INDIGENOUS KNOWLEDGE FOR AGRICULTURAL DEVELOPMENT: A FRAMEWORK FOR POTATO FARMING IN BUI DIVISION, NORTH WEST REGION OF CAMEROON

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A thesis submitted in fulfilment of the requirements for the degree of Doctor of Business Administration in the Faculty of Business and Economic Sciences at the Nelson Mandela University

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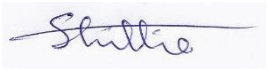

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DEDICATION

This degree is dedicated to my parents Mr/Mrs Ngala Clement Shillie and to my daughter Fomefiyin Davina Peteers Shillie

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ABSTRACT

Over the years, people have planned and carried out their activities depending on their indigenous knowledge base. In agriculture, documented importance of indigenous knowledge has been noted in different ways such as in crop health management, soil nutrient management, food processing and food preservation. Indigenous smallholder farmers across the world have developed techniques that reflect their intimate knowledge of their local environments and ecosystems to improve their agricultural yields and minimise postharvest losses. However, such indigenous knowledge techniques are rarely documented or enhanced to boost agricultural practice and ensure food security.

The present study has identified potato farming in Cameroon as a potential contributor to the socio-economic development of farmers, their communities and their country. The potato farming industry largely consists of smallholder farmers, predominantly women, producing primarily of immediate consumption. Historically, these farmers have been sustaining their farms through indigenous knowledge and practices that are not being exploited to the fullest beneficial opportunities for these farmers. It has often been suggested that Western highly mechanised approaches should be implemented to commercialise these farms in order to access these benefits. These approaches of mechanisation require large capital outlays, which these smallholder farmers cannot afford, hence the approach taken by the present study to capitalise on the indigenous knowledge and practices of these farmers.

The present study argued that working with the existing indigenous knowledge and practices of these farmers, a level of commercialisation, with the resulting job creation and economic benefits, could be achieved.

This study has succeeded in identifying the causes of postharvest potato losses on the smallholding farms, the obstacles in reducing these losses and the techniques to reduce these losses. The study provides important recommendations to improve

smallholder potato farming in Cameroon. By implementing the findings of this study, the Cameroon government, prospective potato farmers, entrepreneurs, traditional authorities and NGOs could make a significant contribution to the improvement of socio-economic conditions and the reduction of poverty levels in these farming communities.

Keywords: Indigenous Knowledge Systems; Agricultural Commercialisation; Postharvest Loss, Socio-economic Development

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ABBREVIATIONS

ACEFA	Programme for the Improvement of the Competitiveness of Agro-pastoral Farm Families
ATP	Agricultural Training Project
CAMGEW	Cameroon Gender and Environmental Watch
CEEPA	Centre for Environmental Economics and Policy in Africa
CIP	International Potato Centre
CPB	Context, practice and belief
DDARD	Divisional Delegation of Agriculture and Rural Development
FAO	Food and Agriculture Organisation
IEK	Indigenous Ecological Knowledge
IFAD	International Fund for Agricultural Development
IFOAM	International Federation of Organic Agriculture Movements
IK	Indigenous Knowledge
IRAD	Institute for Agricultural Research for Development
MINADER	Ministry of Agricultural and Rural Development
MINEPIA	Ministry of Livestock, Fisheries and Animal Husbandry
NIS	National Institute of Statistics
NGO	Non-governmental organisation
PACA	Agricultural Competitiveness Project
SOPISDEW	Society for the Promotion of Initiative in Sustainable Development and Welfare
UNFCCC	United Nations Framework Convention on Climate Change

UNIDO	United Nations Industrial Development Organisation
UNPFII	United Nations Permanent Forum on Indigenous Issues
WBG	World Bank Group
WFP	World Food Programme
WIPO	World Intellectual Property Organisation

CHAPTER 1

SCOPE OF THE STUDY

1.1 INTRODUCTION

Over the years, people have planned and carried out their activities depending on their indigenous knowledge base. Such knowledge has been used in different aspects of life such as health care, construction, communication and exploitation of resources. As stated by Warren (2001), every society has indigenous knowledge mechanisms that provide the basis for decision-making and the development of techniques for coping with current problems. Barasa (2007) defines indigenous knowledge as holistic tradition, scientific knowledge of a people, land, natural resources and environmental development over time resulting from the inter-relationship of the people and their natural environment. Based on this definition by Barasa (2007), agricultural practice and development in the respected communities across the world can be linked to the indigenous knowledge base of the people in those communities.

