable this irrigation mode, there is a perennial stream that flows through my homestead. This has kept our farming project going on during the dry season. My father reflected on how best we could utilise this water and that was through diversion furrows, in the late 1990s. My father used his background of diversion furrows from observing water canals that diverted water from Mutare River for gold processing in the local mines. The physical landscape at my homestead enabled us to drain water through gravity and using a diversion furrow from a nearby stream flow. The knowledge I got from my own father on market gardening and winter cropping and the theoretical agriculture knowledge that I also got from school were an added advantage. We used to water crops using dishes and watering cans but I reflected with FCS 3, LN who demonstrated how water can be extracted from a water reservoir using hosepipes through the syphoning technique.

CD: That is interesting I will come and take photos of your diversion furrows at your home. Thank you. What about you **FCS 3, LN**, do you have any other insights that you want to share with me today?

FCS 3, LN Thank you. As an individual, I have passion for farming from secondary school and at my own home I am the ‘master’ farmer there! I enjoy gardening too. Apart from personal interest I attend trainings as far as Harare (capital city of Zimbabwe). I also read books and training manuals that we get from the training such as the bee-keeping, rabbit keeping, crop farming as a business and so on. More, I learnt a lot from the local agriculture extension service about good farming practices and composts. I also learnt to change our practice from the market itself and this has been through a series of rejection of our products, that way we were learning. The changing climate was also a big teacher as we had to adapt to the shifting seasons and experience. The physical landscape also helped us in adapting to flood irrigation, powered by gravitational force as you can see here.

CD: Thank you so much for these insights. We will continue to meet and discuss these issues. Turning to **FCS 4, SM²**: What about you Sir, what do you say to me today?

FCS 4, SM²: To enable this irrigation mode, there is a perennial stream that flows through my homestead. The stream that passes by my homestead is perennial and we have always protected this stream by observing the cultural taboos against polluting it. This has kept our farming project going on during the dry season. We do not use kitchen utensils with soot to fetch water. We do not fetch water at night from this stream and by so doing we have kept it flowing. More, we do not use our water pump to extract water directly from the stream, but from a small pond that we dug a few meters away from the stream, into our plastic tank.

CD: Well that sounds great. Where and how did you learn about this new practice?

FCS 4 SM²: I started by attending Field Days especially those that were held at the communal demonstration site. I took videos using my personal smart phone. I then played back these videos at home and reflected on the learnt practice. I discussed this with my family and extended family in the

diaspora, and through the internet, we further reflected and agreed to embark on a similar project like the one at the youths' demonstration site, but using a different type of water reservoir, plastic tank and powered by fuel pump.

CD: What about profits? Do you make a lot of profit out of this project?

FCS 4, SM² While I enjoy the new practice, market based conservation farming, but the small quantities that I send to the market makes my business unprofitable, once I factor in transport costs. Only if I can increase my crop production, then I can safely enjoy the profits. But we, through reflecting on the challenges of marketing that the youths faced at the demonstration site, decided to go for modern market-based crops such as cauliflower, beetroot, lettuce and spinach. Learning for transformation was through understanding challenges faced by others. As a marketing strategy, can you try to target a group of people with the knowledge of organic products? The rich maybe for a start, that is a group of people with the money and who also value their health and eating habits.

CD: Thank you I will come again and we share more insights.

02-10-14

FCS 2, BC (VH¹) Focus Group Interview at homestead (4 family members present)

CD: How are you our Village Head¹, **FCS 2, BC**? Today I want to learn more from your experience of the village in terms of changing weather and climate patterns since the early 1950s to date (2014). Your family members are free to come in and contribute to the discussion so that we capture as much information as is possible. What type of farming are you practicing and what are your major inputs?

FCS 2, BC: In the early 1950s, in this village, we used to receive first rains around the 13th to the 18th of September and this was called *gukurahundi*. The *bumharutsva*, rains were experienced between 29th September to the 1st of October. Whenever we received this, it was an indicator that the rain season was about to start, onset rains were around the 15th of October, and that was the date most of our farmers planted maize seeds [OPV- Hickory-King-Hakiri-king in local language] into the soils. But today onset rains have shifted, creating a shorter season which can no longer support our traditional maize crop which needed more time to mature. In the 1950s, no artificial fertilisers were applied in those days in this entire village. It was manure from cow dung. You can be surprised, we used to make composts in those early days [1950-70s] by then, were different from the ones we prepare today. Because we knew the onset rainfall dates well and the rains were reliable then, we could start planting on the 2nd of October or even the 29th of September (dry planting) as we waited for the first rains which would be near. The planting season could run up to beginning of November, and thereafter no one was ever going to plant maize crop. Once the rains came in October, it was continuous but could give us breaks for weeding. This happened up to the early 1980s, there after we saw changes. Today onset rains have shifted, creating a shorter season which can no longer support our traditional maize crop which needed more time to mature. I can say the shift in rain seasons has forced us to abandon the OPV seed variety that we had linked to farm since the 1950s. Everyone nowadays is going for certified seed varieties which are more prone to weather changes and diseases than the traditional OPV seed varieties. Certified seed varieties are also too expensive for us as compared to our traditional OPV. Extension service helped us understand the link between the changes in climate and the new seed varieties.

FCS 10, VC: (son to BC). We appreciate all this help. We have been left exposed as we are now 'captured'. Today we just rely on government subsidies and handouts. Rather, we want the basic means to produce, water supply to be afforded at homestead level so that we can plant crops throughout the year, buy our own seeds and fertilisers if we want to and not rely on government handouts. Our people will be enabled to revert back to our OPV as our main field crop without problems. Seed houses, extension service and researchers in the country therefore introduced short season varieties to adapt to the reduced rainfall season. People have attained education, formally and informally, we have come to realise that it is unprofitable to waste a certain time of the year, idle when the soils and water are available. We say, 'let us utilise the soils throughout the year. We appreciate all this help [government and partners' free seed and fertiliser input distribution to all farmers], but we have been left exposed. We just rely on government and donor support and without that we cannot survive. You see our people will be enabled to revert back to our OPV as our main field crop without problems [water related constraints].

CD: That is interesting.

FCS, 10 VC and son to FCS 2, BC: Old man Fred (*a late neighbour*) used to plant on the 29th of September and was the only one who was interested in dry planting. We would watch his practice and once we observe him do his dry planting, then, we would know the rains are near.

FCS 2, BC: But we still practise our traditional maize crop (OPV) under rainfed agriculture and mainly in our gardens (wetlands) since they (OPV) need a longer time to mature and they also need to be away from the conventional seed varieties. We all later copied that practice of dry planting. If we plant them next to the conventional hybrid seeds, we risk cross pollination and we lose our (OPV) seed that we have preserved since the 1950s.

CD: What about the seed varieties of those days and those of today? How did you and do you access it?

FCS 2, BC: We don't buy the seed but we have always exchanged with others in the village over generations. We have always had our local maize seed variety with fruit seeds that looked like the then SR52 green revolution seed variety. That local variety used to grow well under good rains. Can I take a sample since we are still using that type of seed in some of our fields?

FCS 2, BC: Here is a sample of the original locally based maize variety that we inherited from our fathers and continuously planted over the years to keep the seed variety in practice only in a few of our fields to avoid it 'polluted' by new seed varieties (cross breeding). Some of the traditional maize variety could come in multi-colours, blackish, yellowish, brownish, and reddish and so on. Some of our villagers still have that multi-coloured maize variety as of today (02-10-14).

FCS 3, LN: Did you apply any artificial fertiliser on this traditional maize variety?

FCS 2, BC: No artificial fertilisers were applied in those days. It was compost manure and cow dung. You can be surprised, we used to make composts in those early days but then were different from the ones you prepare today. We used to dig big pits then burry the decomposable materials and leave them to rot then extract them later as manure. We used to dig the pit at the end of a contour ridge which by then used to drain off water. The drained water would flow straight into the pit and help the decomposable materials (maize cobs, grass and so on) to rot fast. If you have time we can go and observe the ancient compost pits that are still present in this field.

FCS 3, LN: We saw it when we were coming here and we wondered what the round pits were supposed to mean in the field.

FCS 2, BC: Once the compost matured into good manure, we would spread it in the field. We did not concentrate the manure in a hole as we now do in conservation farming.

CD: You showed me a very good maize cob with big fruits, why did you abandon such crops and opt for current varieties.

FCS 2, BC: We have been taken by the winds of change, we left our old practice (OPV) and have been taught by extension and donor agents to plant the modern seed varieties which is prone to diseases. But, we know our old maize seed variety (OPV) gives better mealie-meal and is resistant to diseases. Well! Everyone nowadays is going for certified seed varieties. We are taught these are good as they have been tried and tested by experts, so we also go for them and yet we are aware that the real mealie-meal is found in our traditional seed variety. But we still practise our traditional maize crop under and mainly in our gardens (wetlands) since they need a longer time to mature and they need to be away from the conventional seed varieties, they can cross pollinate and we lose the seed.

CD: What about other traditional crops?

FCS 2, BC: *Rapoko* Yes, traditional rice yes, sweet potatoes, yes, we used to have all those here but never *mhunga*, a millet variety. That one is prohibited in this village and district as it is believed to be a wish for droughts.

CD: Now can you explain the difference between the old farming methods and the new.

FCS 10, VC: Family member 2: From the early 1980s we saw the introduction of different maize varieties, SR52, R200, R201, R213 and R214. Around 1984 we were introduced to R215 maize variety.

CD: What were the reasons behind the introduction of all these maize seed varieties in this village?

FCS 10, VC: Is also a family member 2: Well! Today, we have been taken by the winds of change. Everyone nowadays is changing. We are going for certified seed varieties which are prone to weather changes and diseases and are too expensive for us. Through observing shifting in rainfall patterns in the 1980s when we experienced major droughts in the country, it was no longer reasonable for us to

plant the long season varieties (SR52) or the traditional *Hikiri-king* (Hickory King). The shifting seasons [climate change/variability] actually forced us to adapt to new seed varieties. You heard of the shift from SR52 to these 200s. In this village as you noted at the beginning of this conversation, rains used to come early and they could continue for a much longer season than they do today. SR52 was a variety that needed a lot of rainfall and a longer agriculture season. Through observing the shifting rainfall patterns in the 1980s when we experienced major droughts in the country, it was no longer reasonable to use the long season varieties. The shifting seasons (climate change) actually forced us to adapt to new seed varieties. Seed houses in the country therefore introduce short season varieties to cater for the reduced rainfall season. The traditional maize crop variety, also a long season variety could no longer survive under the changing weather patterns. Before 1980 short variety crops could not survive also in this village as these would mature in the mid rain season thereby giving farmers harvesting and storage challenges. Seasons are changing and country policies also change and all these make the farmer to change so as to move with time and seasons. Government policies such as a shift towards the provision of free seed and fertilisers meant that people had to practice farming using the same seed variety in the same region and the same village. Researchers too have played a role in the shift to new practices. We understand research came up with the new seed varieties that adapt to the short rain season and frequent droughts and pests. This saw the introduction of R201, R213 and so on. But as we have observed SR52 is not completely out of the market but we can see that researchers have reworked on it and gave it a new name as 709 (*Nzou*) whilst the other R's we talked about have been reworked and renamed as *Mbizi*. The problem that was discovered with those so called new varieties was that they were quickly attacked by weevils whilst standing and before you even harvest the crop. Today, we now have pioneer seed, a much resistant variety. This variety adapts to condition of both heavy and low rainfall and on harvest you won't find weevils. I can also say that today's methods are better than the old methods in that we now plant twice a year unlike in the old days when farming was a one off seasonal event. The introduction of different crops also brought this change. We now have winter crops and these we plant and harvest before the traditional summer crops. Plus because people have attained education, formally and informally, we have come to realise that it is unprofitable to waste a certain of the year being idle when the soils and water are available. We say, 'let us utilise the soils'. We observe and come to the calculations that if we still have a few more months into the rain season that is supposed to last around April, then we plant bean crop which is a short season crop, whilst we utilise the still continued rain season. At times with enough moisture in the soils we plant winter wheat and veggies, we are no longer an idle people. Nowadays we do conservation farming where manure is concentrated in a single hole unlike the old methods where manure were left on top of the soils near a crop. We also learnt that we reuse the same hole several times since it has enough nutrients to cater for other crops. The holes are often dug in linear formation giving enough air circulation between plants. Today (2016) with water for irrigation [a new production mode and means to achieve new functionings] some of our people in this village [LN, SM, JM, SS, etc] now practise winter cropping and these, they plant and harvest the winter crops before the traditional summer crops. They (farmers) have come to realise that it is unprofitable to waste a certain time of the year being idle when the soils and water are available.

CD: How did you learn about all these new adaptive practices?

FCS 10, VC: *Family member 2:* On the changing weather patterns, we learn from our extension officers, formal education at school. By being at school you gain a lot of knowledge from teachers, peers or even from reading books. More, our parents and grandparents are a source of new and old farming methods too. Learning starts with playing pots [games before formal education], and what the extension officers do is to strengthen the knowledge that we get from many other formal and informal sources. We learn from our extension officers and from formal education at school.

CD: What resources or inputs do you use in the conservation farming (farming through concentrating manure in a single hole), digging basins?

FCS 10, VC: *Family member 2:* We dig holes and put manure in each hole. We also apply artificial fertiliser Compound D. we also apply the Ammonium Nitrate synthetic fertiliser and all that is concentrated in the same hole. (*Current research studies seem to point to the fact that potatoes planted in bags, often take up a lot of fertilisers that concentrate inside the bag without the chance to escape and that is said to be a potential health problem. More research is still needed on the type of*

conservation farming that the Muchena people are practicing if the concentration of fertilisers in a single hole is good for people's health or not). People like this type of conservation farming and the people are enjoying the new practice. Everyone in this village is practicing that type of farming and that is over 1000 households. Nowadays we do conservation farming where cow dung manure is concentrated in a single hole unlike the old methods where manure were spread on top of the crop. We also learnt from extension service to reuse the same hole several times since it has enough nutrients.

CD: How and where do you get climate change education?

FCS 10, VC: *Family member 2:* I can say trying to concentrate on your own knowledge and understanding of environmental issues does not pay (Vid_20141002_130430 time when statement was said: 10:46). We all learn from others and with others (10:56 minutes on the same video). Together people bring out different views on the changing weather patterns the 'don't you see this and that concept', set the tone for debate. You then digest what others say and come up with a better understanding of climate change. When we meet as a group with our extension officers we digest different views on the climate and in the end, we all learn from others and we move forward as a village towards adaptation. But I can say around 1992, that is when we began to observe major changes. Most trees lost their leaves, a phenomenon that was strange in that year. Every morning when we visited our off-the-field wetlands for wetland farming of yams and bananas, we noticed a lot of mist around the wetlands and we were surprised by the observations. There after we never experienced wetlands farming as they dried up showing that the water table had gone very deep. (it is on record that Zimbabwe experienced a severe drought in 1992).

CD: What about markets?

FCS 2, BC: People used to sell at local level and at times it was just barter trade. The issue of market has been introduced with the coming up of new trainings and new farming methods. We are now being encouraged to farm as business.

CD: How do you preserve the maize seed from pests like weevils?

FCS 2, BC: [in 2014]. Well, well, to prevent weevils we normally hang in the traditional kitchens the seed maize of our traditional crop, where there is soot and whenever we do that the seed is not attacked by weevils at all. But this meant that you cannot preserve as much seed as today's seed houses do [laughter].

FCS 10, VC: Apart from crop farming, tree planting has a painful history in this village. The introduction of exotic trees in this province has a painful history. Exotic trees were a priority of the early White settlers; the Whites had installed fear in Blacks in this district by taking over all productive land and put it under exotic tree plantations. Our people therefore feared to plant gum or pine trees at their homesteads saying, 'Once the White man sees that your place is good for exotic trees then your land will be taken and you get resettled elsewhere' As a result most people feared to plant exotic trees at their homesteads. Instead of gum seedlings I opted for fruit tree seedlings production, not because off fear but just to differ from what the youths were doing. But generally I can say there have been many factors that made us shift from one mode of farming to another. Before 1980 short season variety crops could not survive in this village since these would mature in the mid-rain-season thereby giving farmers harvesting and storage challenges. Seasons are changing and country policies also change and all these make the farmers change so as to move with time and seasons. Seed houses in the country therefore introduced short season varieties to cater for the reduced rainfall season....

CD: Thank you for all this powerful information, I will come again!

Interview with FCS 6, JM² 06/06/16 FCS 3, LN in attendance

CD: Good afternoon Mr **FCS 6, JM²**. Today I would want you to take me through the road that you travelled in your new farming practice which is solar powered. My story into this new farming practice is very short, we started this practice in 2015. From our ten plastic tanks we utilise flood irrigation down gradient and in winter we do not just irrigate our tomatoes but we also burn sawdust to create a micro-warmer climate around the plants and so reduce frost, a traditional knowledge system we learnt as we warmed our selves overfire the at night.

CD: Great. Who sponsored you and how did it happen?

FCS 6, JM². We used to have fruit tree plantations but these had over-grown and were no longer productive. With erratic rains, we were no longer getting enough fruits to enable us to survive and to buy our staple food, maize meal. So, I attended a Field Tour at **FCS 4, SM²** where I learnt of market gardening. He had a single Plastic Tank of 5 litre capacity and a fuel powered water pump as his inputs. I reflected with others back home and with relatives in town. We agreed to start a market gardening project under four hectares with ten large plastic tanks and solar power.

CD: That is good to hear. Apart from learning of market gardening from **FCS 4, SM²**, who else inspired you into this new practice of market gardening especially solar powered irrigation?

FCS 6, JM² I also learnt about irrigation farming through informal learning from television and radio programmes in the local languages Shona and Ndebele, '*Murimi wanhasi-uMlimi wanamhla*', [Today's Farmer] and television's English programme, 'Talking Farming' and from trainings by donors. These, at times dwelt a lot on irrigation farming [centre pivot] and not small scale innovations. I also learnt about the need for irrigation through the donor trainings on Farming Business and after reflecting as a family and extended family, we came up with the idea of a solar powered system to supply ten plastic tanks. So I can say climate change and harsh economic challenges also taught me to think on new ways of farming including irrigation so as to raise income and for job creation.

CD: Well that is good so you mean that the radio and television programmes also help in transforming people's lives?

FCS 6, JM². Yes, yes, but I can also say that climate change and harsh economic challenges (lack of jobs) also taught me to think of new ways of farming including irrigation so as to raise income.

CD: What about the challenges that you face as tensions emanating from this new farming practice?

FCS 6, JM² My crop field is quite big [the crop field is around 4 hectares and this is quite big according to this village's standard of average field size] and the fact that we are also moving towards organic farming, getting manure and making composts for a such a large field is a big challenge. More! On traditional knowledge and innovations, in winter of 2016 we burnt sawdust throughout the night and the smoke drove away frost from my tomato crop and I was happy that the traditional mechanism worked.

FCS 3, LN. Do you value the idea that we cooperate by growing one crop at the same time and we sell to one big agro-industrial market one day?

FCS 6, JM². Producing for the agro-industry is my wish too. We need to be selling to bigger urban or to agro-industries next year (2018). One individual cannot meet the demands of an industry but when we combine forces, we can do it.

CD: What about markets?

FCS 6, JM²: We rely on the local open market so far. The vendors from our local open market come and place their orders here and we supply them in bulk. We have veggies, onion and tomato so far. You know we used to specialise in fruit trees for a very long time, we stopped all that now. Today we have clean energy in a solar powered pump and a very large water reserve in ten large plastic tanks to enable us do the market mode of production through green maize, garlic and horticulture products such as onion, tomatoes and vegetables.

CD: Can you talk about winter cropping, how did you manage?

FCS 6, JM²: In winter it was a challenge. I had to reflect on our old ways of how we were kept warm at night in winter, by lighting a fire. We had to burn sawdust to try and suppress condensation and frost at ground level.

CD: Thank you for all this information I will come again and continue sharing ideas about your new farming practice another day.

24/06/16 video 110226 Video 1

Apiarist LM³ of Ward 26 Muchena village Mutasa District during a Field tour at FCS3

CD: Good morning Sir, can you introduce yourself and what you do for a living.