In agriculture, indigenous knowledge has been utilised in different ways such as in crop health management, soil nutrient management, food processing and food preservation. Indigenous agricultural practices are noted to have helped smallholder farmers in ensuring good yields as a means of food security and nutrition in preserving their harvest and benefiting from higher prices during off-farming seasons (Govinden, 1984). Various studies (Govinden, 1984; Zimmer, 1998; FAO, 1996;Misiko, 2007) have also demonstrated that indigenous agriculture positively contributes to reducing environmental degradation. For instance, a study by Misiko (2007) asserts that indigenous farmers in Kenya have used intercropping and rotational cropping to improve soil fertility and to combat environmental degradation.

In Cameroon, as in many countries in Africa, indigenous agriculture plays a very important role in developing the agricultural sector. A greater contribution can be made to developing agriculture if indigenous agricultural practices are encouraged and developed. In this study, the researcher examines indigenous practices that can be advanced or developed to minimise postharvest losses (loss due to physical damage to crops and consequently financial losses to farmers) in potato farming in Bui Division, North-West Region of Cameroon. The study is centred within the framework of value addition in agriculture with a focus on the role of indigenous knowledge in agricultural development. The study argues that if advanced, some important indigenous potato farming practices can contribute to minimising postharvest losses.

1.2 BACKGROUND TO THE STUDY

In Cameroon, agro-processing is considered a “sunrise sector” of the economy despite its large potential for growth and socioeconomic impacts on employment, income generation and foreign exchange earnings. In spite of the importance of agriculture, commercial processing of produce is significantly low. This has resulted in postharvest losses due to physical damage to crops in the agricultural sector, most significantly in potato farming (MINADER, 2016).

This study seeks to examine indigenous techniques that can be applied to prevent qualitative and quantitative damage postharvest in potato farming in Bui Division in the North-West Region of Cameroon. The problem stems from the fact that potato farming in Bui Division and in most parts of Cameroon, registers very high postharvest losses (loss due to physical damage to crops and consequently financial losses to farmers), and is practised by smallholder farmers using indigenous techniques. This is a problem largely ignored by the government.

According to the United Nations Industrial Development Organisation (UNIDO, 2006), the sectors involved in the processing and preservation of local products of mass consumption, which are mostly agricultural products, are not well developed in Africa. To date, the situation remains the same in Cameroon with postharvest losses posing a serious problem, affecting incomes of resource-poor smallholder farmers and thus the socioeconomic livelihoods of the people of the country at large (MINADER, 2016).

Estimates suggest that global postharvest losses (qualitative and quantitative) are about one third of global food production (FAO–World Bank, 2010; Prusky, 2011). In this light, two fundamental questions that need to be answered are: How much food is lost and wasted in rural communities in Cameroon today?; and how can these losses be minimised? These questions apply to the entire agricultural industry and especially to perishable crops like potatoes. Thus if food security in Cameroon must be enhanced, urgent attention needs to be given to the postharvest losses.

Enhancing potato production is desirable and necessary in order to contribute significantly to food security, nutrition, income generation and enhanced livelihoods of potato farmers in Cameroon. A very important method of realising this objective is to promote indigenous practices. Indigenous farming practices have been largely ignored in Cameroon (Takoutsing et al., 2012). This study argues that identifying and advancing effective indigenous farming practices can contribute significantly in the fight against food insecurity in Cameroon.

According to the 1995 evaluation report of the United Nations Agenda for the Development of Africa in the 1990s (United Nations, 1995), when the development process is rooted in people's indigenous system of rationality and creativity, emerging solutions will more often be quite different and long-lasting. Therefore, enhancing the indigenous knowledge systems utilised in potato farming

by the people of Bui Division in relation to value addition and reduction of postharvest losses will significantly affect the agricultural industry of the region and will cater for sustainable food security.

In Bui Division, farmers are semi-subsistence, smallholder-orientated and have in-depth knowledge of indigenous practices. Improving the potato value chain through indigenous knowledge-based systems depends on human beings and their interaction with the environment, which relates to the indigenous knowledge that has been passed down from generation to generation through family members and communities (Barasa, 2007; Warren, 2001).

According to Akiiki (2006) and Mascarenhas (2004), in developing countries including Cameroon, the inadequacies in the approach for managing knowledge reduces the ability of isolated individuals to take advantage of generally available indigenous skills to improve their farming activities. According to Ngulube (2002), the fact that extension workers prefer using exogenous knowledge gives little room for the indigenous knowledge resources of the community to be merged with rural knowledge and information systems. Studies (see Karlsson, 1995; Thrupp, 1989) maintain that greater emphasis is needed to manage these indigenous knowledge systems in a systematic way, similar to other knowledge systems, before they disappear, considering that failures in the indigenous knowledge systems may have a negative effect on rural development.

Because many rural smallholder farmers live on the margins of food insecurity, reducing food losses can result in an immediate and significant impact on rural livelihoods (FAO, 2008). This study is based on the foundation that indigenous methods of potato processing and preservation have not been advanced or developed in order to minimise postharvest losses. In addition, indigenous techniques of potato cultivation are grossly undervalued and are not

widely known, even to policy makers (Mushi, 2008; Lwoga & Ngulube, 2008; Moyo, 2010).

According to Altieri, Nicholls and Montalba (2017), it is necessary to understand indigenous agriculture for it can be helpful in designing sustainable agricultural systems to remedy the shortcomings associated with modern agriculture. Ahmed, Sanders and Nell (2000) contend that the completion (evolution) of culture and environment results from local agricultural systems, so that enhancing indigenous practices in potato farming can be of help in ensuring sustainable food production. Altieri, et al. (2017) and Ahmed et al., (2000) thus suggest that better ways of enhancing agricultural production systems and minimize postharvest losses may be through building on an indigenous knowledge base.

Nevertheless, scholars have divergent viewpoints concerning the value of indigenous knowledge. Some argue that indigenous knowledge has much potential that needs to be exploited, while others claim indigenous knowledge lacks capacity. For instance, Ross et al. (2011) posit that indigenous knowledge has the capacity to help in the sustainable development drive including the management of natural resources. By contrast, some scholars argue that indigenous people depending on their indigenous knowledge cannot change anything for societal benefit implying that indigenous knowledge cannot have any effective impact on sustainable development and natural resource management (Murdoch & Clark, 1994).In spite of these arguments, the underlying issue is the fact that scholars see value in indigenous knowledge. The researcher is this study argues that such value needs to be studied and advanced for societal benefit.

Briggs (2005), however, quotes a smallholder farmer in Tanzania who asks: “If indigenous knowledge is so good, why is my farm so poor?” In so doing, Briggs (2005) presents the limitations of indigenous knowledge to agricultural practice. For

instance, according to Briggs (2005), the use of shifting cultivation and mixed cropping has resulted in a reduction in the productive capacity of farming land. Further, Briggs (2005) argues that indigenous farming practices such as fallowing and the slash and burn of land after each farming cycle, have negatively affected the survival of wildlife and biodiversity in general. For such reasons, indigenous knowledge is viewed as not fully supporting agricultural development. There is need for agricultural extension workers to collaborate with farmers so that best practices may be fostered.