FCS 8, LM³: My name is **LM³** of Muchena village in ward 26 in Mutasa district. I am an apiarist. We observed that nowadays the rain seasons have become tricky [shifting seasons]. This makes maize farming difficult with poor or no harvests at all we chose to concentrate on apiculture which has always been a family venture but at a very small scale [just a hobby]. We now concentrate on apiary as we get money which we then use to buy maize. I used to work in the local forest industry but I left

all that. The remuneration was not good enough (2006-2009). From formal employment I could not manage to fend for my family and yet with beekeeping, I earn many times more than what I earned a month when I was formally employed. I bought furniture from apiary, we buy food from the honey and we send our children to school and so we are now a happy family as we can now afford to survive independent of formal employment. My advice to the other young adults is that we need more apiary farmers as the market is just too big and we cannot even meet the demands of 30 tonnes per year. More, beekeeping has the capacity to reduce domestic violence. With the availability of honey in the home, families always have cash at hand and hence less social stress and less domestic violence especially those emanating from financial stress. To other young adults I say to you self-employment through beekeeping is the way forward instead of wasting time looking for a job that hardly pays you enough to sustain your life and that of your family. We still use family labour in honey extraction and marketing.

CD: Tell us more about how you start apiary as a practice?

FCS 8, LM³: We have learnt that our climate is changing and we have learnt from donors and our local extension service that apiary, which was a practice we learnt from our own parents as a hobby, can be good as an alternative to maize crop farming. We used to receive rains in November each year but today this is not the case. Rains are no longer predictable. We noticed that maize cropping is being affected by shortage of rains (frequent droughts) and pests and at times there is just too much rains leading to flooding. Every year we experience poor maize harvests. So, we resorted to apiary that we used to practice as a family hobby, but now as a business. Apiary is good. Here in this field we can see there is a peas crop that needs crop pollination and as apiarists we get pollen and nectar from the trees around for honey processing. After honey is processed we sell the honey and buy maize from those who produce maize. We still need maize as our staple food. So apiary is an alternative to maize crop farming.

CD: How many of your apiaries are fully swarmed?

FCS 8, LM³: I have a total of 111 with 64 fully swarmed apiaries. We (*as a family*) extract honey three or four times in a year. We harvest three to four times a year and we used to sell locally but today we sell to a Harare market. The prices are not attractive though.

CD: Tell me about your market.

FCS 8, LM³: We used to sell to the local community but now we managed to secure a market from Harare. It is a company from Harare, I have forgotten its name.

CD: How do they want to buy your honey, is it in Litres of Kgs and how much?

FCS 8, LM³: They take in kilograms at USD \$2.50/kg and last time I managed to send 120kg and that is an amount of USD \$300.00. This price of USD \$2.50 is not good for us as apiary farmers. Not just myself but all other apiarists are complaining about the price. We expected a price of USD \$3.50 but just last week, the buyers said they are going down to USD \$1.25 instead. Many apiarists are not selling to this Harare Company but are holding to their products while they continue selling to the local market.

CD: Why, what is their reason for a downward pricing?

FCS 8, LM³: I have 111 apiaries and 64 are fully swarmed. Today we sell to a Harare market. They say the market is flooded with honey and so the price goes down. But, surprisingly some of the Harare buyers are saying that they need honey in large tonnage and not small quantities and such large tonnes are nowhere to be found in this village. But they say the market is flooded in Harare and yet some Harare buyers come to us and say they want 30 tonnes of honey. So, it confuses us when one buyer says the market is flooded and yet another says they actually need more.

CD: Let's go back to the issue of insect pollination of crops by bees. From which crops do the bees collect pollen back at your own homestead.

FCS 8, LM³: Bees collect from pumpkin leaves and flowers, peas and from maize flowers and from the indigenous trees and eucalyptus trees (*absent is the bottle brush plant for bees see also FCS 10, VC*). We encourage the farmers not to spray their crops because spraying kills insects including bees.

CD: What other advice do you want to give to other local farmers?

FCS 8, LM³: I encourage other local farmers to keep bees too. The market is just too big. Bees are a good alternative to maize crop farming. Maize is affected by droughts and diseases.

CD: We last had a video recording in 2011 if you can still remember. What changes have you noticed in your apiary business since 2011?

FCS 8, LM³: Between 2011 and 2016 and I can see a lot of changes in my life. I used to take apiary as a hobby while I earned a living through working in the nearby forest industries. Today (2016) I survive of apiary which I now take as my full employment. I buy my food from apiary sales, buy clothing and send my children to school.

FCS 3, LN: *Youth Leader.* I just want to add on one advantage of keeping bees next to crops. The crop yield will increase due to pollination by bees. You see we expect a higher yield this time around since we have bees around helping our peas in pollination.

24/06/16 video 111412 Video 2

Apiarist FCS 8, LM³ of Ward 26 Muchena village Mutasa District during a Field Tour at FCS 3

CD: Can you carry on with your story **FCS 8, LM³.**

FCS 8, LM³ Apiary has been a family hobby for ages, I continued with apiary as a hobby though. The old apiaries [bee-hives] that we inherited were made from bark and then we later used gumwood planks to come up with mere boxes as the hives.' At the next village (D) there is a farmer (C) who has 256 fully swarmed beehives and he hires them out to apple tree farmers in (N) area to pollinate the fruit trees. At the next village (D) there is a farmer (C) who has 256 fully swarmed beehives and he hires them out to apple tree farmers in (N) area to pollinate the fruit trees. This normally happens when the apple trees are at flowering stage, he strategically settles the hives at every convenient site of the fruit plantation field. The bees do their work in collecting their loads from the apple trees and so the farmers benefit from an improved fruit harvest. The apiary farmer can also continue harvesting his honey while the bees are also being paid for the work done in the apple trees. The apiarist gets a double benefit, cash from hiring out the apiaries and honey.

FCS 3, LN: That is a true story. I heard that trucks come to the village in question to collect the apiaries from this village next to ours. The apiaries are then lined up at the edge of the apple fields and the bees do their work as the farmer enjoys both the money and the honey. I hear this is done when the apple trees are flowering so that the bees do waste energy to go and look for flowers elsewhere but the apple field. I also heard each apiary out of 256, will be paid per hour for the services rendered in pollination.

CD: **FCS 8, LM³,** do you want to add other information?

FCS 8, LM³: Still on hiring out of apiaries, when harvesting time comes the apiarist travels to Nyanga to harvest his product and send the honey to his usual customers. Hiring out of the apiaries does not disturb the harvesting and marketing process.

CD: Can you give your comment on apiary as a climate change adaptive mechanisms.

FCS 8, LM³ Like a farmer, bees do not work in wet weather. Bees work better in dry conditions. Bees start work as early as 0400hrs going to collect collectables, water, pollen, nectar and so on. So in drought conditions when it is not good for maize cropping, farmers can turn to apiary (*as adaptation to droughts*). On average a bee can make as high as 40 trips a day and such trips that involve at times long distances, favours drier conditions?

FCS 9, FN: As a small-scale and new apiarists (*entered into apiary in 2015*) I am learning and will still learn a lot from the (*Father of Apiary-Gogodera reNyuchi, FCS 8, LM³*), in the next two to three years I will also be holding an apiary field day at my apiaries so that I become the first female apiarist to do that (*laughter!*)

FCS 8, LM³: I also want to give advice to the youths and young families that they have to be involved in apiary farming and not waste time socialising at beerhalls from morning to sunset. Idleness in young families is one cause of domestic violence in this village. What the youths need to do is just to look for a planks to construct the Kenyan bar hives and mount it and make efforts to attract the bees by waxing the hives. I no longer experience domestic violence in my own household, there is plenty of honey at home, my wife can just sell a few kilograms and buys what she wants. There is no need for my wife to ask a cent from me when as a family we have plenty of honey on the market. So, apiary farming reduces domestic violence especially those caused by economic problems.

CD: Thank you so much **FCS8, LM³.**

24/06/16 Apiarist FCS 8, LM³ of Ward 26 Muchena village Mutasa District during a Field tour at FCS 3, LN. VID_20160624_113441 (Continues with previous interview)

CD: You said you had left out some important issues. Can you carry on?

FCS 8, LM³: Yes, I had left out the point that the buyers from Harare are saying they want 30 tonnes worth of honey.

CD: Can you afford sending 30 tonnes worth of honey to Harare?

FCS 8, LM³: Thirty tonnes is an uphill task for one person. One person cannot afford supplying that quantity it is not easy. Even if we were to team up, it is not easy to produce thirty tonnes as demanded by the Harare market. We will try but it is not achievable. We will see how many tonnes we can produce and send to the Harare market.

CD: As an individual apiarist, how many kilograms or tonnes can you afford to send to the market? Can you send thirty tonnes to the market as a single apiarist?

FCS 8, LM³: In terms of harvest, I can exceed 200kg that is one drum (*ten drums are equivalent to one tonne*). At present I can harvest up to 200kg per harvest, so it is not easy to reach a tonne and more, 30 tonnes as demanded by one Harare market. But with more apiary farmers we will try. We continue to get trained by our local extension service

CD: What about your colleagues from this village and from the next village? Can they raise the thirty tonnes?

FCS 8, LM³: It depends, some are just beginning and they have few apiaries. Some had their apiaries affected by veld fires. Those from the next village, **N**, had their apiaries affected by veld fires and that created a big problem. One can say I can only afford sending a bucketful of unprocessed honey (20kgs) another one can say I can only afford half a bucket of unprocessed honey (10 kgs) and that creates a lot of challenges. To reach a target of a single tonne, it is quite heavy, and more, thirty tonnes is not easy to reach that. We need many apiarists working together in order for us to reach a single tonne.

CD: But are these not the same Harare buyers you said are buying unprocessed honey at a very low price, citing that the market is flooded?

FCS 8, LM³: That often confuse us, they say there is too much honey on the market and so the prices are low and next they say we actually need thirty tonnes, quantities that we cannot even dream of achieving as small scale farmers. But more, the prices are just demotivating us from doing business with them.

CD: Still on that, how are you selling your honey, I mean the measure you use, is it small 400g plastic bottles or buckets (20kg)?

FCS 8, LM³: The Harare buyers who are coming today (24/06/16), prefer buckets (20kgs) but those from the village who have health problems such as common colds and asthma, they normally buy from smaller quantities (400g plastic bottles) @ USD\$3.00 per bottle. For the Harare buyers we weigh the contents in the buckets and the buyers pay per kilogramme. At times they pay USD\$40.00 and at times USD \$50.00 depending on the weight of the unprocessed honey. Their pricing system is not good for us the apiary farmers. We sell at (USD) \$2.50/kg and in 2016 I managed to sell \$120kg (\$300.00) but this price is not good for us because we cannot break through. We rely on sales from apiculture in order for us to buy maize, our staple food, send our children to school and pay for our medication. The buyers even said that they want to reduce the price to \$1.25/kg, they are saying the market is flooded there in Harare and so the prices go down. We continue talking to them. We expected the price to go up to \$3.50 and not reducing as they are suggesting. Most apiary farmers here are not happy with the prices and so they hold onto their product and resort back to selling to the local market instead.

CD: What about the local market?

FCS 8, LM³: Even today we still supply the local market in small quantities of 250g bottle @ \$3.00. We normally sell honey to people who are asthmatic and those with heart problems and the general public who just love honey. They come and buy from our home.

CD: Can you share other challenges with me?

FCS 8, LM³: I have noted several reasons why bees seem to be scarce nowadays in this village, veld fires which were very rare especially in **Ny** village known for beekeeping, are now more frequent. Secondly if I don't have enough wax, to attract the bees, then most of my bee-hives remain empty. Also drought, the rains were not evenly distributed and there were not heavy too, resulting in less flowers. But there are good aspects too. We now concentrate on api-culture and the money that we get

from selling honey, we use it to buy maize, our staple food. Our apicultural activities indirectly help farmers such as the peas and maize producers to increase their yields too since bees pollinate their crops. Today we specialise in selling honey to a bigger market in Harare. I don't know the name of the company since we deal with a middleman. In return, we buy maize and other foods from the honey proceeds. More! We observed that nowadays the rain seasons have become tricky [shifting seasons]. This makes maize farming difficult with poor or no harvests at all we chose to concentrate on apiculture which has always been a family venture but at a very small scale [just a hobby]. We now concentrate on apiary as we get money which we then use to buy maize. As noted before, I used to work in the local forest industry [name withheld] but I left all that, the remuneration was not good enough. I could not manage to fend for my family and yet with apiculture, in a year, I earn many times more than what I earned when I was formally employed. I wasted time in the formal employment sector, it was not worth the time I spent. We observed that nowadays the rain seasons have become tricky [shifting seasons]. This makes maize farming difficult with poor or no harvests at all we chose to concentrate on apiculture which has always been a family venture but at a very small scale [just a hobby]. We now concentrate on apiary as we get money which we then use to buy maize. I used to work in the local forest industry [name withheld] but I left all that, the remuneration was not good enough. I could not manage to fend for my family and yet with apiculture, in a year, I earn many times more than what I earned when I was formally employed. I wasted time in the formal employment sector, it was not worth the time I spent.

CD: In brief what can you advise the young apiarists in this village?

FCS 8, LM³: My advice to the other young adults is that we need more apiary farmers as the market is just too big and we cannot even meet the demands of 30 tonnes per year. Apiary has the capacity to reduce domestic violence in our homes. With the availability of honey families always have cash at hand and hence less social stress and less domestic violence especially those emanating from financial stress. We encourage farmers even the youths here, to hire out apiaries to crop farmers for the pollination of plantations and field crops. I am happy to see more farmers into apiary.

CD: Thank you so much **FCS 8, LM³**

24/06/16

Apiarist FCS, FN9 of Ward 26 Muchena village Mutasa District during a Field tour at FCS 3, LN. FCS 9, FN also does aqua-culture (fish farming) and apiary (beekeeping) (4 other participants were present) Video 112323 (VID_20160624_112323)

CD: Good morning **FCS 9, FN** can you give me your perception on changing seasons especially the shifts in rainfall patterns and intensity. We once talked about the same issues some time ago and you told me of the rainfall patterns from the 1950s to early 1980s, which we are done with, today I want to know about your recent experiences.

FCS 9, FN: Last year 2015, our rain season was poor. The rains did not come as expected in October as it used to but came late. We received rains on the 5th of December. But, the seeds could not germinate. This was a major problem in 2015-2016 season. It affected everyone. Seeds could not germinate. We tried to replant but that could not work, there was just no rains. The rains came later in January but again the maize seeds could not germinate as was the case in early December. This is the reasons why most of us had a poor maize yield. This was mainly because of a shift in the rainfall pattern and a poor seed variety that failed to germinate.

CD: When the rains stopped again in January, when did the rains resume falling? I mean in which months or dates if you still remember?

FCS 9, FN: The rains resumed falling in February. To be specific it was on the 7th of February 2016. The rains then continued falling but it stopped again. Normal rain season of continuous rains was in March of 2016. (*Missing are dates and so poor record keeping*). By that time it was too late for a maize cropping and so we knew there was going to be poor maize harvest.

CD: When that happened what did you do? Since the maize season had elapsed what alternative to maize cropping did you think of engaging.

FCS 9, FN: Faced with a drought that affected the maize crop, we thought of garden crops as alternative to maize crop. We started farming green vegies, peas and onion. We have some small water earth built reservoirs where we keep water for irrigation. We also practice aqua-culture or fish farming. We have a water reservoir (dam) where we practice farming. We learnt of fish farming. We

now have knowledge on fisheries. One male fish can service 4four female fish. Once the fish lay their eggs, we remove the eggs and take them to a separate reservoir, the nursery dam. We remove the eggs using nets, mosquito nets. After we put the eggs in the nursery dam, the females continue to lay eggs. If we do not remove eggs, female growth would be retarded. From the nursery we put the fingerlings in the growers' dam. The nursery dam continues accommodating the eggs while the growers' dam continues accommodating fingerlings and that is how I do it.

CD: So I hope this shows that you had a passion of fishpond farming before?

FCS 9, FN: Yes, I had the passion for fish pond farming as I had some tilapia before 2015, but I wanted to be recognised in the whole district as one of the first female farmers to do three things, organic farming, apiary and fisheries at the same time. But more I can say I was also motivated by you, **CD** when you showed us videos of fish pond farming in Beitbridge, a dry region of Zimbabwe. I said to myself, if people in Beitbridge are keeping fish, why can't I do it here, a region with plenty of streams and ponds in most of our gardens. I kept thinking about it, until I was approached by one extension officer who invited me for fish pond farming training, and I grabbed that chance.

CD: Can you repeat, where, when and how else did you get this brilliant knowledge?

FCS 9, FN: We were send for training in aqua-culture by our local MP. We were trained at Magamba training centre, a few kilometres from Mutare. That is where we were trained. Honourable IZ funded the training. She fully funded the training. Each individual had to pay quite a good lump sum of money but Honourable MP, IZ fully pain that for us. The amount per individual was USD \$50.00.

CD: How many were you from this village?

FCS 9, FN: From this village there were five of us who were funded for the training in aquaculture.

CD: Who else was trained?

FCS 9, FN: Prisca, Eurita, Tosa, Fransisca and Grace.

CD: What about apiary, can you talk about apiary and how you came to be an apiary farmer.

FCS 9, FN: For sure I am an apiarist. We learnt of apiary as an alternative to maize cropping during a Field day at **FCS 8, LM³** project. We went to **FCS 8, LM³** for a Field Day to observe and learn from him as a local experienced apiarist. We were quite excited with what we saw at **FCS 8, LM³**'s apiary project during the Field Day. We saw over 200 apiaries and we were all excited. As a woman I was greatly motivated with what I saw at **FCS 8, LM³** and so I reflected and said, 'As a woman, why can't I take up the challenge and start apiary.' But at first when we finally started the apiary project, we did not have much knowledge on apiary and it was more of a hit and miss type of practice.

CD: This is good to hear

FCS 9, FN: As a recap, I said I also do beekeeping and I initially learnt of this from **FCS 8, LM³** during a Field Day. I reflected on the possibility of beekeeping after appreciating the number and quality of beehives at **FCS, 8 LM³**. I also reflected on that back home with my family. We were advised that there was going to a training in apiary in Harare's Borrowdale (Art Centre in the Pomona area of Harare). So, I was later trained in Harare Borrowdale. I have twenty beehives with four already swarmed (functional) today (2016). Only two female participants and four males, from the whole of Mutasa District, were selected. I am happy I was one of the two women selected for the training. It was a one week training there in Harare, being trained on apiary by Mr. S. You can also see these photos as evidence (*photos were shown to CD*). I have 22 beehives and four are fully swarmed today (2016). We were given the honey extraction gear at a training in Harare. Our hives are no longer mounted on trees, they are gender sensitive as women we can do honey extraction without having to climb trees. The apiaries are mounted a metre or so above ground and not high up on tree branches as was the case in the old days. After the training, I was now confident to leave maize crop farming. Right now I have my own apiary project. So far I now have 20 apiaries (2016). Four of them are fully swarmed as I said before. I am continuing with the construction of more apiaries, I haven't stopped yet, I need more apiaries. I also reflected on changing seasons (*climate change*) as I learnt from the **FCS 8, LM³**, that apiary can be a good alternative to maize crop farming. Rains are no longer reliable and so we are now doing many projects like apiary.

CD: That is great. What else did you learn about apiary farming in Harare?

FCS 9, FN: We learnt that a bee sting boosts one's immune system against malaria. Bees can predict visitors, if a bee flies into your house it signifies the coming of a visitor. If it makes several rounds

flying inside your room, it shows the number of days the visitor is likely to spend and if the bee flies close to your eye, it signifies that the visitor is very close to you. That is what I can say.

CD: Which other projects are you engaging with?

FCS 9, FN: I am also an organic farmer, farming without artificial fertilisers and chemicals... We have cattle, goats and traditional chickens, two large water ponds and so organic farming under irrigation is easy for us. I also practice piggery as a project. We were given two pigs as a group of fourteen. We engaged in feeding the two pigs and we vowed that we have to keep the group intact until each one of us would be having a pig each. We did exactly that, giving each other a pig each and currently each member has two (*meaning that so far (2016) they have realised 28 piglets in two years*). Mine now needs to be serviced such that by the end of the year I will be looking to having many. We also rear road runners (*indigenous chickens*), goats and cattle. Road runners were affected by diseases and so as a family we have ten and three goats.

CD: That is good. Do you want to add any other information?

FCS 9, FN: Yes, I want to add, what we produce in our garden, we do not use artificial fertilisers, we use cow dung manure and compost. We call our type of farming, organic. Use of fertilisers and heavy chemicals and metals, are causing a lot of non-communicable diseases or chronic illnesses of today. Crops without the application of fertilisers and chemicals is healthy for our bodies, we call such farming, organic. More! We learnt that a bee sting boosts one's immune system against malaria. Bees can predict visitors, if a bee flies into your house it signifies the coming of a visitor. If it makes several rounds flying inside your room, it shows the number of days the visitor is likely to spend and if the bee flies close to your eye, it signifies that the visitor is very very close to you.

CD: When we paid a field trip to Agro Industry¹ in Mutare, during the focus group discussion there, the agro-industry if you farm as a group, do one crop as a group so that you harvest in bulky, then industry could support you as small-scale farmers. Today they were saying do you have 60 tonnes of onion? Can we as a group of small-scale farmers meet such a target of 60 tonnes to supply industry?

FCS 9, FN: We can meet the target, we will try (*matanda maedzwa unorega nerakaora*, a Shona language proverb meaning you just have to attempt at something otherwise the task might be easy and doable).

FCS 8, LM³ (*who was also present during the field tour at FCS 3, at the youths demonstration centre*). I have a question to FCS 9, FN, do you feed your fish and with what?

FCS 9, FN: Yes we feed the fish with chicken droppings and cow dung manure. Especially chicken droppings and feeds processed from millet.

FCS 8, LM³: If that is the case then that is good. Fish needs to be fed.

FCS 9, FN: Yes we also learnt from others that pig droppings are good for fish. I had left out important points. We have eleven goats and five cattle. Goats and cattle provide the manure for our organic crops. We also put pig droppings in our fields as alternative to artificial fertilisers. More! I had the passion for fish pond farming as I had some tilapia fish before 2015, but I wanted to be recognised in the whole district [Mutasa] as one of the first female farmers to do beekeeping, fisheries and organic farming, at the same time.

CD: Thank you very much **FCS 9, FN**

24 June 2016

VH², EM: Village Head² of Ward 26 Muchena Village Mutasa District during a Field tour at FCS 3, LN (4 other participants were also present). **VID_20160624_114153**

CD: Good morning **VH², EM** Sir. Today I am interested to hear more about the changing climate and changing seasons. What is your comment as the Village Head about the rains in the 2015-2016 season, how was the situation like in your village?

VH², EM: In the 2015-2016 rain season, the rains came late as compared to the previous seasons. From my observations, the situation was different from the previous years. Instead of mid-October, we only got first rains (onset) in December.

CD: Still on that, what can we do to adapt to the situation? How best can we do or learn about water harvesting? If there are funders what exactly, as the village head, do you want the village to do and to be helped in?

VH², EM: Yaa in our village, we had plans for water harvesting and for a pipeline to carry water from the main pipeline that passes through the village from Pungwe River to Mutare. The Zimbabwe

National Water Authority (ZINWA) came up last time and we held a meeting together concerning the issue of water supply. In our deliberations we also talked about the existing dams in the next village on how best we as Muchena village could access that water. Through reflection with the ZINWA officers we resolved that it was difficult and very expensive to have pumps or machines that could pump water from the dam up the hills into the village. (*The village is on a plateau while the dams are down gradient*). Instead we resolved after reflecting together with ZINWA that we rather get water from the Pungwe Water Project which has a pipe line that passes through our village. That idea was accepted and so it was passed as a resolution. But at present we are waiting to hear from the ZINWA for feedback from higher authorities in town (*The Local City Council which is the main target for the Pungwe Water Project*). We still hope that it will work out well in our favour.

CD: That is great, last year (2015), if you still remember, we assembled here (*demonstration site FCS 3*) for a Field Day on peas crop. From here we went to Agro-Industry¹ in Mutare, the Agro industry encouraged the Muchena communal farmers to work together and come up with a single crop which the industry will buy in bulky. They talked about 60 tonnes worth of king onion. Can the farmers in this village pull resources together in order to supply the 60 tonnes to Agro-Industry¹?

VH², EM: Yes they have the capability to supply the 60 tonnes but water is a disabler of that capability. Water is a big challenge, without water how can they achieve that? Our people are just subsistence, they rely on the human head to ferry water for watering gardens, and now to imagine 60 tonnes that is a big mountain to climb when people do not have irrigation facilities or a consistent water supply. But as was promised by ZINWA, if the water issue was to be resolved then the production line was going to be opened and the village could supply the required 60 tonnes. More! In order for this community to be contracted to produce for big agro-industrial markets the village needs constant water supply mechanisms. We have a big dam nearby but it is way down gradient and so the dam only benefits farmers and communities that are further down gradient and not us. The National Water Authority came here and we had a need analysis workshop with them. Our communal area is more on a raised plateau, it was going to be very difficult and expensive to extract water from the nearby dam as we need a big water pump, communal reservoirs and a pipeline from the dam up gradient into the village.

CD: Thankyou **VH², EM** Sir for sharing with us your thoughts.

24 June 2016

FCS 10, VC (Dendrologist) Ward 26 Muchena Village Mutasa District during a Field tour at FCS 3, LN (4 other participants were also present). VID_20160624_115603

CD: How are you Sir **FCS 10, VC**? Can we have a chat on how you have moved on with your project as a dendrologist?

FCS 10, VC: I am fine Sir **CD**? How are you too? I am **VC** (FCS 10) and I live in this Muchena village in Ward 26. I want to take you back from how we used to survive in this village. I reflect on how our own fathers used to survive and how we as youthful families are also surviving today. Our fathers and forefathers used to survive on farming and other piece jobs. Life depends on farming, farming is good. Everything that we eat, comes from the soils. Long ago, there were rainfall patterns of those days which are now different from the rainfall patterns of today. Our elders knew the dates when to expect which type of rainfall as we once discussed in 2014 if you still remember Mr **CD**?

CD: Let's reflect on 2015, how was the season like?

FCS 10, VC: In 2015 the season was tricky. The rains came very late, this is a result of changing seasons from our old days to the situation today. This is climate change. We used to expect our rains in October in the early 1980s but this had shifted to early November thereafter. But in 2015 it was totally a different story, the rains came in February and that was not good for farming.

CD: Upon realising that the season was not good for maize cropping in 2015, how did you adapt?

FCS 10, VC: We reflected together with **CD** that because of the shifting and changing seasons, we can no longer rely on maize crop farming, but to diversify into other farming activities. We reflected on fruit tree seedlings, shrubs and herbal production (dendrology) as alternatives to maize crop farming. Rains are now erratic and that is not good for maize production. Because if changing climate maize are also affected by many diseases and pests which are difficult to overcome and so we thought of *dendrology* as an alternative to maize crop farming. At first we used to produce gum seedlings with **CD** but we later diversified into, fruit trees, flowers, shrubs, herbs and a variety of indigenous trees.

We now produce what the market demands. Hospitals for instance, normally take from us, ornamental plants that improve on the décor of their environs. Schools and colleges are also demanding such ornamental plants to improve on their outlook. We also move around schools and we talk about environmental awareness so that they protect trees and as a result but, more trees from us. As a result if such environmental campaigns, the different institutions also buy our trees and shrubs and as a result we earn a living out of it. In the end we get money to buy the much needed maize that is our staple food. As an alternative to maize crop farming dendrology actually provides the much needed cash to buy our staple food, maize which we are now failing to produce due to climate change. You see our business in dendrology actually has created employment to some of our community members.

CD: That is good to hear.

FCS 10, VC: Dendrology as an alternative to climate change or an adaptation to climate change has led to job creation as people engage with piece jobs in our fruit tree project. The majority of our villagers are also realising good health from the fruits that they get from the fruit trees that we produce. You see we also a situation where development can also be realised in this village. The fruits that the villagers get from the fruit trees that we sell to them, will also be bought and this will bring development on the village. So, dendrology as an alternative to maize crop farming can be a centre for rural development. The village indirectly and directly benefits but more the village has benefitted from **CD** is doing in the village.

CD: That is good to hear. I heard you had a Field Day on dendrology, what exactly did showcase to our people and to visitors?

FCS 10, VC: For sure we made all preparations for the Field Day, but you know at times there are always challenges (disablers or ills). Our main challenge was that there was a funeral in the village and so we had to postpone from the first date and we later did that. On the other hand the demand for fruit tree seedlings and herbs was on the increase and many seedlings had been collected and so it was no longer worth calling people to observe trees that were no longer available on the ground. The Field Day had an advantage as you would explain on how to do raise fruit trees and shrubs seedlings and herbs to many people at a time instead of explaining to individuals when they come to buy, so the Field Day had an advantage of numbers (*Field Day as a source of learning or a learning platform which has the advantage of covering many people at a time*). During the Field Day we explained to many people on the advantages of trees to the environment and more the good part of raising fruit trees, shrubs and herbs to people's health and as alternative to maize crop farming in these days when rains are not favourable to maize crop farming. Fruit trees and ornamental plants also beautify places apart from protecting the soils from erosion, they make our schools and hospitals look beautiful. Even homes, they look alive when they are surrounded by trees including fruit trees and ornamental trees and shrubs.

CD: That is powerful. So far, in terms of quantities, how many tree seedlings did you have in the 2015-2016 season?

FCS 10, VC: The plants that we had in this season were sixteen thousand seven hundred (16,700). These were all fruit trees. (*For argument's sake if all the tree seedlings were to be bought at a minimum of USD2.00 then the young farmer could have realised a total of USD33, 400. Which is a handsome amount by local standards*)

CD: How much were you disposing each tree seedling?

FCS 10, VC: Our tree seedlings do have different prices depending on the mode of production and type of tree. In 2015 we had 16 027 plants that we sold. Trees that we produced from seed such as mangos and avocados, we sold them at USD \$2.50 to \$3.00 and those that we produced through grafting such as oranges and apple, we sold them at USD \$3 to \$5.00.

CD: This is good to hear.

FCS 10, VC: We cannot complain much as we are now able to do many other things from the funds that we raise from the fruit trees. We can buy for ourselves maize, other foodstuffs, send children to school, build a house as you can see here, we dug and constructed a protected well for our water supply, fenced off our yard and many others. We are now happy at last as we can now afford to hire labour and create employment for other youths in the village. More, some Harare buyers took some of our mango seedling-samples to Z [a name of a country] for a possible export market. The Honeys have a very small seed and so they have a high flesh to seed ratio. These are good for canning since

they are non-fibrous. We have trees that are independent of grafting and budding such as those produced directly from seeds like pawpaw, granadilla, pitches, guava and avocado, such trees go for cheaper prices as there isn't much labour or expertise needed. In most of the cases we sell these for USD 2.00. Those that we produce through budding like mulberries and apple trees go for USD 2.50 while those that we graft such as orange and natjies go for USD 3.50 to USD 4.00 (2016 prices before the currency changed to a local RTGS dollar in 2019).

CD: That is good to hear. Where do you sell your tree seedlings? What is your market?

FCS 10, VC: At first we used to sell in-situ that is on the spot for local village buyers but as the market grew bigger we had to expand into schools and hospitals for flower trees and other ornamental plants, we also deliver in schools and hospitals, exotic and indigenous trees and herbal shrubs such as *moringa*. We also produce moringa tree seedlings. Moringa is in high demand in the country for its medicinal values and high proteins levels. We also produce the bottle brush tree [*Callistemon* species which have commonly been referred to as bottlebrushes because of their cylindrical, brush like flowers resembling a traditional bottle brush] which attracts bees and so it is in demand from apiarists. We have many apiarists around and these provide a market for our bottle brush trees. In our business we classify bottle brush under flower trees. We also supply in schools and hospitals fruit trees. We have also penetrated into communal areas where people now do appreciate that planting trees go beyond fruit trees but also flower trees and indigenous trees are also good for the environment. Trees also encourages the build-up of precipitation.

CD: This is good to hear

FCS 10, VC: Yaaah! This village is blessed, with a cool wet climate as a result of its geographical location on a high altitude and at times heavy rains and that makes it good for tree seedling production. In fact these two factors are good for tree growth. So we thought of raising tree seedlings instead of concentrating on maize crop farming only since maize was now vulnerable to the changing climate. As I said before we finally held a tree seedling Field Day early this year (2016) where we showcased our products and new capability to other farmers. We learnt that tree nurseries have brought up many other functionings such as a market based economy, food security, nutrition from the fruits, family stability as there are less 'family in-fights' that are normally associated with financial deprivation.

CD: Uuuh that is powerful. Now can you explain the challenges that you face as one of the known *dendrologist* in this area.

FCS 10, VC: Our current major problem is water supply. Our aim is to have water supply that is sufficient for our target number of trees that we aim to produce in a year. Water is our greatest disabler as without water we cannot achieve what we aim to achieve in a year. We also face problems of the polythene plastic pots that we use to pack the tree seedlings. The plastic polythene pots are very expensive. We hope we will get some well-wishers to supply us with plastic pots and provide us with water supply. (24 June 2016, see also interview with **FCS 10, VC** a day later on 25 June 2016). Once we get these *capability assets and commodities* resources then we can also engage others by a way of job creation. Our fellow villagers will come and get some piece jobs here and feed their families also.

CD: That is good to hear. Now going back to the issue of water supply what is your plan? What have you done on your own so far to lessen the burden of water shortage?

FCS 10, VC: We are trying our level best, we are in the process of digging a deep well but it is not yet complete.

CD: But how do you intend to utilise the water? Do you want to use the water from the deep-well directly from the well into the nursery beds or you intend to build water reservoirs so that you mine the water and keep it in reservoirs for future use?

FCS 10, VC: Sure our wish is to have a deep well where we can extract water and reserve in in reservoirs and then we supply the water into our nurseries through a network of pipes. At my homestead where we (*referring to his nucleated family*) carrying out our dendrology project, is flat and far away from rivers and streams and so we will rely on the deep well for our water supply and because of the fat gradient we will have to build gradient by having elevated reservoirs so that they would release water with enough pressure to water the nurseries using hosepipes.

CD: What about rain water, can't you harvest it also?

FCS 10, VC: Harvesting rainfall is a good possibility that might or can help us. But more, Government policies such as the shift towards provision of free seed and fertilisers after

independence, meant that people had to practise farming using the same seed variety in the same region and the same village. Missing was the knowledge on water harvesting to enable the seeds and fertilisers pass through major droughts or even temporary droughts.

CD: *To the other four participants who were present during this field visit.* Are there questions and contributions from others here present? What do you want to say to our expert *dendrologist FCS 10, VC*? But before they ask questions, can I have a recap of what you said on markets and marketing, where and how do you market your plants?

FCS 10, VC: In Mutasa District we have our own competitors but as far as we are concerned we are so far the only farmers in dendrology who supply an urban markets (*Mutare and Harare*), more, we supply as far as Harare. We hear some buyers from Zambia are also interested in our mango seedlings. So, we have moved from a local (village) market to a district and urban market and now to an export market. How have we penetrated the urban market? The good work that we do help us market our business. Those who buy from us often help us in spreading the good news about our work and so our name goes beyond our province, Manicaland. (*Learning is spread through good workmanship and quality of products and this can be Layer 4-5*)

CD: In Mutare where do you market your trees from?

FCS 10, VC: We are found near Fidelity Life Insurance building.

CD: That is good can you elaborate on the Zambian market.

FCS 10, VC: From the foreign market we supply mangos. We have a variety of mango tree seedlings which we can name by their scientific names. We have sensation mangoes, zeal, tomato can. Sensation mango is a small mango type purple in colour and they are fibreless and is ever sweet. Zeal mango is shaped like cowpeas (*nyemba*) and they too are in purple colour. The tomato can mango, we also have our own terms and names that we use to identify them such as Indian mango or bull mangos and these are big and round mangos and they turn yellow white they are ripen. At times the tomato can type of mangoes are also found in purple colour too. In this province (*Manicaland*) tomato mango is the last type of mango to be harvested of all mango type in the province, this means that they take longer to ripen. These are the mangos we find on the market around April-May. (*Another transitive dimension of knowledge on mangos as this might refer to the seasonal production of mangoes and might not be the case on mangos under irrigation facilities where mangoes can be harvested two or three times in a cycle*). These are the mangos that we are selling on the market. The fibreless mangoes are most likely to be on demand in other countries such as Zambia. We had some of our customers who pleaded with us that we should supply the fibreless mango tree seedlings in large quantities so that they can feed the export market. We are not very popular yet but from those who buy from us, they spread the good work that we do and supply and we are beginning to see many customers looking for our seedlings.

CD: Thank you very much.

24 June 2016

AB (Organic Farmer) Ward 26 Muchena Village Mutasa District during a Field Tour at FCS 3, LN (10 other participants were also present at that time of videoing). VID_20160624_125639 and VID_20160624_125849.

Song: *Tinotenda Jesu, Tinotenda Jesu, Tinotenda Jesu, Hallelluya Amen.* Thank you Jesus my Lord, Thank you Jesus my Lord, Halleluiah amen. And a prayer.

CD: Welcome to this Field Day Mrs **AB, Organic Farmer**. Today we want to hear from you about your comments on the rainfall situation in 2015-2016 season.

AB: (*Organic farmer at a field tour at the youth's demonstration site*). In the year 2015-2015 rains delayed. The rains were quite erratic in the 2015-2016 season. Most of us had lost hope of planting maize. But we had hope that one day the rains will come. We planted late and the rains disappeared again. Finally the rains came but the quality of harvest had deteriorated.

CD: Ok do you still remember the dates when the rains came (onset).

AB: *Organic farmer.* The rains came in December 2015 instead the usual October 15. But when it started raining in December of 2015 that is when most of us started planting and we continued into January of 2016.

CD: Now that we have come to realise that rains are now erratic, how can we adapt to the situation (climate change) as small-scale farmers?

AB: *Organic farmer.* To adapt, depends on where you are (geographical location). If there are some water sources, then it is easy to adapt by applying irrigation. I can say, rains are quite erratic nowadays and we are moving into market gardening under small scale irrigation. We now venture into vegetables, peas, carrots and so on. To rely on maize production is now tricky because of erratic rains. For example if we plant maize crop late in the season, it will be attacked by winter frost and that will be a waste of time.

CD: Currently what do you have in your garden, which crops do you currently have (24 June 2016)?

AB: *Organic farmer.* In my garden this time of the year, I plant beetroot and covo (veges) and my aim is to take the products to an agriculture show which is normally in August. I also have peas and cabbages with the aim of taking them to the Agricultural Show. But because my garden was not properly protected, a herd of cattle grazed some of my crop. My garden is near a river and so water for watering is perennial. I am actually looking for a plan on how best I can extract the water from the river into my garden.

CD: Do you still remember Mrs **AB**, last time we went to Agro Industry¹ where we were advised to plant king onion with the hope that they will take 60 tonnes from our community-based farmers. Is that so? They even said they wanted so many tonnes of beans, isn't it? Where are we with that project? Now that we are here as the farmers what can we tell each other about that contract farming venture?

AB: (*Organic farmer*). It is time that we put heads together so that we plant one crop on the same date, harvest at the same time and send our crops to the agro-industry market at the same time too. We want serious farmers who are committed to their practice so that we engage them in contract farming. As for the type of bean needed by X agro-company, we need to plant the crop in January so that we harvest it before winter since beans can be attacked by frost. As far as I am concerned, it is a great idea, but it is time that we put heads together so that we plant the crop on the same date, harvest at the same time and send our crops to the agro-industry market at the same time too. By so doing we will be able to supply the crops in large quantities at the same time. We want serious farmers who are committed to their practice as I have said already.

CD: That is a good idea. Are there comments from the other farmers here present? Do you have something to say or ask Mrs **AB**? If there are no questions, can Mrs **AB** give us a comment on the bean crop that the agro-industry talked about? How many of our farmers here can we bank on for contract farming? How many households can safely raise hands and say yes we are here?

FCS 9, LN: May be ten to fifteen households do have the capacity to do that? The rest they might want but they lack the capacity like water supply and so on.

CD: Ten to fifteen farmers, Is that so Mrs **AB**?

FCS 9, FN: Ten to fifteen is a manageable group, if there are too many of us it becomes difficult to control.