More interesting is the limitation of indigenous knowledge-based techniques to handle the adverse effects of climate change. Scholars such as Ziervogel et al. (2006), and Zoellick (2009), have argued that the limited capacity of indigenous knowledge in the face of climate change has adversely affected agricultural production, especially in Africa where agriculture is still highly dependent on indigenous knowledge. The advent of climate change has resulted in shifts in rainfall patterns (Zoellick, 2009), making agricultural yields poor and increasing the vulnerability of smallholder farmers whose agricultural practice depends largely on indigenous knowledge techniques (UNFCCC, 2007). Judging from the reports (see OECD/FAO, 2016) on projected falls in crop yields in Africa by the year 2025, as a result of climate change, further show the extent to which indigenous agricultural practice may become unimportant with growing climate change. To overcome this challenge, and coupled with the resource-constrained setting of smallholder farmers in Africa, there is an urgent need for concerted efforts towards enhancement of indigenous knowledge with Western knowledge-based techniques so that smallholder farmers may have enough to feed themselves and their families.

Indigenous knowledge provides effective and sustainable alternatives to farmers especially in rural areas. Agricultural practice, processing and preservation in most areas in the developing world are still very dependent on indigenous

knowledge practices. As noted by Ofor (2011), innovative food preservation techniques such as canning, pickling, irradiation, pasteurisation, smoking, and the addition of chemical additives or spices used globally are not affordable or practicable for the resource-poor smallholder farmers. This makes it important for indigenous practices in agriculture to be encouraged. Also, indigenous agricultural practices have been observed to be very effective in fighting climate change as diversity of traditional crop varieties and practices play an important role in building resilience to climate change (UNPFII, 2011).

There is growing interest in indigenous knowledge in the fields such as medicine, human health, soil science, agriculture, management, forestry, sustainability development (Agrawal, 1995). As a result, emphasis is being placed on indigenous knowledge by both local and international organisations. It is becoming clearer that indigenous knowledge has the capacity to help global efforts towards sustainable natural resource management and development (Ross et al., 2011).

Indigenous knowledge holds assurance for agriculture, food security and sustainable development (Agrawal, 1995; World Bank, 1998).Agrawal (1995) argues that indigenous knowledge is cost-effective and sustainable and could possibly facilitate development in all aspects of life. Such arguments uphold the value of indigenous knowledge and the need for such knowledge to be studied and advanced.

Trung, Le Xuan and Vu (2007) provide evidence of the importance of indigenous knowledge from their study in Vietnam. They found that 54 ethnic groups in Vietnam had a solid indigenous knowledge base, which created a strong relationship between the local culture and natural resources, and had helped protect biodiversity. Trung et al. (2007) explained that in the village of Ban Buahis in Vietnam, ritual forest practices helped maintain an ecological balance as the

villagers knew what they could collect from the forest and at what time (they collected wood in the form of dried branches and fallen trees). This model was reported to have been used by the government of Vietnam to create community forest management systems based on indigenous knowledge.

Furthermore, Claxton, (2010) illustrated the importance of indigenous knowledge with evidence from maize farming in the district of Dong Van in the northern region of Vietnam. According to Claxton (2010), in this rocky mountain region, farmers built pockets filled with enough soil in the lower levels of the mountain as well as the high levels and plant maize. By the evaluations made by Claxton (2010), this indigenous knowledge maize farming technique of using pockets was less expensive than modern techniques in this area. Claxton (2010) highlighted the fact that the maize grown through this technique was reported by farmers to be more delicious. Similarly, Davis and Ebbe (1993) maintained that despite the merits of modern technology such as its ability to solve the problem of food and fibre needs, the high cost associated with it made indigenous knowledge far more important, especially to resource-poor smallholder farmers.

Indigenous knowledge has also been reported to have an interesting influence in the field of medicine. For example, the World Bank (2002) reported that Vietnam has around 3830 different medicinal plants which are being used to heal diseases such as malaria, and headaches. Further, these plants contribute to fighting hunger and poverty as the local people collect and sell them. In this regard, indigenous knowledge provides a basis for community problem-solving.