CD: But the problem is yesterday (23 June 2016) I received a telephone call from **CM**² who said that a group of researchers is coming to the village this week to assess the situation. They want to visit farmers who currently have a crop in their fields (*Farmers with a winter crop. Zimbabwe receives summer rains and winter droughts. A farmer who has a winter crop, has a source of irrigation*). They said they were interested in observing the crop that was currently in the field and not listening to what people say about their capability to do farming. So do you agree with others Mrs **AB**, that ten to fifteen farmers do have the capability to do contract farming in this village?

AB: (*Organic farmer*). I agree with others, but we need to assess one another and check if we are all committed to contract farming. Some are not just serious and want to wait time while others might like it but lack the capabilities to do it. We wouldn't want to have numbers of people who cannot produce and by the end of the day we will look stupid before the buyers.

CD: But it can be two way, they say they want 60 tonnes and when the people produce the 60 tonnes then they (agro-industry) start to change goal posts when the crop is ripen, changing prices, despite a valid contract in place. We heard from FCS 8, **LM**³, how some honey buyers from Harare changing prices from USD \$3.00 to USD \$2.50. We also need to be careful also like what one of us has said. But let us try this contract farming issue and see how it goes. We understand Agro Industry¹ needs beans, has anyone in this village, tried to plant the type of bean crop that they want? I will also try to talk to the agro-industry so that they put it in writing that they will not change on what would have

been agreed on in the contract. *(All voiced, Yes, so that they will not change the agreed prices, because changing what was agreed upon will discourage the farmers from future production)* I think that is what I will negotiate with the industry so that they will respect the contract.

AB: *Organic farmer.* In this village we need to plant beans crop at the same time we plant our maize crop and if we miss that target then we have to target early January. As for the type of bean needed by Agro-Industry¹, we need to plant the crop in January so that we harvest it before winter since beans can be attacked by frost.

CD: But the 30 tonnes that the agro-industry was talking about, can you meet such a target? Do you have the capability commodities and assets to do that as a community?

AB: *Organic Farmer.* I also say if we are to start a community project we need a leader to help guide us and we choose you **CD** to lead us. Once we start contract farming, we would urge you **CD** to be strong in leading us so that we sail through. We will be looking upon you. We will consider the contract as our own source of living and survival because we will look forward to get cash from it. Since you are part of us, you will understand the kind of challenges that we face as farmers and we are also free to say out our challenges to you and we trust you will help us solve our challenges.

CD: But for us to succeed we need to engage the Agritex officers (extension service) We make a special appeal that our extension officers remain within us so that we walk together through this journey towards contract farming. Moving together with extension service will have many advantages to us especially in as far as expertise knowledge is concerned. We should continue respecting Agritex officers since these are government employees that were brought to us to share with us good farming practices. We need them. Don't forget when we went to Agro-Industry¹ for a Field Tour, the extension officers were amongst us. We had FGDs with them as part of us, so we need them amongst us through and through.

AB: *(Organic farmer 23)* Anyway it is time that we put heads together so that we plant the crop *(for the agro-market)* on the same date, harvest at the same time and send our crop to the agro-industry market at the same time too.

CD: Thank you for the wise words.

24 June 2016

FCS 3, SM¹ Female Youth: Ward 26 Muchena Village Mutasa District during a Field Tour at the demonstration site (10 other participants were also present at that time of videoing).
VID_20160624_140004

CD: Good morning FCS 3, **SM¹**, and tell us more on your farming practices here at this demonstration site and back home as you carry the knowledge with you from the demonstration site back home. More, I want to hear more about how you looked for markets at the early days of this project in 2012-2013.

FCS 3, SM¹ Female Youth: We were taught farming business by G [a donor agent]. Now we start by taking a sample of our produce to the market [urban hypermarkets] and if the market favours our product then we come back to the site and pack the produce in larger quantities. We have receipts as evidence of what we sell. Today [June 2016] I personally bought a water pump for my own organic gardening activities as I learnt from the youth garden project that market gardening without irrigation is not sustainable. When our crop was ready for market, we could take samples from our products such as king onion and send them to town (*Mutare*). That was the time we could negotiate on price. But in most cases the market would tell us how much they were willing to buy our crops and not the other way round. Once the market was satisfied with the quality of our product, then we would come and pack the quantities that were required by the market and packed them in the right packages. For onion we used to send to *M* and *T* whole sellers who normally supply other shops in town. As for peas we used to send to two other big shops in town. FCS 3, **LN³** I have forgotten some of the details, can you cheap in.

FCS 3, LN³: At first the two big shops did not like the types of plastics that we used to pack our products in, they were black. Can you pick it from there?

FCS 3, SM¹ Female Youth: Yes, at first the big shops would simply advise us to and go and pack our products. They would not advise us on the type of packaging that they required according to their own standards. We would pack in black plastics and when we reached the shops they would tell us that they would not take products that were packed in such types of packaging. Then you would go back

to look for the correct packaging materials. That was a major challenge in our early experiences in marketing our crops in town (*a social conversion factors as a disabler of the youths' capability of marketing*).

CD: Tell us more about those who talked about company registration? What exactly did they say?

FCS 3, LN: To address that, we went to *O (name suppressed)*, supermarket, they told us we buy from farmers with a VAT number (*Value added Tax*). So they advised us we should sell our products to *M*, whole sellers then we will buy from them. We did not have the VAT number because our activities were not registered at all. *O (not real name)* supermarkets encouraged us to get registered.

CD: I am happy that one of our farmers **FCS 10, VC** has completed the process of company registration. Remind me when we go to his homestead so that we get evidence of such company registration. **FCS 10, FC** now has a company certificate, a logo and company receipt books. We all have to go and learn from **FCS 10, VC** and get how he managed to have his activities get registered. Once you get registered then it will be easy for you (*FCS 3, the youths at the demonstration site*) to send products to a wider market. Well back to you **CD** to **FCS 3, SM¹ Female Youth**. After you learnt market based farming practices from this demonstration site, how do you utilise the learnt knowledge back home? Now tell us how you managed to utilise the knowledge learnt from here back home.

FCS 3, SM¹ Female Youth: I learnt that in order to do farming, you need water (*a capability commodity and asset needed to convert to the function of irrigation and perennial farming practice*) So, we dug a deep protected well for our water supply. I do gardening and use water from the deep well to water my crops.

CD: How do you extract the water from your well and how do you water the crops?

FCS 3, SM¹ Female Youth: I extract the water using a can and I water my garden using a bucket. I carry the water using the human muscle (*carrying the bucket on head*).

CD: So you don't have a water reservoir such as a tank or a drum? Do you have hope to own a water reservoir in the near future?

FCS 3, SM¹ Female Youth: Sure we hope one day we will have a water reservoir but currently we don't have money to construct one or to buy one.

CD: If one day you get sponsorship to have the water reservoirs in place, what do you promise to do about it?

FCS 3, SM¹ Female Youth: I have great hopes, I already secured a water pump. I am left with a water reservoir and a generator only. I have hope I will get the tank and hosepipes and start work. I already have some homemade bricks reserved for that job. What we simply want are a few bags of cement, the rest my husband can help, with the construction and the collection of river sand and pit sand. I also talked to one of our local builders but he only said he will cost the job once I am ready to embark on it. So, am trying my best of level.

CD: I will be happy one day to see you having a water reservoir constructed at your homestead so that you embark on commercial farming since you have a good piece of land (*two hectares*) under organic conditions. One day I will see how best I might help you get sponsorship. Anyway do have anything to add from what we have been discussing?

FCS 3, SM¹ Female Youth: I bought the pump from monies that I raised from a chicken rearing project. We are working hard in the garden despite the difficulties we face in watering. Currently I am not raising much from the garden as I am concentrating on a small space since I do not have the watering mechanisms to do the practice on a much bigger space.

CD: It is my sincere hope that you will get water supply one day. I bank on you and **FCS 1, VS**. The two of you have the farming capabilities such as knowledge and land but you lack watering mechanisms. Thank you so much for the conversation have a good day.

24 June 2016

FCS 3, JM¹ Female Youth and OD Male Youth: Ward 26 Muchena Village Mutasa District during a Field Tour at the demonstration site (10 other participants were also present at that time of videoing). VID_20160625_074502

D: How are you **FCS 3, JM¹**? Tell me more about your farming practice here at this demonstration site and what you do in the project.

FCS 3, JM¹ Female Youth: We practice organic farming, we don't use artificial fertilisers and we do not use chemicals (*heavy metals*). We use cow dung manure, mulch and composite. (*cow dung might*

not be the only and best type of organic manure). For this peas crop (2016) we had to quicken the germination process by immersing the peas seed in a bucket with water for a few days as we worked on the field. This was on the 23rd of March. Once the seed germinated whilst in water then we had to plant on the field that was already prepared. By the 30th of March (2016) we had planted all the seed. We maintained a between row regular distance of 25centimeters throughout the field as you can see from the crop here. From cowdung we also prepared liquid manure.

CD: What is this liquid manure and can you elaborate on how you prepare it.

FCS 3, JM¹ Female Youth: We fill a two hundred litre drum to one third with cow dung and we fill the rest with water and stir the mixture. We tightly close the drum for seven days or so then we use the liquid to water the crop. We use the liquid to water our peas crop and so after it has worked for us as we get a good yield as good as one who uses artificial fertilisers in terms of size. But of course ours is very healthy. We also do manual weeding with hoes. (*manual weeding is done despite the fact that availability of herbicides that kill weeds on the market*).

CD: I can also see dry grass covering the peas crop, what and why do you need it?

FCS 3, JM¹ Female Youth: The grass is for mulching the crop. We do mulching in order to preserve moisture, this is a process that we normally do when the crop is a few centimeters off the ground so that the plants are not suffocated in the grass but are well covered to avoid moisture loss.

CD: What benefits do you get from the proceeds that you get from this project?

FCS 3, JM¹ Female Youth: Normally when we get some cash from the project we send our children to school, paying school fees. We also buy our children and parents food and clothing. In 2015-2016 season the marketing was not an easy task. The marketing journey has been bumpy. We learnt from the market in 2015 that timing of the dates for planting of the peas-crop was very important. To harvest in June we have to plant in early February so that by March or April we will be the first to supply the market and get good price from our peas-crop. If we delay in planting then the market will be flooded by June and July and the prices fall. Had we been using chemicals, we could be planting throughout the year and maximise on the off-season market but because of diseases and aphids that attack peas in the hot season, we cannot do that since we are doing organic so we rely on winter cropping.

CD: Are you happy with your practice?

FCS 3, JM¹: At times it can be stressing. But we are happy in terms of peas we have created a name for ourselves, the buyers now phone us in advance enquiring if we will be supplying peas on Mondays or Saturdays. But we are happy in terms of peas we have created a name for ourselves, the buyers now phone us in advance enquiring if we will be supplying peas on Mondays or Saturdays.

CD: Can you talk about the inverted bottle drip irrigation?

FCS 3, JM¹: Our water pump developed a major technical engine problem and knocked off. We were stuck with a quarter hectare of tomato crop in the field. We had to reflect on other ways of irrigation apart from syphoning and flooding until we replaced the water pump. Sticking to a technology that was no longer functioning was not helpful as the crop was succumbing to moisture threat. We had to think fast and look for other ways of irrigation. The inverted bottle drip irrigation was an innovation that we learnt from a video that **CD** brought from Muzarabani [MC province] where it was used by a small-scale tobacco farmer. In the video, demonstrated how the inverted bottle works and so we experimented on it and moved into the innovation. The inverted bottle-drip with two holes as we learnt from Muzarabani could last those three weeks of watering a plant-station, but in our case as we experimented on this new innovation, having two holes one at the bottom and one at the top (lid), the drip could not last, five days of watering a plant-station. We don't know why our inverted bottles failed to last the three weeks that the MC province farmers enjoyed and so we had to do another experiment by reducing the number of holes from two to just one small one on the centre of the lid of the bottle cap. With one hole, the inverted bottle-drip drip irrigation technique worked better and lasted longer than 5 days.

CD: And you FCS 3, **OD**, what is your story?

FCS 3, OD Male Youth: I am part of this project.

CD: From morning until sunset what will you be doing?

FCS 3, OD Male Youth It depend but normally we put manure, watering and drive away pests (*monkeys*) on a daily basis. Manual weeding and continuous monitoring of the crop.

CD: Can you elaborate on the water source and how you do your watering in this demonstration site?

FCS 3, OD Male Youth: There is a small stream from which we captured water is a kind of a pond. From this earth build pond we use a fuel powered water pump to to extract the water from the water pond into two built up water reservoirs up gradient. From the water reservoirs we use the syphoning technic and the power of the force of gravity to do flood irrigation.

CD: What benefits do you get from this project?

FCS 3, OD Male Youth: The proceeds that we get from the project I use them to buy food, to pay part of my school fees and busfare. Part of it we use it to reinvest in the project and to buy fuel and related overheads.

CD: looking at this project in line with climate change, what lessons can we get from this winter crop?

FCS 3, OD Male Youth: I learnt that it is possible that people can do farming without over-relying on rain water but irrigation. As long as there is not a long drought (hydrological drought) that might dry up wells and streams, people can still harvest underground water and water from streams into reservoirs and use it for irrigation (*more of climate change adaptation*). Irrigation and mulch are good ways to adapt to climate change.

CD: What advice do you want to give to other youths who are not employed?

FCS 3, OD Male Youth: That it is possible to run your own project and earn a living.

CD: Why do you say farming projects are good? Can you link this project with industrial development?

FCS 3, OD Male Youth: Industries are running short of raw materials and as youths we can supply the raw materials to keep the industries open and create jobs for the youths in towns and those of us in the communal areas and the farms. When we take farming seriously then we can become the major suppliers of industries. Industry in return will produce products for the market and in the process creates employment. Well let me conclude by saying: Agro-industries need raw materials, and it is our duty as farmers to produce such in bulk for the development of the agro-industry. Agro-industry in return will offer us the youths and university graduates jobs. Now if we don't produce then industries might remain shut down and as youths we don't get the jobs at all.

CD: This is good to hear. Now let us hear from our expert in organic farming (*Gogodera reOrganic farming*), **FCS 3, LN**.

FCS 3, LN leader of the youth group: I have been in this project since 2010 as we were trying to establish the project, terracing the place and putting humus into the soils to start the organic process. We also do pot-holing (*conservation basins*), put manure in the single hole and plant a crop in each single hole. The pot hole apart from it being a source of soil fertility, it also conserves water. When we water the single holes, water is conserved for a longer time because of the manure and mulch that we use to cover the hole. These provide cover to the plant from evaporation by wind and heat from the sun. The process also controls running water erosion. When it rains water is prevented by the series of holes from running away, thereby preventing soil erosion. We are committed to the local organic standards which bar us from using artificial fertilisers, chemicals and where possible, we avoid hybrid seed. So, since 2010. We also learnt from elders [intergenerational] how to prepare seed maize from this traditional maize crop (OPV). We learnt that from FCS 2, BC who gave us the seed. We are now our own monitors we don't need someone to keep checking on us whether or not we are still practicing organic farming year in year out.

CD: This is good to hear. Now tell us about liquid manure, how did you come to know about it and how do you do it?

FCS 3, LN: Between 2012 and 2014, we used to apply organic manure directly on and near a crop. But the yields were poor. We reflected upon what we learnt from GC who used to be part of us. We then came up with the idea of upscaling on what we used to do with GC by engaging larger containers (*200litre-containers or drums*). This worked wonders. For this crop (2016), we applied manure before we planted the crop (*basal manure*) then we applied liquid manure after the crop was a few centimeters from the ground. We also applied liquid manure when the crop is about to flower. We are happy to say that liquid manure actually helped us more than when we applied solid manure directly into the soil. Look, this time we expect a big harvest all because of liquid manure. [*Transfactuality, in the absence of laboratory soil tests on soil nutrients, liquid manure might look like the best of all*]

organic manure but might also lack other nutrients which are best done by other types of organic manure like irons fixed by chicken manure].

FCS 3, MM: The rains are now erratic nowadays and coupled with poor sandy soils, we hardly harvest maize. I can also say, the light-sandy soils of 2007, were not good for crops, we enriched the soils through composts but these were not nourishing the soils enough to our satisfaction and so, we reflected on what our expert, then **GC** who taught us about liquid manure application between 2010 and 2012. We reflected on the knowledge learnt on the use and production of liquid manure but this time, instead of using small cans to make the liquid manure, we opted for three large drums (200 litre-containers) and this was the 'miracle-water' that took us to competitive levels in 2016-2017 season. Thus from infertile sandy-light soils of 2007 to healthy soils we see today and from non-harvests of 2007 to recognised products for the agro-industrial market, with canned peas in the year 2018. Liquid manure played a big role. So, with liquid manure and irrigation, we fully moved from being rain-fed subsistence to small scale market based farmers supplying urban market in 2017 and industry in 2018.

FCS 3, MM continues: Before 2012, from this crop field and demonstration site we could hardly harvest any meaningful maize crop [situation as shown in the photo above]. We further reflected with our Granny here in the demonstration site on how best we could move into an organic farming practice. Granny advised that we start with small grain, rapoko, for it enriches the soils and does not need artificial fertilisers and was drought resistant too. We readily accepted that idea.

CD: Now I want you to link your peas crop with apiary farming.

FCS 3, LN: *Leader of the youths* Apiary farming helps us a lot. Bees come and collect pollen from our crops and thereby help in pollination of the crops. This then increases production. We currently have three apiaries but we hope to construct more apiaries.

CD: That is good. Can you comment on why the Agritex Officers boycotted today's Field Tour where ten farmers attended? (24 June 2016)

FCS 3, LN: *Leader of the youths.* The extension officers have a problem. They always want to lead and they don't want to follow. I think they want farmers who seem to struggle with their work. If you show some signs of excelling in your work, they will shun your activities. However they say they want to be in the forefront starting with the planning and then planting up to harvesting. In our case we did everything on our own without their input and so they said they were not coming to witness activities at a field they were not part of.

CD: So, how can we solve the problem, the extension officers are a government arm sent to us by government to help us in farming practices. What is your suggestion?

FCS 3, LN: *Leader of the youths.* For our next crop we will do exactly that. We will seek for their guidance from planning until harvesting.

CD: Now can you comment on the issue of supplying peas products to Agro-Industry¹.

FCS 3, LN: *Leader of the youths.* The agro-industry want beans and onions about sixteen tonnes. Next year (2017) we will try to venture into that. Next year we will try to plant early king onion and beans, as early as February.

CD: So can we safely say, the agro-industry is in need of products but there is nothing in the fields.

FCS 3, LN: *Leader of the youths* I might want to add a few points to the other youths. We hear people saying how can we farm without artificial fertilisers. But look, here, we produce a good produce without using artificial fertilisers.

CD: That is a good advice. Let me cross check on the quantity of peas seed that you used? How many kilograms of peas seed did you use?

FCS 3, LN: *Leader of the youths.* Currently we used 9 kilograms at \$5 per kilogram and that is USD 45.00. We are looking forward to harvesting approximately 1000 kilograms and the buyer is saying he is buying at USD 1.30 per kilogram. We are committed to the local organic standards which bar us from using artificial fertilisers, chemicals and where possible, we avoid hybrid seed. So, since 2010 we are committed to organic standards without any push from outside forces. We also learnt from elders how to prepare seed maize from this traditional maize crop (OPV). More, we also learnt a lot from **FCS 2, BC** who gave us the traditional maize crop seed. We are now our own monitors we don't need someone to keep checking on us whether or not we are still practising organic farming year in year out, it is now part of us.

CD: Do you still have anything to add?

FCS 3, LN. I have a few more remarks to make. At times we get education on farming business [through government's extension service and through donor funded trainings] but we do not get the knowledge on the markets during the farming business trainings. I mean knowledge on where to send our products and how to enter into such markets. This makes our life very difficult as we are often stuck with products with no where to sell them. You see we had many tree nurseries which ended up overgrowing without buyers in 2014. We are not the only ones who suffered that way, the story was the same for the round-nuts farmers of (M-rural) district in this province as noted by CM² (2015), the communal farmers were left with so many tons of round-nuts without buyers. They were also left frustrated after getting trainings in round nuts production and produced the round nuts in large volumes but were stuck with it. Trainings that do not spell out the marketing mechanisms seem not to be good enough for us, that is why you find people going back to their old ways of doing things instead of progressing well with the new ways that will often disappoint them in the end.

CD: That is a good observation. Thank you very much we will continue talking about these issues when we meet again.

25 June 2016: Water collection point: FCS 3, LN, VID_20160625_093339

CD: Now take us through the process of how you provide water for your organic project.

FCS 3, LN: For our farming venture we irrigate using water. We collect water from a small stream that trickles from underneath a rock into a small pipe. We constructed a small *pond* dam. We collect water from the small stream into the pond and then pump it into the water reservoirs. The water from the small stream fills up the *pond* dam which is approximately one meter and a half deep. When the pond is full, we pump it into reservoir number one up gradient using a water pump. From reservoir one we pump into reservoir two in the upper gradient. Reservoir number one is approximately thirty meters away from the *pond* tiny dam. Once the reservoirs are full then we start watering the field. Water is released through the force of gravity and we use hosepipes to water as flood irrigation. We do not permanent disturb the flow of water in the stream. We stop the water from flowing so that it fills up the pond for just a few hours. Once the water is full and once we are done with pumping into the two reservoirs then we open up the water from the stoppage in the pond so that the water from the stream continues flowing down stream into Tsambe River. *Tsambe River then feeds into Mutare River which then feeds into Odzi River which in turn feeds into Sabi River and the Sabi Rivers flows into the sea.* We put our pump on a flat surface on top of the pond so that it can pump well without it getting damaged. We have two reservoirs but we have plans to put up a third one which will be the biggest of them all. With a third reservoir we will be able to water the whole field throughout the year and all coming from a small stream.

CD: Thank you so much FCS 3, LN. I appreciate especially the fact that all the big reservoirs get water from this small stream.

25 June 2016 (Field Tour)

FCS 10, VC (Dendrologist): Ward 26 Muchena Village Mutasa District during a Field Tour at VC's homestead (FCS 3, LN was also present at that time of videoing). VID_20160625_105256

CD: We have met again FCS 10, VC. Can you take me through the road you travelled in dendrology?

FCS 10, VC Dendrologist Wellcome CD. I am VC and a practicing dendrologist. I realised that our climate is changing and no longer favourable for the cultivation of maize crop. Rains are quite erratic nowadays. But we reflected and came to realise that maize cropping is not the only farming activity that we could engage with (*but there are alternatives to maize crop farming and can be used to raise money so that the farmer can still buy the maize that he wants*). We have several survival strategies (*adaptations to climate change*) but we opted for tree seedling production (*dendrology*). We also realised that this region is good for tree planting, cool and rainy in most of cases. We also reflected and realised that tree seedlings pay much better than maize. From the sales that we get from tree seedlings we can actually survive better than when we do maize crop farming. Apart from selling plant seedlings, we also plant our own fruit trees here so that in the long run we will survive by selling our own fruits while we take the fruits as food also. We also have other communal farmers here who are also interested in buying our plants and to those we also supply. We also reflected and came to realise that it is no longer profitable for us to do maize crop farming. Look at our land where we have just started mounted a protecting fence, we have already planted fruit trees. At present it will be intercropping with the trees co-existing with maize crops but in the long run we will resort to fruit

production only. Our aim is to fence off the whole area. We are making efforts to provide water supply. Come and see, we have dug a deep well and we are in the process of trying to acquire a water pump so that we pump from the deep well into reservoirs. This point where we dug our well, was properly surveyed and we understand there is enough water to water our whole field and to water our plants. With enough water we can actually supply our community and other areas with fruit tree seedlings. We are going to remove all these maize stalks, level this place so that we lay down our tree seedling pots. It has to be an attractive place where we can produce seedlings for sale.

CD: That is good, can you elaborate on the water issue.

FCS 10, VC Dendrologist From the topography where we are settled, the water table is very deep. We know that through the presence of shallow wells which are found down gradient and so we concluded that the water table here is also very deep judging on the presence of wells further down gradient (*Transfactuality that the water table normally curves depending on the topography*). We also reflected that it would be difficult to extract water from the shallow wells down gradient and carry it up gradient to water our trees. As a result we thought of digging a deep well.

CD: That is good, now let us move to the tree seedlings themselves.

FCS 10, VC: To begin with, we got the polythene pots from CD (15 000 pots) for the production of our fruit tree seedlings. Today we now have a protected well to supply our project with water. We still need to buy a plastic tank as a reservoir where we pump up the water from the well and then into the field. Well, we normally place our tree seedlings pots under the cover of tree shade to avoid direct sun heat and evaporation. Because of water shortage we normally want to place the tree seedlings under shade in order to conserve moisture. Our pot levels have gone down because most of our seedlings were bought and these are just left overs. People bought the trees on credit since we wanted to dispose them fast in order to reduce the demand for water supply. In a good year we normally dispose of around twenty-thousand tree seedlings.

CD: Do you drink opaque beer (*after observing empty plastic beer bottles that are used as pots to hold tree seedlings*)

FCS 10, VC Dendrologist I personally don't drink beer but I frequent the local drinking places to pick up the empty plastic beer bottles that I cut by the neck and plant my tree seedlings and then fill the plastic bottle with loam soil and planted the tree seedlings and cuttings, it worked well. I can say, No, I don't drink beer. But the plenty empty beer bottles that you see here reflects the way we started. We started by collecting plastic beer bottles, cut them on the side and plant a crop and it worked, we later tried to plant trees in that horizontal position and it was difficult to carry when sending the plastic pot to buyers. We then had to cut the top part of the empty plastic bottle so that the tree and the bottle are vertical. At the bottom, we pierced the thick bottom of the empty plastic beer bottle so that the perforations could drain water easily where we water the plant. This worked well as we could maximise on space when packing the tree seedlings to the market. We weaned ourselves from using the empty plastic beer bottles when **CD** gave us polythene plastic pots. Look at them, these were the plastic pots that **CD** gave us. But we still have a challenge as far as the pots are concerned, we don't have enough to cater for our tree seedlings.

CD: I am also very happy that you are working on waste management. By using empty plastic beer bottles you will be cleaning the environment of unwanted wastes. The empty plastic beer bottles do have another use through recycling to use them for tree seedling production.

FCS 10, VC Dendrologist Sure, the tree and shrubs that we currently have include *moringa* over there. *Moringa* has a very high demand on the market because of its perceived medicinal value.

CD: To wind up, just take me through your road towards marketing in town.

FCS 10, VC: The road towards marketing of my fruit tree seedlings, flowers, medicinal trees, ornamental trees and shrubs (dendrology) started with the legal registration process. The trajectory towards attaining the legal registration of our farming activities was long and reflexive starting early 2015. We then managed to register our citrus tree seedling company with the Zimbabwe Revenue Authority (ZIMRA) under the name: E&V nurseries: Specialists in fruit plants and herbs, at the end of 2015. The reflexive process towards registration is long and winding, but the actual registration is just easy as I told you the other time. Every year we are supposed to account for taxes. You see we now operate legally and we feel free doing our business in town.

CD: Great, that is good to hear.

25/06/16 Interview continues in VID_20160625_105958

FCS 10, VC Dendrologist Moringa is also popular amongst our people since the leaves are also used taken as a relish. The roots are also take as a medicine. The roots are cut into small pieces and eaten like we do with green beans.

FCS 3, LN: What about those tree seedlings, what type of tree is that?

FCS 10, VC Dendrologist Those trees area an assortment of mere tree leftovers from different varieties.

Interview continues in VID_20160625_110058

FCS 10, VC Dendrologist This one in particular (*touching a tree plant*) is called bottle brush. Bottle brush is a tree that is loved by bees. It is in the flower trees group. The tree is loved by apiarists and the flowers are loved by bees and so bottle brush has a good market amongst apiarists.

CD: Can you elaborate on the company registration process that you underwent.

FCS 10, VC Dendrologist. I then managed to register our citrus tree seedling company with the Zimbabwe Revenue Authority [ZIMRA] under the name [E&V nurseries: Specialists in fruit plants and herbs] at the end of 2015. We managed to get an invoice book and a banking facility. In 2015 we had 16 027 plants [fruit tree seedlings]. We sold the trees at varying prices. Trees that we produced from seed such as mangos and avocados, we sold them between USD \$2.50 and \$3.00 and those that we produced through grafting such as oranges and apples, we sold them between USD \$3 and \$5.00. We [as a family] are now happy at last as we can now afford to hire labour and create employment to other youths in the village. We registered with the Zimbabwe Revenue Authority (ZIMRA). We know very well that if we register with government then our operations become legal. Thus if I want to operate from towns I don't have any worries as I don't fear the authorities since my operations are legal. I went to the ZIMRA offices in Mutare. I went in and said I wanted to get my tree business registered. For the registration process I paid USD 140.

CD: Apart from the USD 140, what else did they demand from you?

FCS 10, VC Dendrologist. They need a company name upon registration. The process does not take long. Now we have a certificate. We use it when buying and selling. We produce our certificate whenever we are doing business in town in case the authorities might harass thinking that we are illegal vendors. At the end of each year we are supposed to remit USD140 to ZIMRA. We also work closely with the Environmental Management Agency (EMA). EMA demands that we desist from environmental degradation and so we avoid extracting soils anywhere and anyhow. We get our soils from designated places only.

CD: So, currently where are you extracting the soils for potting?

FCS 10, VC Dendrologist. We selected a place within our field, a place that is less prone to soil erosion. We are also reflecting on compost making since composts provide healthy soils.

25 June 2016 (Field Tour)

FCS 10, VC (Dendrologist): Ward 26 Muchena Village Mutasa District during a Field Tour at VC's homestead (FCS 3, LN was also present at that time of videoing). VID_20160625_112353

Interview continues

FCS 10, VC (Dendrologist) Our problem of depending on formal employment can be traced back from birth. We were therefore socialised in such a way that when we grow up we had to look for jobs in towns preferably. A formal job such as a teacher, nurse, doctor, policeman/woman, lawyer, clerk, accountant or even pilot. We were never socialised into being self-employed beings. I also looked for employment at an urban timber industry as a general hand while my wife supplimented with rain-fed farming here at home. The job was paying me just USD110.00 in the early 2000. The journey towards this new production [referring to denrology] was long. It was full of reflections on the various projects that were being done in this village on exotic tree seedling production, on apiary, on aquaculture fisheries, on maize crops, on conservation farming. Upon reflection together with my wife, we settled on tree seedlings production as our best capability option under climate change and a harsh economic hardship after we had reflected that maize crop could not be the only means that we should have for our survival. We also reflected that trees pay much better than maize crop. As a result we buy our maize needs from the proceeds that we get from the tree seedlings sales. Upon further reflection, I noted that we could not all produce gum trees but I thought of diversifying into fruit trees, hedges and flowers that have a ready market from schools, hospitals and so on. Today we are fully established

fruit tree seedling producers and the demand for our seedling plants and flowers is high. Thus I personally realised that formal employed, yes we all want to be formally employed but we all know when one is born, getting employed assures you of a starting point in life. I reflected that USD110 was not enough, I could not afford sending children to school, care for my family and remain with enough busfare for me to commute to work. More, it was not easily to foot medical bills, that amount was just too small for a family man. I reflected and thought of other activities as alternative to formal employment. I thought of venturing in tree seedlings production (*dendrology*). I tried to raise vegetables in plastic bottles at it worked. I then thought of raising tree seedlings in empty plastic beer bottles and again it worked. I then worked out a plan to raise the tree seedlings in bulky. With this tree seedlings venture I have come to realise that I wasted time in formal employment. I raise quite a lot as a private tree producer than as an employee at a company.

CD: Can you elaborate on challenges?

FCS 10, VC: The challenge is that while the samples of our non-fibrous mangos were warmly received by our Harare market for possible exports, the numbers that the large market require are just beyond our production capabilities, water, pots and labour. But just to wind up our discussion, I can try to summarise our activities as I have said before. The tree business venture has helped us a lot. We also produce moringa tree seedlings. Moringa is in high demand in the country for its medicinal values and high protein levels. We also produce the bottle brush tree, bottle brush tree also attracts bees and so it is on demand from beekeepers. We supply our fruit trees to the local market, but we now moved to cover beyond our village but the district too. More, some Harare buyers took some of our mango seedling-samples to Z for a possible export market. I am now fully registered and recognised as a legal producer of fruit tree seedlings in this country and so I can market my products anywhere in the country and beyond and I can finally say, I managed to register my citrus tree seedling company with the Zimbabwe Revenue Authority (ZIMRA).

CD: That is all good. We will continue sharing these insights whenever we meet. Thank you.

25 June 2016 (Field Tour)

FCS 10, VC (*Dendrologist*) together with FCS 3, LN in a joint interview at VC's homestead VID_20160625_113204

CD: Can you carry on FCS 3, LN, what have you learnt from FCS 10, VC here?

FCS 3, LN Youth leader I have learnt a lot from FCS 10, VC here who is a dendrologist, a specialist in fruit tree, hedges, herbs and shrub nurseries. I learnt mainly how he managed to break into the urban market. As youths we are also involved in farming. We do organic farming. During one Field Day in 2015 at our demonstration site, we narrated how we were pushed away from urban markets because we did not have the necessary legal papers to allow us to sell products in the urban areas. Today I am happy that FCS 10, VC has narrated the trajectory that he took until he managed to get his activities registered. I learnt that we need to go to ZIMRA offices, get registered and get a certificate so that we sell our products legally and freely in town without playing hide and seek with authorities in town.

CD: This is good to hear. So, when are you going to sort out the company papers?

FCS 3, LN Youth leader. This coming Tuesday we should start the process. That is 28th of June 2016. With that knowledge and the certificate we will be able to sell our products in hotels, supermarkets and government hospitals without exposing ourselves to running battles with the police. (*Transfactuality, missing was the PRAZ certificate that opens up markets in government institutions*)

CD: That is good to hear, now let us thank FCS 10, VC for all the knowledge that he shared with us. But I still have questions to FCS 10, VC on receipt books. Where did you get them printed?

FCS 10, VC (*Dendrologist*). We have an invoice Book an A4 size which we buy at USD6.50. Just to wind up I have some more reflections to make about our new practices. Through observing the shifting rainfall patterns in the 1980s when we experienced major droughts in the country, it was no longer reasonable to farm the long season maize varieties (OPV). The shifting seasons [climate change] actually forced us [referring to family since decisions to make changes in the family field is done collectively, Layer 2 reflexivity] to adapt to new seed varieties and to dendrology.

CD: Thank you VC for such vital information. And to you FCS 3, LN, what can you say as a way of summary?

FCS 3, LN: [during an interview held at FCS 10, VC's homestead during a Field Tour on 25 June 2016] I learnt a lot from FCS 10, VC on how he managed to register his activities. He went a step further and managed to legalise his activities and today we are here to learn from him on the road towards business registration. He cleared our fears and anxiety as he managed to clearly explain to us how simple the process is after all.

CD: Thank

26/11/16

FCS 9, FN (Aqua-culturalist) together with FCS 3, LN, FCS 8, LM³ at FN's fish ponds. Three other community farmers were present during the Field Tour. VID_20161126_171609

CD: Good Afternoon FCS, 9, FN *aquaculturalist*. Can you take us through your new farming practice, in aqua culture?

FCS 9, FN *Aqua-culturalist*: I am FN and I do fish farming (*aqua-culture*).

CD: How are you FCS 9, FN can you go ahead with your explanation, what do you specialise with here and why did you embark on this practice.

FCS 9, FN: *Aquaculturalist*: I do fish farming *aquaculture*. I started fish farming *aquaculture* in April 2015. As I have said, I started formal fish pond farming in April 2015. Before, we had our tilapia fish already that we had to remove from our old fishponds to this monitored project fishpond.

CD: How do you describe the mode of your aquacultural farming?

FCS 9, FN: In my fishpond farming project the mode of production is just subsistence as we so far produce for the family and a few to share with close relatives and neighbours. As for a formal fish pond farming mode we were trained at a youth training centre, the local MP paid for our training, it was USD50 per head for the training in 2015. We learnt a lot about fishpond farming [*aquaculture*]. For every one male there must be five females, we separate the females from the males. Once there are fingerlings we separate them (fingerlings) from adults and so on. We feed the fish (Tilapia) using chicken droppings.

CD: Great but how did you start? Can you take me through the trajectory that you took through this new mode of farming?

FCS 9, FN: *Aquaculturalist*: We used to have a few tilapia fish in our lower ponds. We were keeping fish as a hobby and for home consumption but Cde IZ (*Local MP*) send us for a proper training in *aquaculture* at one local training centre outside Mutare. Cde IZ also taught us that for every single male fish it can service four females. Once there are fertilised eggs we remove them and put them in one of the upper nursery ponds. We wait for the hatched babies to reach fingerling stage and we then remove them using nets and put them in the growers' pond which is down there. The mothers will continue laying eggs and we continue with the process of separation so that breeding is not stopped whilst the bred fish reach adulthood in the growers' pond down there. We were also taught how to identify the sex of the fish, when we catch them we can tell this one is male and this one female.

CD: Do you harvest, and how often and what do you do with the catch?

FCS 9, FN: *Aquaculturalist*: Yes we harvest and we sell to neighbours. We managed to sell a bucketful of fish (20kgs). For our neighbours we sold 4 breams (*tilapia fish*) for a dollar that is USD1 per 4 fish. We haven't come to understand how many fish can constitute a bucket and as a result we do not know how much a bucket can cost us. But I think a bucket could give us up to ten USD Dollars or even fifteen. On barter and *aquaculture*, FCS 9, FN said, "I have not really started selling my fish harvest but I share one or two with my neighbours, yes, we exchange fish with other goods [barter]. [Thus while barter still exists in the community, absent is monetary exchange, especially problematic when the farmer wants to buy other goods and services].

CD: Can you come again, where were you trained?

FCS 9, FN: *Aquaculturalist*: We were trained at M training centre here in Mutasa District of Manicaland province. M training centre is a few kilometres outside Mutare city.

CD: Where does the water come from, I mean the source of water from these ponds?

FCS 9, FN: *Aquaculturalist*: The water comes from underneath the *mukute* trees and feed into the water ponds for our *aquacultural* farming and small scale irrigation.

CD: What do you recommend to other *aquacultures* in the village and country at large?

FCS 9, FN: *Aquaculturalist*: The people can start by harvesting water into ponds and other reservoirs so that they can start *aquaculture* farming. They need three reservoirs or ponds for the different stages

of fish production. In our case underground water is just plenty. Even in severe droughts we don't run short of water.

CD: So, you are see the biggest thing is the provision of water. Well, what about fish food, how do you feed the fish?

FCS 9, FN: Aquaculturalist: Just to recap what I said before. The local MP paid for our aquaculture training in 2015. Five women were assisted in this training. There at Magamba, we learnt a lot about fishpond farming. We feed the fish [Tilapia] with chicken droppings or pig droppings. I was also motivated when I saw fishpond farmers from Beitbridge, a dry region in the country and I said to myself, if people in Beitbridge are keeping fish, why I can't do it here, a region with plenty of streams and ponds?

CD: So, are you feeding the fish with the droppings?

FCS 9, FN: Aquaculturalist: Yes we often drop the droppings.

CD: What are the benefits of taking fish?

FCS 9, FN: Aquaculturalist: Most people no longer eat red meat and so fish provides an alternative in white meat. Fish are thus good for people's health. We were taught during training that red meat creates health problems. Some people suffer from gout and white meat is good for them. From the sales we also send grand children to school and to buy other foods including maize and maize seed. (*aquaculture farming as an alternative to maize crop farming*). So, we learnt from trainings that fish as white meat is good for people's health. There are people whose conditions no longer allow them to eat red meat, fish is good for them. Red meat causes gout.

CD: What are your challenges?

FCS 9, FN: I kept wondering, our region still has streams and ponds in most of our gardens [wetlands] but we do not keep fish. Farmers in Beitbridge do. In fact in my own garden are three ponds full of water. I also noted limitations from the trainings that I underwent. What was absent was the training on fishpond farming and not fishery as a hobby. But I do not know where to get the fingerlings yet if I need them. I am now able to identify the sex of my fish which is a good starting point into fish breeding, but I do not know where to get the fingerlings yet, if I need them, where to sell the fish once I want to take the new practice as a business. We were not taught on how to market the product except the understanding that we can sell to our local communities. We were not taught on how to detect diseases (in fish) and what to do in the event of disease outbreak as was the case story with beekeeping where we were taught possible problems and how to treat them.

CD: What other benefits do you realise from fishpond farming or aqua-culture?