Koochkeki and Reza (2005) explain how in Iran, farmlands and ecosystems are managed based on indigenous knowledge. With water shortages in Iran, farmers have been able to use their indigenous knowledge techniques to extract underground water and have been using it for growing black cumin. The choice of black cumin is based on their experience in that the crop has a short cropping

period and does not need a great deal of water during the growing process. This buttresses the importance of indigenous knowledge in agricultural practice in the arid areas.

However, as noted by Angioni (2004) and McGregor (2010), indigenous knowledge has a distinct lack of authority when compared with Western culture in creating local development and management plans and demonstrating lasting positive results, especially in agriculture. In a similar way, Vasquez (2011) explains that in the United States, although indigenous knowledge has been utilised in resource conservation efforts within native communities, very little application has been done in agriculture.

From the aforementioned, indigenous knowledge is involved in the practical and everyday demands of life, increasing the need for it to be explored, even recognised, enhanced and to acknowledge its importance (Leach & Mearns, 1996; Pottier, 2003).

1.3 PROBLEM STATEMENT

In Cameroon, agriculture is the predominant economic activity. Agricultural practices are largely indigenous, passed on from generation to generation. The fact that indigenous agricultural practices have prevailed in Cameroon is an indication that they are effective in promoting agriculture. Unfortunately, there are few structures that identify and promote these practices. In addition, like in other countries (Australia, India) Cameroon is yet to carry out a study on indigenous agricultural practices. Thus, this study is the first in Cameroon on indigenous agricultural practices. Training of agricultural and extension service staff has ignored the potential of indigenous knowledge and has focused more on Western knowledge techniques. As a result, the Cameroonian agricultural sector continues

to remain underdeveloped. One of the major challenges confronting the agricultural sector is postharvest losses, especially in the potato sector.

In Cameroon (as may be the case in other African countries), the dependence of agricultural production on climatic changes implies that variability in output cannot be totally avoided. Potato is perishable, cultivated in farms located in the inlands where roads are very muddy and inaccessible, harvested during the rainy season and to avoid fast spoilage farmers usually do not transport it under the rains. Therefore, to reduce postharvest losses especially during harvest time, adequate on-farm preservation/storage is critical; primarily to provide farmers with food beyond the harvest period and also to boost household incomes considering that prices of agricultural products are usually high during off season. Noting that Western storage and preservation technology is not available, village level storage including on-farm storage is done using indigenous knowledge and skills. This thus calls for a need to enhance indigenous knowledge based techniques and practices being used in preserving the perishable potato tuber in Bui Division North West Region of Cameroon.

Unfortunately, the absence of policies, structures and research projects to identify, acknowledge and promote indigenous practices in farming in Cameroon, has resulted in high postharvest losses, negatively affecting food availability especially during off seasons. For example as noted by Cameroon Tribune (2015), the agricultural sector in Cameroon records about 25% of postharvest losses. Further, as highlighted by WFP and FAO (2011), at any given time, at least 30 percent of Cameroonian households in rural and urban areas remain vulnerable to food insecurity. Also, high postharvest losses results in low incomes to farmers as such negatively impacting on their socioeconomic livelihood conditions and brings about food insecurity especially during off seasons. Also, the employment potential of the agricultural industry is reduced resulting in high poverty levels in the country.

Therefore, this study seeks to identify indigenous agricultural practices that can be enhanced to minimise postharvest losses in potato farming and enhance food security. The study took place in Bui Division in the North-West Region. Potato is one of the main crops cultivated in Bui Division and the most affected by postharvest losses. It is estimated that over 500 tons of potato is wasted annually owing to lack of effective preservation and processing methods (Cameroon Tribune, 2015).