FCS 9, FN: Fish farming, just like beekeeping that I also do, are good for us since we can no longer rely on rain-fed farming. Rainfall is tricky nowadays and you need to have another farming type where you can get money in order to buy maize once there is a drought. So far I have only one fish pond and I don't harvest much from it. Well I have said this before. In the agricultural season of 2014-2015, the rains came a bit late, 5 December was the date for onset rains. The rainfall distribution was poor as there was a temporary drought from mid to end December (2014) until 7 February (2015). And there was another temporary drought with the rains only resuming in March of 2015, but then, the agriculture season had elapsed and so I reflected on gardening and fish pond farming. Thus fish pond farming became a good alternative to maize crop farming.

CD: Thank you, we will continue talking about this new farming practice when we meet next time.

26/11/16

FCS 7, LM² (Apiarist) together with FCS 3, LN. Three other community farmers were present during the Field Tour at FCS 7. VID_20161126_180010

CD: Good afternoon **FCS 7, LM²**. Can you take us through your apiary project?

FCS 7, LM² Apiarist: Thank you, I am **FCS 7 LM²**, a teacher by profession. Today I thank the donor community, for encouraging the Top-Kenyan Bar that is what we are using as new technology in apiary bee-hive making. Bee-keeping has been a family hobby for ages, but as a household head, I started bee-keeping in 1989 when I was still staying in (Ny) village. In 2012, due to persistent droughts we started conservation and later organic farming practice which was good for my apiaries since bees do not like any form of pesticides around. The old bee-hives that we inherited were made from bark and then we later used gumwood planks to come up with mere boxes as hives. Today (2016) I thank the donor community and climate smart agents for training us in the construction of the

top-Kenyan bar that is what we are using as new technology in bee-hive making. As I have already said, in my own nucleated family I started apiary farming in 1989 as a hobby inherited from my own parents. I continued with the same project here in Muchena village in 1989 when I shifted from N village to this space. Currently I have twenty-one apiaries we have at this space and twenty others uphill. Currently five are fully swarmed. We use the funds that we get from apiary farming for children's school fees, processing maize into maize meal and buying groceries. We learnt that bees can be very sensitive you must not disturb their entrance when they are busy at work. But when you stand aside away from their entrance, bees are not a problem at all you at all. I can even open up and show you how the bees are settled in the apiary, they don't create a problem to you. But when you temper around their entrance then you can invite trouble. Bees don't want to be disturbed while at work.

CD: What is the difference in the type of apiaries that you used to have in N village and the once you currently have in Muchena village? If they are different, what are the differences?

CD: That is good to hear. What else do you want to say?

FCS 7, LM² Apiarist: In N village the traditional apiaries were made from tree bark and we moved to wooden boxes, mere hollow boxes. Now we were taught to make the present Kenyan Key bar. In the new practice we use rectangular bars. With the Kenyan horizontal or T bars it is easy to check if the bees are ok and there are no predators and pests such as ants and to check if the hive is ready for harvesting and so on. With the traditional tree bark or the hollow box, it was not easy to monitor activities in the apiary.

CD: Ok, who taught you about this current Top-Kenyan Bar?

FCS 7, LM² Apiarist: We were workshoped by one Donor Agent EA. They taught us about how to construct the Kenyan Top Bar apiary, the correct measurements and how and where to site them. I thank the donor community for training us and encouraging the top-Kenyan bar that is what we are using as new technology in bee-hive making. This has advantages as compared to the old, the new provides demarcations for the bees to [colonise] operate from, I have noted several reasons why bees seem to be scarce nowadays in this village, and veld fires don't have enough wax. Also drought, the rains were not evenly distributed.

CD: You said you have five from this side that are fully swarmed?

FCS 7, LM²: I have 46 apiaries of which six are fully swarmed. I started harvesting the honey in August 2016 and I managed to get 2.5x20litres =50litres of processed honey. More, I also got buyers from Harare. The price from the industrial market in Harare (market) was \$2.50 per kg. From that market I managed to get a total of USD75.00 in 2016.

CD: You said you have 5 swarmed hives, have you harvested them?

FCS 7, LM² Apiarist: Yes we have harvested from the five that are located this side of the apiaries. We managed to fill two twenty-litre containers and a half which is about 50litres or an equivalent of 50kgs. We were lucky to have some Harare buyers who came to buy from us this year (2016)

CD: How much were they paying per bucket (20-litre container)

FCS 7, LM² Apiarist: They were paying USD 2.50 per kilogram. It was a fair deal?

CD: What do you consider as a fair deal, how much was that?

FCS 7, LM² Apiarist: Urban market does not just buy any product they look at the quality first. If the quality is good they buy and if it is not they reject it. But, the rejection help in teaching us where we might be lacking especially in terms of standards that are demanded by the Harare industries (honey) and the quality of honey they demand. That made us improve on quality of honey. They indeed bought from us. It was USD75.00. It was a fair deal.

CD: That is good, how do they want the honey, I mean the condition at market?

FCS 7, LM² Apiarist: They buy straight from the hive. Not processed. You put your bucket on a scale and they weigh the quantity and pay according to the weight.

CD: How do you compare the way you used to sell your honey as compared to the way you sell to the Harare buyers? Which one is better than the other?

FCS 7, LM² Apiarist: The current market is better than the former. It is good because it is methodical. You are paid according to the weight of your product. You don't feel cheated. You get satisfied when you get what you actually delivered since the weighting process is transparent. In the village prices

are negotiable and at times you sell more than a bucket for very little but with the Harare buyers you get the value of what you supplied.

CD: So you are saying there are advantages in selling to Harare companies?

FCS 7, LM² Apiarist: Sure while they buy from you they also share with you knowledge on where you will be having challenges. So we actually learn from our mistakes and we also learn from the market. I see it as a better option [selling honey products to an urban market] than selling to our local market where at times prices are always negotiated downwards or at times the product is often exchanged with other products where money is scarce [barter]. **CD:** How many times in a year do you harvest the honey?

FCS 7, LM² Apiarist: We are supposed to harvest twice or three times in a year. But this year the movement of bees was disturbed. This year there was drought and so there were few flowers around. But this year we expect many flowers since we are currently having some rains. We also planted flowers around the apiaries to supplement the flowers from trees. We want the bees to collect the flowers from shorter distances. (*absent is the bottle brush plant which is loved by bees*).

CD: Others are hiring out apiaries to plantation farmers especially the apple tree plantations. What is your comment on that?

FCS 7, LM² Apiarist: I heard of it and I am reflecting on it. I actually have an orchard here which is quite big. I will try to bring the apiaries next to the orchard and see what happens. But my fear is that my orchard is near the houses and bringing bees near houses can be a problem. But we will try it.

CD: Thank you so much **FCS 7, LM²**, and thanks you also for all the poems that you wrote and were recited by children throughout this thesis.

FCS 7, LM² Apiarist: For sure I am the one who wrote all the poems that were recited during all the Field day functions that you held for your Thesis project. Our children also benefitted as they also gained knowledge of organic farming, they also showed their poetry talents. As a farmer I also benefit a lot from projects. With projects you can get money anytime and so you cannot wait until month end for you to get money and that is quite empowering. You actually empowered us **CD** by empowering us into starting projects. Projects have improved our lives and we are so grateful. We learnt that we should not wait to look for jobs but you can actually create jobs on your own.

CD: Thank you so much **FCS 7, LM²**.

2/05/17 Interview with FCS 6, JM²

CD: Good morning Mr. **FCS 6, JM²**. Last time in 2016, **FCS 3, LN** talked about a possibility of collectively producing one product at the same for an industrial market. Are you ready this year, I got some information on one agro-industry that wants to contract small-scale farmers in tomato production. Since you have four hectares of land under solar powered irrigation, you might be the ideal person to lead this contract. What do you say?

FCS 6, JM² We could not agree with my extended family on the logistics of the collective production project you know where there are profits involved there exist many ownership wrangles. Thus when I muted the idea to my extended family it created tensions and so at the mean time I am not in a better position to join this contract farming project.

CD: Anyway, thank you very much for taking your time to explain that to me. Good day.

12/06/17

Field Tour and demonstration on how liquid manure is applied by the youths at the demonstration site: Applying-Liquid-Manure_20170612_144803

CD: Can you explain how you apply liquid manure to your crops?

FCS 3, MD Female youth: This is how we do it. We use a small tins and plastic bottles to fetch the liquid manure and supply each plant station.

FCS 3, MD Female Youth: We could easily use watering cans but cans can be a problem when you are targeting a single plant station. Using tins is good for it is easy to control the output and flow of the liquid manure from the tin onto the plant station.

CD: After you have supplied the liquid manure on each station what do you do?

FCS 3, LN Leader of Youths: Once we are done with this process then we water the crop to make sure the liquid manure sinks or infiltrates into the soil.

CD: But we still have a challenge with the water pump which is under repair. I am not sure if it will be ready by tomorrow (**13/06/17**).

FCS 3, LN Leader of Youths: For the new pump we don't want one with a large output muzzle.

CD: Thank you so much.

13/06/17

Filed Tour and Interview with FCS 9, FN Apiarist: VID 20170613_100408. Also present were **FCS 3, LN** and **BD**

CD: Good morning **FCS 9, FN**. Last year we met here on 26 November (2016) and you showcased your aqua-culture project. Now can you take us through your apiary project?

FCS 9, FN Apiarist: My journey into apiary farming starts from the gum tree seedlings. We worked on a gum tree project. We were supplied with the seedlings by Mr CD in 2009. We got 1000 tree seedlings from CD on 10 November 2009. We planted our trees on 10 November 2009 (*that is eight years ago*) and our main purpose was to have woodlots for fire wood (*wood fuel for cooking*), fencing poles and roofing timber. Now we are having another benefit. We are now into apiary farming mainly because we have trees around. The gum trees provide flowers for bees. We put apiaries in the gum tree woodlot. (*more bees take nectar from gum trees*). We were taught that the gumtree flowers provide high quality honey which is also clean (*free from pollution*). Now that the trees are flowering they are providing shelter, nectar and flowers to the bees. I then attended a workshop by Connex (TM³) who talked about keeping bees apart from harvesting trees for sale. I reflected on that but kept wondering why I could not do it and where I could be trained. I was lucky as I was one of the two women from Mutasa district to be selected by one donor to go and train in beekeeping in Harare in 2015.

CD: Uuuh that is good. What other benefits do you get from trees (*woodlot*) apart from housing apiaries, fencing and provision of roofing timber? What is your comment on issues of environmental degradation, long ago the landscape was scarified with a lot of dongas and galleys, how do you compare the landscape before the tree seedling programme of 2009 and that of today?

FCS 9, FN Apiarist: We can see a great change. Soils are now conserved. Gum tree roots are quite strong (*spread sideways and so provides a network of roots that hold soils together thereby preventing soil erosion*).

CD: Can you reflect on the number of gum trees that you planted in 2009? How many were they?

FCS 9, FN Apiarist: Apart from those that might have died, we planted a total of one thousand gum trees.

CD: Suppose we are selling the one thousand trees and each going for USD10.00 how much will you have? Roughly it should be ten thousand USD isn't it? And when you reflect, how many households benefitted from **CD's** 2009 gum tree project?

FCS 3, LN: (*who is also present*). The whole village benefitted.

FCS 9, FN Apiarist: The whole village and mainly those who were willing to take the tree seedlings since the seedlings were given by **CD** for free. All those who were willing were supplied with the trees.

CD: From your understanding how many households in in this village actually benefitted?

FCS 3, LN: *Youth leader*. They were way above one hundred beneficiaries.

CD: So we are saying if each household took a thousand trees, then one hundred households could account for one hundred thousand trees that were meant to fight soil erosion in thus village (*the 2009 tree project by CD roughly added one hundred thousand trees in the village which are now used for fire wood and roofing and fencing poles thereby lessening the burden on women*). For argument's sake if the hundred beneficiaries were to put up apiaries in their woodlots, we will have hundred apiarists in the village, isn't it?

FCS 9, FN Apiarist: We also get cleaner air. Trees give us clean air (*inductive reasoning as the farmer could link the photosynthesis process and the provision of oxygen and taking up of carbon dioxide. Trees are good as temporary mitigation to climate change by sequestering carbon dioxide*). Trees also act as wind break to crops and to houses.

CD: True in other places, because the landscape is too open, there is a lot of wind damage but here there is wind break. It is also warmer here because of trees. The landscape is not exposed to strong winds.

FCS 3, LN Youth leader also present during the field tour at **FCS 9, FN** the apiarist had this to say:

Can I also add something? These gum trees are not just going to provide fencing and roofing poles, but as they grow older we are looking at sending them to the industries for wood processing. In this village we are so lucky, we have some of our people who deal in saw milling. They process timber into wood. The wood is then sent to Harare for various other purposes with some being exported outside the country (*there is a small scale wood sawmilling industry in the village, see also Dirwai, 2009*). So, we look forward to send them to the industrial market.

CD: Uuu that is good to hear. That is why it is good to have you around, you always chip in with important information. I had totally forgotten about the link between the tree woodlots in the village and the timber industry at the local business centre here and the markets in Harare and exports. That is good.

FCS 3, LN Youth leader Once we get time, we can go together to the business service centre, you will see our community members processing time from logs. We are looking forward to see the bush saw-millers to camp in this woodlot and process timber from here. Large trucks will come and collect timber from here for Harare markets. By so doing we will be creating jobs to other youths in the village who are involved in saw milling whilst we also get money by selling our timber.

CD: Thank you so much.

13/06/17

From Video Clip Francisca-Bees-Gear_20170613_102933

FCS 9, FN: as I noted before, I also do practise apiary farming [beekeeping] and I learnt of this from FCS 8, **LM**³ during a Field Day. I reflected on the possibility of apiculture [beekeeping] after appreciating the number and quality of apiaries beehives at FCS 8, **LM**³ 111 with 64 fully swarmed. I was really moved. Now I want to take you through my apiary project. We learnt about apiary farming, first we started by learning about the construction of the apiaries (*The Kenyan T-bar*). To embark on apiary farming, we started by planting trees in the year 2009. We were given the tree seedlings for free by Mr **CD**. It was on a willing taker basis. I was willing and so I took one thousand trees seedlings on 10 November 2009 and we planted them. (*We referring to her family and extended family members*) Our aim was that we wanted to prepare woodlots for the provision of firewood. The more people were being settled in this village, the more pressure we were likely to face on firewood provision. So we opted for planting trees so that we will not face wood fuel challenges in future. Also the government *through the Environmental Management Agency (EMA)* discourages the indiscriminate cutting down of trees. So, we planted trees so that we secure for ourselves, wood fuel, fencing and roofing poles that we had envisioned were going to be scarce in future. (*inductive reasoning as FCS 9, FN could envision the stress on wood fuel as linked to the increased population in the village. Absent at that time was the change in people's lifestyles where people were now opting for natural gas for cooking, the provision of electricity to rural households and so on. But in 2009 wood fuel was the only energy source for cooking. Also absent in 2009 was the vision for apiaries*).

CD: Currently do you have cases from the local village of people who come and ask for roofing poles from your woodlot?

FCS 9, FN Apiarist: To date they are so many. There are seven houses that were roofed from timber from this woodlot. They simply come and borrow and I have been giving out the roofing timber to locals for free so far. By so doing they are also saving money instead of them wasting money to buy the timber from the commercial timber producers. They also save money for transport since they can now access roofing timber in the neighbourhood.

CD: That is good to hear. Now let us come back to our main issue, apiaries. How many apiaries do you have and how many are fully swarmed.

FCS 9, FN: I started beekeeping in 2015 after having realised that maize cropping was being affected by droughts and I had to look around for other alternatives. I found apiary and fishpond farming being better alternatives that were not directly affected by droughts. We have a total of twenty-two apiaries of which five are fully swarmed. You know from the training I attended in Harare I also learnt a lot. We were taught that bees are like a donor, they supply you with everything while you are just resting at home. We were taught at training not to be afraid of bees they are like your brother or sister-in-law. As an in-law you need to observe certain boundaries. Thus you do not have to temper around their entrance as they do not want to be disturbed.

CD: What about challenges. Can you talk about challenges in apiary farming?

FCS 9, FN Apiarist: I got trained on how to make the beehives, to care for the bees, how to attract swarms into the hives and how to extract the honey. I have 22 hives and only 5 have bees while some of the hives were left empty when the bees swarm away due to ants and mice. We learnt from our trainings in Harare that we cannot use insecticides since they will kill the bees. But I will go to **FCS 8, LM³** to learn on how he treats such problems. But at training they taught us to use ashes as a repellent, I am yet to try it. We do have many challenges, pests such as ants, mice and even snakes make the bees swarm away. Mainly ants, they disturb bees and so bees swarm away. At times the bees would have produced so much honey and because of ants they swarm away.

CD: So how are you treating ants from making the bees swarm away.

FCS 9, FN Apiarist: We were taught to drive away ants using ashes. We also use water to drive away ants by water. We put water in a tin under the trees where the ants move from the holes into the apiaries. Instead of them going into the apiaries they end up in the water and so we save the apiaries.

CD: So when are you going to apply this type of treatment.

FCS 9, FN Apiarist: I will do that soon. I have been out for some time in the hospital, I had a mother who was not well. I spent two months in hospital taking care of my sick mother. As a result I failed to get time to maintain my apiaries. Had I been around, my apiaries would not have been affected by pests especially ants. Now I am free to concentrate on my apiary project.

CD: Thank you for the information. What about the honey extraction gear combat where do you get it?

FCS 9, FN Apiarist: We got it from Harare Borrowdale (*Art Farm*) where we got trained in apiary farming. They trained us and they did not just give us skills in producing honey but in the extraction of honey. (*Capability assets and commodities in honey extraction gear was a necessary capability needed by the apiarist for the conversion to the function of honey extraction that was safe for the farmer and the bees*) We trained by one Mr S in apiary farming. We spent one week during that training in Borrowdale. The technicians from Mr S' Farm taught us a lot, especially how to construct the modern apiaries. We were also taught to make apiaries that can be mounted on a stand a meter or so high unlike the old apiaries that were mounted in trees which disadvantaged women. The new siting of apiaries are gender sensitive since they are easy for women to exact. They are sited at a good height. There were many women who were trained by Mr S in the construction of apiaries as well as in honey extraction. We are fully empowered now as we can do the construction and extraction on our own. We were taught by Mr S that bees are like your brother or sister-in-law (**metaphor**), bees are your donor (**metaphor**), so you must not fear bees but you should love them. He said we look forward to donors from outside the country and yet bees are a local donor that is readily available at your homestead. He said (*Mr S*) you should be free to your bees as you feel safe to play around with your brother or sister-in-law. Bees are a donor and you must not fear your donor. Today I no longer fear bees or even fearing bee stings. We learnt that bee stings are a source of healing. We were taught that ten percent of diseases in your body can be removed by bee stings. (*to be verified although it is fact that honey has a lot of medicinal purposes. It is yet to be established if bee sting itself has medicinal qualities*)

FCS 3, LN Youth Leader: We learnt that if you are stung by bees then you will not suffer from Malaria (*bees as an immune booster is yet to be verified. But research has also proved that bees can be used to drive away elephants from people's crops in some villages in north western Zimbabwe (Binga) and this information is absent from this interview*)

CD: So that year you will not suffer from malaria

FCS 3, LN Youth Leader: Yes that year you will be free from malaria. Bees can predict the coming of visitors. If it flies into your house and takes one round it signifies the number of days the visitor will stay at your home. If it takes so many rounds in your house then it signifies that the visitor will take so many days at your homestead. If the bee turns around your head and comes almost to your eye then it signifies how close the visitor is to you and that s/he is a person you like most.

FCS 9, FN The apiarist: We also learnt that the pollen that bees carry, can be captured by putting a tin under the hive so that you can capture the pollen that falls off the legs of the bees as they enter the hive. The pollen is used as a medicinal mechanism to treat cancers. He actually sell the pollen outside the country where they use pollen to produce drugs. From the honey combs, they extract some white stuff which they extract using a syringe, that white stuff (*jelly like*) is precious and used to

produce drugs for the mentally challenged patients. They say they sell that jelly outside the country (*missing is the fact that the country sells jelly and it imports drugs at a very expensive price, instead of using the jelly to produce the drugs for the whole world, that is an absent*). The maragadu tablets have some components from bees.

CD: Now I have learnt a lot of information. Do you have anything to add **FCS 3, LN** can you add some more information?

FCS 3, LN Youth Leader: The wax is used for candle making.

FCS 9, FN The apiarist: The sunscreen that is used by our people with albinism is also made from some honey by-products, the wax. (*absent is how to reduce that and why the country suffers from foreign currency shortage when there are plenty of bees to produce drugs and sun screens?*) People of an Indian culture, have some special small candles which they use during bereavement. These small special candles are made from wax, a bye product of honey production.

CD: I have learnt a lot from you. **FCS 3, LN**, do you have something to add again?

FCS 9, FN The apiarist: Plus honey is used to make medicines for coughs. Yes!

CD: I only knew hone as used to manufacture medicines for coughs that is the only thing that I knew about honey as a medicine, the rest of the things that you have said, I had no idea about all that.

FCS 9, FN The apiarist: We also learnt that honey can make a child bright in class. By eating honey a child's intellectual ability will be enhanced. The child will be as intelligent as a bee.

FCS 3, LN Youth Leader: Honey is also good for those who suffer from asthma attacks. Honey can help treat asthma.

FCS 9, FN The apiarist: We learnt a lot during our apiary training some of which I might be forgetting since I did not write the issues down. But bees do have a lot to offer to us. Most medicines that we use have some components from bees. (*so why does the country suffer from drug shortage when there are plenty bees? Education 5.0, how can universities work with communities to open up research and industries? Why not send people outside the country for trainings into all these potential medical industries and take the country to another level of a middle income by 2030?*)

CD: Thank you so much **FCS 9, FN** and **FCS 3, LN**

13/06/17

From Video Clip Franscisca-Honey-Extraction-Demo-20170613_105137

FCS 3, BD checking on the health of an apiary. There is just too many ants in this apiary and there is very little honey. After extracting the honey I have to go some thirty meters in an opposite direction from homestead. Bees have a tendency of following up and once you take the direction home then you are most likely to bring bees home. So you take a different direction and when the bees have gone back to the apiary then you take the route home.

CD: That is new to me. I have learnt a lot from beekeeping to honey extraction.

CD: Thankyou.

6/06/17

FCS 3, LN on –Apiaries from the demonstration site-20170612_111206

FCS 3, LN: The new apiaries as was also demonstrated by **FCS 9, FN**, are sited just a meter or so above ground. They are easy to work with that is when extracting honey especially by women. As farmers we use bees to pollinate our crops by placing the apiaries at the edge of the fields and so the new type of apiary is easy to shift as per need and demand, *unlike the old traditional ways of siting apiaries which was handing them on tree tops. That was not gender sensitive.* Hanging the apiaries on tree tops had other disadvantages apart from the need fir a ladder to climb so as to gain access to the apiary. When you get stung by bees from tree tops then you can fall down and get hurt (*secondary injuries*), but when I get a bee sting from an apiary that is just one meter high, I won't fall down anyway as I will already be standing on the ground and so I don't get *secondary injuries* apart from the pain from the bee sting.

CD: This is good. Where were you taught of all this information?

FCS 3, LN: Youth Leader We learnt of all these techniques from Mr S in Harare. We were also given books on apiary and I also keep referring and reflecting on the books during practice.

CD: Good what else do want to say?

FCS 3, LN: Youth Leader We wish we could have enough equipment including work suits, hoes, safety shoes, head gear to protect from direct sun heat, garden folks and a new pump so that our work

is made easy and efficient. More! We learnt of the insect pollination of crops from FCS 8, LM³ and from books. We experimented on insect pollination by putting one swarmed hive in the pea plants with several empty others. We failed to work at that time due to bee-stings. I can also say, 'We are committed to the local organic standards which bar us from using artificial fertilisers, heavy chemicals and where possible, we avoid hybrid seed.' We are our own monitors, we don't need someone to keep checking on us whether or not we are still practising organic farming year in year out, it is now part of us. This includes organic honey production.

CD: We will try to work on that budget. And anything that you want to add on how you learnt the type of irrigation in this demonstration site. I know you have said something before, can you elaborate?

FCS 3, LN: Since 2012 we were watering our crops directly from a garden tape attached onto the water reservoir and through a hose pipe and in most cases this was labour intensive, we reflected on other ways of irrigation. We experimented on getting water directly from deep into the water reservoir [syphoning] and straight into the field trenches and basins using a 40 inch hosepipe as flood irrigation. It worked. We learnt of this type of syphoning from a video from a village in Beitbridge, CD shared the video with us here in the community-based garden project. Thus we experimented on the new innovation using a much bigger hosepipe and from a much deeper and bigger water reservoir than what was learnt from the video, it worked better. We learnt from X-High school [a Harare high school that was practising organic farming under drip irrigation] that irrigation has to be done during the day when the sun is hottest because that is when the plant fully utilise the water in food production [photosynthesis], so, we shifted from irrigating during the evenings and early morning to doing it during the day light.

12/06/17

FCS 3, LN, Bees Vid 20170612_103351

CD: Can you carry on with your demonstration of apiary activities

FCS 3, LN Youth Leader at the demonstration site. Today is 12 June 2017, last year (2016) we had a peas crop about four contours strips. This year we increased our cropping space to nine contour strips.

CD: How do you do your practice, I can see some grass what is it for?

FCS 3, LN Leader of the youths. It is grass mulch. We practice organic farming and the mulch apart from enhancing soil fertility, they act as cover for crop from rapid evaporation. That is to say mulch can act as a water conservation technique. Mulch also prevents the growth of weeds. Once we provide mulch then weeds are suppressed from growth. When we plant the next crop the grass mulch will be mixed with soils and they will be manure to the next crop. Last year we held a Field Tour and one apiarist talked about how the farmers in DR village are hiring out apiaries to plantation farmers of N Plantations. We learnt that once the plantations are at flowering stage, they hire the apiaries from the next village to help in pollinating the tree plantations. We have tested this technique to see if indeed it can help us come up with a higher yield this year than before. We also have planted five of our apiaries, one of them is fully swarmed and the other will be waiting to be swarmed as more bees come to pollinate our crops.

CD: Good and how do you measure the contribution of apiaries?

FCS 3, LN By comparing the two yields one from last year and the other from this year. The difference could roughly give us an estimate.

CD: What about the market?

FCS 3, LN Last year (2016) we were supplying the open market. It was a challenge. Prices kept changing. For you to benefit from such a market you just have to plant early before the market is flooded with peas. (*The issue if dates is crucial in farming*). A slight delay the market will be flooded and you don't fetch much out of the crop. This year we planted early and so we are likely to see our crop on the market earlier than most farmers. The hotel markets also said they need our crops this year and we also targeting them. Different buyers want the peas at different levels some want them as baby peas while others want them fully ripen and so on. The other problem with the open market is that their measure is not standard. Their bucket (20kg) is different from ours. Theirs is slightly bigger than ours and in most of cases we lose out in such a poor measuring scale. Thus when we measure our ten buckets then we would be assured that the will measure eight with two buckets going to lose.

CD: How do you intend to solve that problem?

FCS 3, LN: We are frustrated. We are still looking for our own organic market. In the open market we are treated the same as those farmers who produce crops under conventional farming techniques and that is not good for us. We will try the hotels may be, this time. Currently we don't have a market that takes organic products?

CD: Can I have your comment again on liquid manure as compared to compost manure that you used to do?

FCS 3, LN Liquid manure is good and we use very few manure as compared to compost. Liquid can be concentrated on a station and the plant benefits directly. Liquid manure works fast on a plant while compost manure takes long to decompose and be utilised by the plant.

CD: What did you learn from extension service about liquid manure as compared to compost manure?

FCS 3, LN CM¹ gave us a metaphor of porridge. That's compost is like putting porridge onto the mouth of the baby hoping that some will go directly into the mouth of the child while some falls down while liquid manure is like feeding porridge directly into the mouth of the child.

CD: How do you extract the honey from the apiaries?

FCS 3, LN We put on the honey extraction gear like what **FCS 9, FN** and **FCS 3, BD** were putting on. Most of the apiaries here are not fully swarmed and had they been swarmed we were going to be stung since we are not putting on the honey extraction gear. For all these empty apiaries we need to attract the bees by wax.

CD: Which type of seed variety of peas did you plant this time around and when?

FCS 3, LN We planted the Lincoln variety on the 31st of March 2017.

CD: After the peas crop what are you going to plant?

FCS 3, LN After the peas crop we want to plant tomatoes.

CD: We take this as a demonstration site where people come and learn about good practices. Are people in this community planting under organic conditions?

FCS 3, LN There are several farmers in this village who are into peas crop farming, **FCS 4, SM¹**; **FCS 6 JM²**; **FCS 8 LM²** and several others who are in this village and the next village N.

CD: Thank you FCS 3, LN can you carry on with more explanations on apiaries (*see next video*)

12/06/17

FCS 3, LN, Bess Vid 20170612_105321

FCS 3, LN I want to add more on apiaries. The knowledge that we learnt from Harare. Bees when they enter the apiary they use one side and one entrance. When you want to observe them, you need to avoid the entrance. Once you disturb them from work then you are likely to be stung. But when you approach them from the opposite direction you are likely not to be harmed. So it is easy for us to do our work without disturbing the bees as long as we are not working around their entrance (*This was easier said than done as the youths failed to do work because if bees stings and so they ended up doing some harvesting of contours strips that were near the apiaries early in the morning and in the evenings*) We also put a water container at the entrance of the apiary so that the bees get water nearby and avoid travelling long distances to go and fetch water. We also brought the apiaries near the crop so that the bees can fetch pollen from a nearby crop (*absent is the provision of bottle brush, a flower plant that naturally attracts bees*). We also learnt that one worker bee travels forty times to go and fetch water? By putting a tin with water we reduce that time so that the bee can travel shorter distance and maximize on production. We also learnt that the queen bee's duties are to lay eggs and she can lay as many eggs as two thousand per hour. We learnt that each apiary survive with one queen bee and a queen can survive for six weeks. The drones are the males which mates with the queen bee and each drone after meeting the queen bee will die. The drones also play an important role in closing the apiary with nectar so that it is warm and protected. Here we are trying to attract the bees so that they produce organic honey since our peas crop is organically produced. If we manage to have organic honey then it will be easy for us to look for organic honey markets such as chemists. If the hotel market might want to come then they can come around 25 June we will be ready for them.

CD: What message can you give to other youths?

FCS 3, LN I would advise them to embark on organic farming which reduces unemployment and other social vices like thievery.

12/06/17

FCS 3, LN On Organic Manure_Vid 20170612_121746

FCS 3, LN Youth of Leader We practice organic farming and the manure comes from compost, dung and rabbit droppings. We keep rabbits. Some of the weeds that we weed from our field such as black jack (*Biddens Pilosa*). We feed our rabbits with *biddens pilosa*. We use the manure to feed our crops.

FCS 3, LN We also get cash from the rabbits, apart from organic manure. We do not just keep rabbits and chickens but we also produce the traditional maize crop the Open Pollinated Variety (OPV) *The Hickorry King* maize variety. *Photo 34 shows FCS 3, LN show-casing the traditional maize fruit.*

FCS 3, LN Youth Leader plant maize but not the one bought from the shops (*Conventional maize varieties*). We recently harvested our OPV and we are preparing to make the seed from the harvest. When we prepare seed we cut off the top most and the bottom most parts of the OPV fruit crop. The two parts cut from the fruit crop will be used for maize meal or pop-corns (*maputi*) while the middle part will be used for seed maize. We shell the maize and we preserve the seed. We do not use any pesticides but we preserve the seed by traditional methods. We take gum tree leaves and the golden merry (*mukambanje*) we mix them and place them inside the maize seed container. By so doing we don't experience any moths, but we keep checking if the maize seed is still free of moths.

CD: Some use soot from the traditional hut stuck inside the grass thatch. Have you ever heard of the use of soot to preserve OPV maize seed crop.

FCS 3, LN: I have not heard of that, but I am happy since I also have learnt something new. More! We learnt from elders like **FCS 2, BC** that this type of maize crop is similar to the then SR52 and requires a lot of water, long season variety. On how to treat traditional maize seed variety OPV against after harvest pests, **FCS 2, BC** said, 'To prevent weevils [attacking the stored seed crop], we normally hang the seed maize in the kitchen where there is soot [traditional knowledge] and whenever we do that the seed is not attacked by weevils at all. Luckily in this demonstration site, we have 'irrigation' facility and liquid manure as new innovations. We plant our OPV [traditional maize seed and a long season variety] during the dry period of September and we harvest it by March after five months.

CD: But you can still learn more from **FCS 2, BC**, he explained to me how he preserves his **OPV** maize seed variety by hanging the maize in soot. Thank you and tell me what is sealed in those drums?

FCS 3, LN For our liquid manure we take dung and mix it with water (33% dung and 67% water). We take some days a week or so under closed conditions then we open and stir the mixture and start applying the liquid manure onto our crop. Today we have over four hundred litres of liquid manure that we want to apply. We fetch the liquid manure from the drums into buckets and then use small plastic containers to apply the liquid manure per station. A drop of this liquid manure on your shirt will not be easy to remove. The liquid will dye your shirt.

CD: This means that people need protective clothing when applying liquid manure.

FCS 3, LN Yes. We also need gloves to protect hands. The four hundred litres can cover approximately three contour strips. In future we are looking forward to build a small reservoir for the purpose of liquid manure. We need to prepare the liquid in bulky, open a tap from the reservoir and water the crop using hosepipes. That would be easier than making use of small containers to water the crops.

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FCS 3, LN Vid- Water Conservation Vid 20170612_120941

FCS 3, LN After pumping the water is captured in reservoirs up gradient and when all is done then we let the water flow into the main stream then into Tsambe River. We also have our community members who practice gardening downstream. They also need water. The stream also feeds into the river and the river is kept alive as it flows throughout the year. The number of beneficiaries are many as the water flows into the sea.

CD: Thank you.

FCS 3, LN Water Conservation Vid 20170612_115147

FCS 3, LN: To embark on a market-based production model we needed a constant water supply and so we have two earth-built large water reservoirs, a water pump and a network of hosepipes. The gradient is also good too for irrigation through the force of gravity. For all our farming activities at this demonstration site, we collect the water from this simple trickling water point. We heard that long time ago before our own forefathers were born, this small stream was trickling as it does today. One

of my aunts who is now late, used to tell us that she used to drink from this same small spring and water point as far as she remembered. As a point of reference, she would point out drinking from this spring when she was at the age of seven and that was during the First World War [1914–1918]. As far as she remembered that she drank from the same spring during the Second World War [1939–1945]. So, we can safely confirm that the spring has been flowing for over a century now [1914–2017]. But, to extract water from this century-old spring, we (youths) had to observe some ‘Dos and Don’ts’ or taboos that are associated with the continuous or the discontinuous flow of this spring. We thought of the best way we could use it to water our fields since it was a spring of centuries where we only see the water coming out, *cold and clean* but we don’t know where it is coming from, *its source*. We were also taught how to preserve this water source (*IKS*) by not cutting down trees around this water source. Water collection gadgets with soot are not allowed to be used to fetch water. Tins or pots that are often used for cooking are not allowed to be used to fetch water here especially when they are dirt with soot. It is also not allowed to fetch water after sunset. We have cases where the streams and shallow wells got dried up when people did the Don’ts. This water point also serves a large community, they all come and fetch water from here. We did not want to create conflicts with the community by extracting water directly from the water point and so we moved some distance from the water point and we dug a water collection point or pond where we use a water pump to extract the water.

CD: Thank you can you demonstrate on the pumping.

FCS 3, FN: We pump the water into the two reservoirs and then we irrigate the field using flood irrigation powered by syphoning and capitalising on the force of gravity. We also protected the water pond from animals and children. It is a bit deep close to one meter and this can be a danger to children and so we protected it.

CD What about conflicts with the community, conflicts emanating from the water point and from the project in general?

FCS 3, LN Yes there are a lot of people who are jealous of the project. This brings about a lot of conflicts. Every year we get threats that this pond will lead to fatalities when children fell in. Such threats are still common.

CD: How many minutes does it take for the pump to load water and to start throwing the water into the reservoir. How do you know?

FCS 3, LN The process takes approximately five minutes and we know that it has started pumping by the change of sound. Once it starts pumping the sound changes.

CD: Thankyou

Interview with FCS 3, MM on 13/06/17

CD: Afternoon to you **MM**, do you have any other insights to add today?

FCS 3, MM: I just want to say, before 2007, this field was basically ‘light-sandy’ and basically infertile. Today this demonstration site is now used for our new venture, the organic farming production. Granny advised us that we could start with small grain rapoko for it enriches the soils and does not need artificial fertilisers and was drought resistant. So between 2010 and 2012 we worked on further landscaping, terracing and collecting humus from the bushes to enrich the soils. Rain-fed maize was ruled out at that time since it was prone to droughts and the soils were ‘light’ sandy and prone to leaching such that even the artificial fertilisers given by government, could not help much where the soils are too loose like that. But with time, and the introduction of organic farming techniques, and irrigation, the soils improved and we reverted back to maize, this time, the traditional long season variety, a long season variety that thrives well under irrigation.

CD: Thank you, we will continue sharing such good insights.

12/06/17

FCS 3, OD _VID 20170612_104446

FCS 3, OD We are practicing organic farming, peas, king onion and so on. But we have several challenges that are brought about by the planting of gum trees here. Monkeys are now a menace as they hide in the gum trees and often prey on our crops. We do not have much to do about the situation other than scaring them away using catapults. We reflect on pelt-guns but we are not sure how the community elders will perceive the idea.

FCS 3, LN *also present said:* Culturally monkeys are not allowed to be killed. Once the community elders gather the fact that you killed a monkey then you will pay a fine. Once we have a pelt-gun we will use it to scare away monkeys but not to kill the monkeys.

CD: What else do you want to talk about?

FCS 3, OD: I am happy to be part of this project. We are working hard and together with the other youths here. I observed that there were only five major buyers of peas at the urban market in Mutare [*Musika wehuku*]. And, whenever they saw our (supplies) trucks entering the market at 0530hrs, then they would determine the prices of the day as guided by the quantities as observed upon entry through the market security check-point. You only get excited when the prices favour the farmer and not when it favours the buyer. But I am happy, we are now part of the pricing system. They also wait for our truck to arrive in the morning before they determine the peas-price of the day. Worse, the urban open market does not distinguish our organic products from the conventional ones so we had to compete on quantity, quality and size with conventionally produced products. We managed to get some little hard cash when most of the country experienced a liquidity crunch.

CD: I hear you well. What about the advantages?

FCS 3, OD: We supplied the urban open market on average eleven buckets [11x20kgs=220kgs] every Monday and the same quantity every Saturday for a month or so. This meant 440kgs per week at a cash price range of USD \$3-4 per bucket [20kgs of unshelled peas] and that meant we pocketed a range of [USD (\$33-\$44)x2] which culminated to USD \$66-\$88 (cash) per week and that is [USD \$264-\$352] cash in a month of a four week cycle. I am personally happy to have discovered that cash was still available for those rural poor who exchanged a farm produce for money at the open market. Money was not readily available for those who wanted to withdraw it from the bank. Now that we understand their 'game', that supply and demand determine prices, next time if only we acquire a cold-room, then we are going to keep our agro-products fresh for a much longer time and supply the market only when supplies are low while demand and prices increase. There is more! The income that we get from the market contributes to buying food and to schooling since I am still in university. I also learnt that farming can be a good source of income and it is not always that youths should look for formal employment in towns or in industries. When properly organised, farming is good an employer too. I also learnt that time is over that people should rely on rainfed farming but irrigation too. We learnt from agro-industries during our trip to the industries that they needed from farmers like us, raw materials for them to fully operate. It is our duty as farmers to produce such raw materials in bulk for the development of industry and without raw materials industry cannot grow. Industry in return will offer us the youths and university graduates, jobs. So, if we don't produce in large quantities then industries might remain shut down and we don't get jobs. More! Now that we understand their 'game', that supply and demand determined prices, next time if only we acquire a cold-room then we can preserve our peas products for long so that we dispose the product when it would be scarce. That way it will fetch a higher price. I also learnt that farming can be a source of income and it is not always that youths should look for formal employment. When properly organised, farming is good as employer too. I also learnt that time is over when people should rely on rainfed farming but irrigation too. The most interesting part in this farming practice [market mode] is the marketing itself, the way we negotiated with the buyers in an urban market and how the prices changed each day were good lessons for us the young farmers.