This study maintains that there should be special focus on advancing indigenous knowledge and practices in transforming potato farming in Bui Division, since it is the main agricultural activity in the area with ecological conditions in the area relatively suitable for high yields. Unfortunately, the potentials of the crop have been largely undermined, cultivation is still largely subsistence employing very rudimentary methods and tools with high postharvest losses due to disease attack. Considering that innovative food preservation techniques such as canning, pickling, irradiation, pasteurization, smoking, and the addition of chemical additives or spices, that are used globally, are not affordable or practicable for the resource-poor small holder farmers (Ofor, 2011) least-cost preservation strategies need to be identified. Indigenous people over the years have developed and used different strategies and mechanisms to minimizing post-harvest losses especially for perishable products like potatoes. These strategies are least-cost and include different indigenous techniques of production, processing, preservation and storage some of which have not received much attention from policy makers. Rural household food needs have been and continue to be highly dependent on preservation done mainly in indigenous ways with knowledge acquired from experience and passed on from generation to generation. Despite its wide use in rural areas, indigenous knowledge practices in potato preservation/processing in Bui Division have not been studied so as to identify its strengths. Thus it is

necessary to study the potato value chain by dwelling on the efficacy of the various indigenous strategies of preservation and processing.

Therefore, the researcher maintains that an insightful examination and capitalization on the indigenous knowledge techniques of potato farmers in the Bui Division, North West region of Cameroon, will to a large extent reduce postharvest losses in that sector. Such insights will add value to the cultivation of potatoes and revive the agricultural economy of the region and the nation at large. This study will thus serve as a frame of reference not only to indigenous potato farmers in Bui Division but also for further studies in other crops across the world. Indigenous smallholder farmers in Bui Division may have an in-depth understanding of the efficacy of indigenous techniques they have been utilising to minimise postharvest losses in potato farming.

1.4 RESEARCH QUESTIONS

Against the background of the preceding literature review, the following research questions were formulated:

(1) What is the nature, extent and impact of potato postharvest losses in the Bui Division on the agricultural economy of Cameroon?
(2) What indigenous practices do potato farmers in Bui Division use to prevent postharvest losses?
(3) How could these indigenous practices be enhanced to prevent these postharvest losses?

1.5 RESEARCH OBJECTIVES

The primary objective of the study is to contribute to the growth of Cameroon's agricultural economy by investigating how indigenous knowledge and practices could be consolidated and enhanced to reduce postharvest losses in that country's potato farming sector.

To achieve this primary objective, the following secondary objectives were pursued:

(1) To conduct a comprehensive literature study on the potato farming sector of Cameroon;
(2) to gather data, using the appropriate research design, on the nature, extent and impact of potato postharvest losses in the Bui Division on the agricultural economy of Cameroon;
(3) to capture and analyse the gathered data;
(4) to record and interpret the research findings;
(5) to discuss the research findings with the aim of consolidating the insights gained into indigenous practices used to prevent postharvest losses; and
(6) to develop a framework for postharvest loss prevention for the potato farming sector of Cameron.

1.6 METHODOLOGY OF THE STUDY

1.6.1 Research paradigm

The study is located within the interpretivist research tradition in which a qualitative methodological paradigm is followed. Data collected in this paradigm are usually in the form of words, phrases, descriptions, themes and trends, as opposed to the quantitative methodological paradigm, in which statistical

calculations are made from numerical data (Babbie & Mouton, 2014). Data are collected through techniques such as open-ended questionnaires, interviews, focus groups, visual observations and written text. Through close contact with indigenous farmers in Bui Division, the researcher developed a profound understanding of their situation through visual observations and individual interviews. Interviews were also conducted with selected staff members in the Cameroon Ministry of Agriculture, staff of NGOs working with farmers, traditional authorities and other community opinion leaders.

1.6.2 Setting

The study site is Bui Division, located between latitude $6^{o}00$ to $6^{o}20$ north of the equator and longitude $10^{o}30$ to $10^{o}60$ east of the Greenwich Meridian. Bui Division is a huge plateau within which passes the Cameroon volcanic line and hosts the highest summit (Mount Oku) in the western highlands of Cameroon. This area has two seasons – the dry and the rainy season. The rainy season runs from March to October and the dry season runs from November to February.