FCS 3, LN: I want to add on something else. When we compare the way we used to farm and the new ways we are practicing in this project, the now methods are good but we are constrained by monkeys. When we planted the gum trees we were happy that we would get firewood, poles and housing of our apiaries, but now monkeys are affecting our progress on the organic products. The youths can also learn a lot from this project, working hard reduces thievery and other social problems associated by idleness. Today we are happy we have irrigation and so we plant crops throughout the year. The period before 2009 we used to wait for rains to come, plant a crop with artificial fertilisation of the soils from synthetic fertilisers. You see we had to wait and pray for rains and more rains to come, today we just pump our water from the reservoirs into the crop field.

CD: Thank you.

12/06/19

FCS 3, JM¹ On Marketing_Vid 20170612_144046

CD: May you please talk more about markets.

FCS 3, JM¹ In terms of marketing if we plant our crop early then we will get a better price but if we plant late then we will get a poor price. *Inductive reasoning.* Whenever we plant our crop early we get a good and better price. Whenever we plant late we get poor prices so we concluded that planting peas crop early is good for a better price on the market. Planting late means the market will be flooded since there will be more farmers sending their crops at that time. The main problem that we faced when ferrying the peas crop to the market in 2016 was that of transport. Per day we used ten USD to ferry the peas to the market and that was not profitable.

CD What is your comment on how the market view your peas crop?

FCS 3, JM¹ The market says organic peas are sweet and palatable as compared to peas that are conventionally produced.

CD How many buckets of peas did you send to the market in 2016?

FCS 3, JM¹ We sent a total of fifty-two and we were selling at five USD a bucket.

CD: Thank you.

13/06/17

FCS 1, VS Vid 20170613_114530 (1)

CD: Afternoon **FCS 1, VS:** Can you take us through your story that has led to this bumper harvest in the 2016-2017 season.

FCS 1, VS: I am **VS** the communal farmer who practiced conservation farming using a form of fertility trenches. After struggling with poor harvests due to climate change for some time, I heard of a Field Day that was being held at *Gogo Hildah's* place where the use of fertility trenches was being show-cased. At first I was reluctant as I felt that was not going to change my situation but I further discussed the issue with my daughter overnight and together we reflected on some benefits in attending that Field Day at *Gogo Hildah's* homestead. There, I learnt of the new practice, digging trenches. This time I have a bumper harvest. I planted the P variety of maize crop. The P variety is good for us, it has big maize seed and it bears two fruits at a time. The maize cob is completely covered and so it is not exposed to prey by birds and cannot easily be attached by moths.

CD: [13June 2017]: Since you started this type of farming, what were your old farming practices and what are they like today and what are your inputs?

FCS 1, VS: Well, ever since before the year 2012 my maize crop farming has always been conventional and rain-fed crop farming. After experiencing poor harvests before 2012. I kept wondering how best I could shift from such a situation. I was shocked to see the huge harvest *Gogo Hildah* was showcasing during the Field Day that she held, I was really moved to see such an elderly woman of her age producing such huge maize harvests while us, were starving. Since I do not have cattle manure, I rely on putting humus from the forests and the maize stalks into trenches and it is working well. But I am happy, I weaned myself from food insecurity [begging bowl] to food security and now the other community-based farmers come and learn from me. But my maize harvest could hardly fill up a small dish *chibage chekukanga maputi*, [loosely translated as a harvest that could produce a few small packets of pop-corns as she could hardly produce a 20kg mealie-meal bag of her staple food]. When I started this new type of farming, my crop harvest has steadily been improving. This year's harvest [2016-2017 season] as you can see from the maize on top of the roof top of my house and from other storage devices in my kitchen, I expect to have Four Tonnes after shelling the maize. The first year I shifted from my old farming practice to this new one, that was 2012-2013 farming season, I harvested 20x50 kg bags of maize [1000kg=1 tonne per yield] in 2013-2014 the yield increased to 35x50kg bags [1750kg=1.75 tonnes per yield] and in the 2014-2015 it was 65 of such bags [65x50kg=3250=3.25 tonnes], and now [2016-2017 season] as you can see, I am expecting [80x50kg=4000=4 tonnes]. If God is willing [a common statement amongst locals that only God has the ultimate plan for people's survival, or it can mean 'if I am still alive by then', or that God gives us the blessings of life and good rains], I will continue experiencing better harvests with time.

CD: And your story again from 2014 to 2017. What can you say as a summary?

FCS 1, VS: The 2014-2015 rain season was tricky but I capitalised on the first rains early December, since my trenches were ready for the crop and mentally I was ready too. The germination was good unlike the situation from most of the fields in the village. But I never rested, I kept observing the condition of the maize crop. Every morning when I wake up to do my field observation at 0500hrs, I

would be surprised to see most of my crop, healthy-green from morning until 1000hrs when it showed signs of moisture stress. I observed again around 1700hrs the crop was green again and discovered that the crop was live again, unlike most of the maize crops in the neighbourhood who did not practice fertility trenches farming. Thus, I concluded that my crop was benefitting from the moisture that had been retained in the maize stalks in the trenches, for a period more than I had not expected, and I was happy. But I also observed some disadvantages from the fertility trenches. The maize stalks are good but they might not be good for a very long dry spell and that is why keep reflecting on the need for a permanent water harvesting mechanism. The fertility trenches also had disadvantages under flooding conditions. You see my field does not drain fairly well. While I was enjoying my new practice of fertility trenches, it was good when the rains were normal and not excessive and flooding. You see it's like the rains that fell this year (2016-2017), they were flooding. I reflected back to our old knowledge, ways of how to drain off wetlands which we used to call 'ridging' or a raised platform so that the water drains off. With that I succeeded.

CD: This is really great. Now can you summarise on why you don't burn maize stalks and maize cobs?

FCS 1, VS: I don't burn maize stalks and maize cobs. I bury them in the trenches. They act as my basal fertilisers every year. I want my maize seed on top of the trenches where the maize stalk and maize cobs are buried. My maize crop grow well and healthy. The buried maize stalks and maize cobs act as water conservation mechanisms. They conserve water for my crop.

CD: Take me through your story again from where you started up to today?

FCS 1, VS: When I started farming (*referring to the year 2012*) I could hardly harvest a bucket (20kg) maize. My harvest was for pop-corns only (*meaning it was not meaningful*) and now (2017) I talk of tonnes. There, [at *Gogo Hildah's* Field Day] I learnt of how to bury maize stalks into trenches and also learnt about mulching where maize stalks and cobs were used in the process. I observed that the mulch she used, later decomposed and was dug into the field as manure, this darkened the soils and improved her soil. The maize stalks and cobs in trenches acted as a sponge. I kept asking *Gogo Hildah* how she got it right and she explained again and again, that she was digging trenches, burying maize stalks and would add cow dung manure into the trenches and leave the ingredients to rot. The rotting maize stalks would retain moisture and add to soil fertility. I continued to think over it as I also shared my thoughts with my daughter. The following day, we started the trenches, because we did not have good maize stalks we started by filling the trenches with humus and top soils from the forests and reflected and say, 'how come *Gogo Hildah*, old as she is, has managed to embark on such a great innovative farming technique, why shouldn't I?

CD: For sure I have seen with my own eyes, there is plenty of maize on roof top, in a maize bunker and in a bunker inside the kitchen, all points to a great yield. This year how many fifty kilogram bags are you going to have?

FCS 1, VS: I think I will have eighty fifty kilograms this year (4000 kgs or 4 tonnes). Yes, this year 2016-2017, I expect from this maize harvest, to get four tonnes and that is for our family and extended family's consumption and for that includes relatives in town. I also wish that if I had cattle manure then I would cease from collecting humus from forests, humus is good but it takes longer to decompose and feed the soils than cow dung could. But anyway I have to live within my means! While the trenches are working for me they have not yet been recognised by the extension offers and so no Field Day has been held at my field as yet. I think they have their own programmes to follow but I am happy, my fellow villagers now come and learn from me. Three farmers and the youths came here for a Field Tour and I hope they benefitted from knowledge sharing with me here. I demonstrated to them what I had learnt from *Gogo Hildah*, showcased how I use grass mulch, leaf-mulch, maize cobs and maize stalks buried in fertility trenches to enhance soil fertility. The youths were impressed but I will make a follow up. I emphasised to them that the maize cobs and maize stalks conserved water in the soils.

CD: During the 2016-2017 season the rains were flooding, how did you cope with flooding?

FCS 1, VS: I was always in the crop field (*constant monitoring*). When it rains, I would wait for it to stop get into the field to do weeding and to ridge so as to drive away the sheet flooding conditions in the field. That ridging process helped me a lot. The maize crop grew tall and healthy as you can see, it is much taller than me. Thus more! But had the rains not come in February, then my crop was never

going to survive on the fertility trenches. The maize stalks are good but they might not be good for a very long dry spell and that is why I keep reflecting on the need for a water reservoir. Only if I could have a steady water supply like a built up reservoir or the plastic tanks then I might continue guessing on what's next. On raised ridges as adaptation to flooding and water logging conditions, I kept reflecting (recursive reflectivity). I did not come out of my field throughout this rain season. I reflected back to our old ways of draining off wetlands by ridging instead of furrowing as is the case with my fertility trenches.

CD: I am so happy the yield is quite good, tall and healthy. If we were to make your field a second demonstration site (*which is a good possibility*) like the one being manned by the youths, what are your major wishes to see that happen (*capability assets and commodities needed*)?

FCS 1, VS: I would be grateful if we can have a water source like a borehole. Once we have that then we can practice our farming throughout the year. You see, with the availability of water, and with more people doing this type of farming [fertility trenches], then the transport system in from this village to the market will improve as there will be more [transport] companies operating here, ferrying our agricultural products to the urban open market. Even our neglected dirty road will be repaired once it becomes busy ferrying products. More! On my current innovation, fertility trenches, I dig trenches as you can see and bury all the maize stalks. I also collect hummus and grass from the forests and bury them too. These rot, provide manure and retain moisture for my crops. You see, I continue to observe that whenever I use the new method [fertility trenches], the maize output continues to increase, and so trenches and humus are good for maize crop output and I enjoy continuing with this method as it is working for me. [*Takainonokera tichigara mumatown*], [meaning, we left farming until old age while we wasted time staying in urban areas]. We were lost when we used poor farming methods that were associated with frustrating harvests, now we are happy with the new methods with good and encouraging harvests. But I am happy, I weaned myself from food insecurity, begging bowl *kungokumbira* and moved towards food security and now other villagers are coming to learn from me.

CD: Thank you so much

Informal Interview with FCS 3, MM 16 November 2017

CD: In summary what do you say about the journey that you took as youths, towards organic farming?

FCS 3, MM: We did not walk this journey alone as youths, we continued to reflect with others [communities of practice] who are our local primary school, the extension service, donor agents and the community at large, through Field Days like this one. During such a learning process other farmers would ask us questions and they could point out where we might have gone wrong. We accepted to be corrected and once we correct the noted mistakes then we could recall the group on the next crop to show our appreciation of the corrected problem.

CD: Do you have incidences when that happened?

FCS 3, MM: Yes, yes **FCS 1, VS** noted the absence of mulch in our crops, we went for a Field Tour at **FCS 1, VS's** field and we learnt from her how best to do mulching. We later invited her in 2017 to showcase the practice of mulch and fertility trenches that we had learnt from her (**VS**). We also recalled **CM¹** in 2015 for him and the community to see the corrected and improved practice on conservation basins.

CD: In summary what do you say about the journey that you took as youths, towards organic farming?

FCS 3, LN: You see we now look forward to be recognised as real organic farmers and so claim our own share in that market and get better prices from the market since the results from the laboratory tests are favourable to us. Who knows we can see our canned products breaking into an export market from 2019. But we also learn a lot from others. We learnt a lot from other farmers around our community and from farmers from other villages that we should not just sit on our potentials (capabilities and freedoms), but we should put our capabilities into practice (functionings). Through experiments and learning together with others we have managed to move towards market gardening and supplying industry. But we lament as said by **FCS 3, MM** the other time on the type of education that we receive from government agents and the donor community. At times we get education on farming business but we do not get the knowledge on the markets where to send our products and how to enter into such market. The communal farmers wasted time on a crop that never brought in any

returns. Since they had abandoned their staple food crop [maize] expecting some cash [to buy maize] from the garlic crop, cash that never came by and so the communal farmers were left with many tonnes of round nuts after being trained into that, but did not get the knowledge on where to sell them.

FCS 3, MM: We did not walk this journey alone as youths, we continued to reflect with others [communities of practice] who are our local primary school, the extension service, donor agents and the community at large, through Field Days like this one. During such a learning process other farmers would ask us questions and they could point out where we might have gone wrong. We accepted to be corrected and once we corrected the noted mistakes then we could recall the group on the next crop to show our appreciation of the corrected problem.

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CD: Thank you **FCS 3, MM**, we will continue to talk about these issues another day. But can you give me a summary of what really happened to your dendrology project in 2014?

FCS 3, MM: Since we had gained experience in producing gum tree seedlings, we thought that was going to be our advantage. But each year the goal-posts kept changing. One year you are told we are taking indigenous tree seedlings when you had exotic tree seedlings, the following year you try to produce the indigenous tree seedlings, then you are told we take exotic or a specific indigenous tree which you had not heard of in time. The following year you then attempt to do both the indigenous and the exotic tree seedlings at the same space and well in time and the exotic trees get diseased in the process. Maybe the diseases that attack the indigenous tree seedlings are responsible for the attack on exotic tree seedlings since they were now produced at the same space. The same disease also attacked **FCS 11, JC's** seedlings in the same year 2014 and he had produced the indigenous and exotic trees in the same space as we had done in 2014. In all cases, the exotic tree seedlings were taken at a low price, much to the disappointment of the farmer.

CD: That is sad. Is there anything that you want to add?

FCS 3, MM: As communal producers, we also liaised with communal producers in other crops from other villages to get their stories on this type of experience from government and non-government buyers. The banana producers from the next village (**H**) further north from here, complained of a similar problem. The buyer tells them to cut the ripe bananas, ready for grading and market. Day one, s/he (buyer) doesn't come, the same applies to day number two and may be up to day five. By the time the buyer appears, some of the banana crops would have lost quality and in the market grade and so the crop gets condemned. Farmers are given all sorts of excuses as a cover-up. The villagers in **H**, also complained about why the buyers would tell them to cut their crop if the buyer was not ready to collect it. As a result some community-based banana farmers lost hope in the new buyers and so resorted back to their old ways of doing things. More! As I noted before, the light-sandy soils of 2007 that could not produce any meaningful maize crop, we enriched the soils through composts but these were not nourishing the soils enough to our satisfaction. We reflected on what our expert then **GC** taught us about liquid manure and this was the 'miracle-water' that took us to competitive levels in 2016-2017 and to agro-industrial market in 2018. So with liquid manure and irrigation, we fully moved from being rain-fed subsistence to small scale market based farmers, we realised our dream to move towards organic farming and a three crop cycle.

FCS 3, LN: A similar fate was faced by community-based farmers in another nearby village (**W**), they were advised to produce garlic which they honestly did in very large quantities. But they were all stuck with the crop as they did not have the knowledge where to market it. So our question is why recommend a market based product without proposing the market?

CD: That is sad to hear.

FCS 3, LN: More, we had accumulated over a million black polythene bags for the community gumtree production project since we did not want our community members to be constrained by lack of such resources. But in 2014, we were notified by our main buyers that the black plastics had been condemned and so they were not going to buy from us since the packaging had changed. They did not

give us the new packaging except that they hinted it needed to be imported. This was the end of the tree seedling project, with the plastics in stock, people on the ground, some of whom were still willing to continue with the work, but that was a complete shut out.

CD: Are there any other challenges that you want to share with me today?

FCS 3, MM: At times there are just too many donors around with many projects on offer to us as a community. Some of the projects we can see straight from the project inception that they are not even viable in our village and community. But we just accept the projects because we do not want to scare away donors. 'Tomorrow' we will need their help in other projects. If we sound 'impossible', they will not sponsor our village in times of need. The donor and government agents train us but they do not give us enough knowledge on markets. We lost much of our peas-crop due to lack of knowledge on markets, at the inception of the project, they all played delaying tactics without coming out in the open that they did not want our product until the product over-ripened and was subsequently out of season. Imagine how much we lost in terms of transport costs, labour and productive time, going to a market that kept giving demands and promises but not taking your product until it is out of season. That was a way of pushing us out of business. More! Since we had gained experience in producing gum tree seedlings each year the goal posts kept changing. The following year you try to do the indigenous trees, only to be told, 'we take exotic or a specific type of indigenous tree', which you had not heard of in time. The following year you then attempt to do both at the same space and time and the exotic trees get diseased in the process and none are taken by the market. We tried to negotiate on why the market was not alerting us at the beginning of the year on which tree seedlings the government and the donor agents were interested in and at what price. That information was not always available to us.

CD: That's sad. Thank you so much, we will talk about these issues next time.

Interview with FCS 11, JC on 16 July 2017

CD: Morning FCS 11, JC. I hope I find you well. We have met again. Can you take me through the road that you have taken in dendrology? What inputs do you have that enable you to do the functioning of dendrology at your new site in MC province?

FCS 11, JC: The road towards dendrology was not straight forward (non-linear) but one full of reflections, sharing of ideas, personal experience and so on. It started way back in 2008 when I attended a briefing on the inception of a tree seedling project that was rolled into our village in 2008. I reflected on the advantages and disadvantages of joining such a project. We accepted to join in the project. I learnt a lot from that project and more, I learnt of the tensions that the youths faced and so I started my own project in MC province with less challenges. We have three permanent water reservoirs from earth constructed ponds at the new household. We also have a water pump to help pump water from the reservoirs into a network of hosepipes in order to water our big exotic tree nursery project. You know gum trees need a lot of water. We water the tree seedlings twice a day, in the morning and towards the evening. We acquired 45 000 polythene bags from CD in 2015.

CD: That is interesting.

FCS 11, JC: In 2009 I started my own gum tree production as a backyard venture. From this backyard venture in Harare then, I managed to get some contracts with some tobacco farmers in 2014-2015. By 2015-2016 we got much bigger contracts with the tobacco companies themselves and this demanded a larger piece of land, more water supply, more labour since tree seedling production is labour intensive, and many plastic pots were needed too. CD provided us with 45 000 polythene black plastic pots for a start and so we moved to establish the gum tree seedling venture in MC province which is a province near most of the tobacco farmers we intended to supply the tree seedlings. I also moved from doing things at a small scale to a medium scale. I moved from funding the project using personal and family resources to accessing bank loans and that showed that I was now being recognised.

CD: What lessons did you learn from the previous project that was run by the youths?

FCS 11, JC: We learnt many lessons from the 2008 project. But we also learnt that most of the agents be they government or non-government are very supportive of the tree projects at the inception of the project but there are always hurdles at the marketing stage of the project. You see we learnt a lot. The buyers would telephone us saying put 50 000 tree seedlings by the school yard or by the roadside so that a big truck would come and collect for a big market which would never happen in time. Day one,

the truck doesn't appear, day two, it doesn't, day three it doesn't again. This could go on. Day 7 maybe, when almost 30-40% of the tree seedlings are now lost, the big truck finally comes, the people condemn 30% and takes only 70%, if you are lucky. This was a common pattern that made most farmers abandon the project. Thus the tree nursery project by the youth had many challenges especially from marketing, I reflected that I needed to start by recognising the market, sign genuine contracts then resume production. More! I learnt together from and with the youths and other villagers since 2008, on how to produce quality tree seedlings and how to market the trees. I was one of the 52 communal members who performed different tasks in the tree seedling project in Muchena village. I learnt how to procure the seed, do the potting, seeding, thinning, trimming of roots and disposition of the final product to the market and how to care for leftovers through root-pruning. As a participant, I continued to reflect on what exactly I might need in order to start my own gum seedling project [also called commodity or inputs or means]. More I learnt from the youths, on how they struggled with the market from verbal contracts that were not binding. The buyers told them that they were coming they don't come until the tree seedlings now by the roadside go to waste. I reflected on that. In my new venture I start by signing a binding contract with the buyer then do the product.

CD: Thank you so much for your insights.