Administratively, Bui Division is located in the North-West Region of Cameroon. It is made up of six subdivisions: Kumbo, Oku, Jakiri, Noni, Nkum and Mbiame. The traditional setup is also very strong with four main *Fondoms (Fondoms are a combination of different villages other the control of a Fon),* namely the Nso, Oku, Mbiame and Noni. Socio-cultural and economic life is fairly evenly distributed throughout the division although there is a concentration of business life in the divisional headquarters.

Bui Division has an agrarian profile and is thus a reasonably representative sample of Cameroon as a whole. Agriculture in this area is organised at the household level, with the community playing supportive roles such as in seed

exchanges, and in taking decisions on when planting and harvesting should start. The smallholder nature of farming activities grounded on indigenous knowledge makes the area a suitable choice as a field laboratory to explore the interplay of indigenous experiences and interventions which affect local farming practices in the sense of minimising postharvest losses in potato farming.

1.6.3 Sample population and sampling technique

The sample population includes farmers, workers in the Ministry of Agriculture, staff of NGOs working with farmers, traditional authorities and other community opinion leaders. The multistage sampling technique was utilised in the selection of respondents for the study. The first stage involved the purposive selection and mapping of the main potato production zones in the study area. After the production zones were identified and mapped, the second stage was then the purposive selection of study participants. This was done based on the fact that the participants are indigenous and are involved in potato farming.

1.6.4 Data collection methods

Data collection was conducted through direct interaction with individuals (participant and field observations), individual interviews and focus group discussions. Data was also collected through open-ended questionnaires from 360 potato farmers.Interviewees included 15 officials of the Ministry of Agriculture and Rural Development, 15 staff members of NGOs and other institutions that support agriculture and 15 traditional authorities.

1.6.5 Methods of data analysis

In this study, the researcher used the thematic network analysis as the analytical technique. After collecting data, the researcher prepared memos (short notes that captured the essence of what the researcher learned) and labelled the data. This was followed by analysing contextual and demographic data, which leads to data coding. After the data had been coded, there was a review of the coded data. By looking at the various responses to the various questions posed, the researcher found specific words, ideas and common issues that recurred. The various responses were then summarised into three main themes (basic themes, organising themes and global themes). As themes emerged from the data, the researcher continued the data review, carefully searching for negative instances of the patterns.

1.7 DELIMITATIONS OF THE STUDY

This study investigates solely indigenous knowledge practices as utilised in potato farming in Bui Division, North-West Region of Cameroon. The main investigation parameter of the study is on postharvest management (that is, indigenous practices utilised to minimise postharvest losses in potato farming).

Therefore, although this study consists of value-addition activities, it does not focus on calculating the value added by the indigenous farmers. Though other crops are mentioned, the study is crop-specific in nature. This is because the interest of the study is specifically focused on potato postharvest losses.

Western or modern practices in potato farming, processing and preservation do not constitute a fundamental aspect of the literature reviewed in this study. However, some literature reviewed in this study makes mention of Western practices to illustrate how the constrained resource setting prevents smallholder

farmers from adopting such methods, showing the necessity of studying, identifying and advancing the indigenous knowledge practices in this setting.

Commercial operators who only engage in buying and selling potatoes did not constitute part of the study population. Likewise, farmers who cultivate potatoes using Western knowledge techniques such as application of fertiliser were not included in the study. The researcher excluded them because their practices in relation to potato farming, processing and preservation are not traditional but foreign, and thus not within the scope of the study.

Young people less than 35 years of age and migrants who had resided in the study area for less than 15 years were not included in the study sample. The researcher considered their indigenous knowledge base and experience in potato farming activities to be inadequate in relation to the stated research questions which address the stated study objectives.

Regarding study methodology, quantitative methods such as random sampling, the use of questionnaires as well as inferential statistical techniques were not adopted in this study. This was motivated by the fact that such quantitative methods will not provide appropriate and in-depth data needed to address the stated study objectives. For example, random sampling could result in sampling somebody who was not involved in potato farming, and who had very little or no knowledge of the indigenous practices utilised in potato farming, processing and preservation.

Bui Division was selected as the study site because the area is entirely devoid of industries; agriculture constitutes the main source of livelihood. The traditional setup in this area is still very strong, with traditional authorities in some cases commanding more authority than political authorities. Bui Division in practical terms is the highest potato-producing division of Cameroon. Farm

holdings in this area are small in nature and agricultural practice is highly if not totally dependent on indigenous knowledge.

1.8 LAYOUT OF THE STUDY

This thesis is divided into five chapters. Chapter 1 introduces the study and the problem the study seeks to examine, as well as discussing the scope of the study. Chapter 2 is a review of the theoretical underpinnings on which the research is built, highlighting successes and challenges of indigenous knowledge in agricultural practice across the world. In this chapter the researcher also reviews literature related to the main concepts of the study such as indigenous knowledge, agriculture, postharvest and postharvest loss. In Chapter 3 the researcher presents the choice of methods and justifies the reasons for those adopted in the research. The characteristics of the study area and its relevance for the study are detailed. Chapter 4 is a presentation of the study's findings. This chapter examines indigenous knowledge-based practices utilised to minimise postharvest losses in potato farming by smallholder indigenous farmers in Bui Division. Chapter 5 is the discussion of study results and provides a framework for the enhancement of indigenous knowledge techniques so as to minimise postharvest losses in potato farming in Bui Division. Also Chapter 5 concludes the study and makes recommendations based on the study's findings.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This study seeks to examine indigenous techniques that can be enhanced to prevent postharvest losses in potato farming in Bui Division in the North-West Region of Cameroon. The problem stems from the fact that potato farming in Bui Division and most parts of Cameroon registers very high postharvest loss – a problem which is largely ignored by the government. Nevertheless, potato farmers have adopted local methods to minimise these losses. This study thus examines the efficacy of these methods and their improvement in preventing losses in potato farming. In this chapter, the researcher has reviewed contemporary studies relevant to the research.

The chapter is divided into four sections. In section A, the researcher discusses the main concepts in the context of the study. Section B is a focus on potato farming as an industry; it also reviews literature on the evolution, types, nature and challenges in potato farming. Section C presents a review of literature on indigenous knowledge with a focus on agriculture and section D discusses the theoretical framework of the study.

2.2 SECTION A: CONCEPTUAL DEVELOPMENT

Different authors have different ways of defining and using concepts based on situations applicable to their studies. In a similar manner, the concepts discussed below are applicable to the context of this study.

2.2.1 Agriculture

The word agriculture is derived from the Latin words *Ager* (land or field) and *Cultura* (cultivation). From these Latin words, different scholars have defined agriculture from different perspectives. However, the different definitions have a single point of convergence which holds that the ultimate purpose of agriculture is for food production, or for economic gain or profit. This implies that no single definition can suit everybody for all purposes. However, this study adopts the following definitions of agriculture.

The 1947 Agriculture Act of the United States of America (USDA, 2015: 35), defines agriculture, as including “horticulture, fruit growing, seed growing, dairy farming and livestock breeding and keeping, the use of land as grazing land, meadow land, osier land, market gardens and nursery grounds, and the use of land for woodlands where that use ancillary to the farming of land for Agricultural purposes”. Based on this definition, agriculture cuts across different spheres and its practice depends on prevailing local environmental conditions.

The ILO (2007) and ILO (1999) define agriculture from different perspectives which include nurturing of animals, plants and fungi for food, fibre, biofuel, medicinal plants and other products with the aim of sustaining and enhancing life. This definition shows that agricultural activities are carried out to satisfy human needs and therefore different needs will determine which agricultural activities are necessary.

According to Rimando (2004), agriculture is basically an organised raising of useful plants and livestock by man. This definition assumes that agriculture is an organised activity and will vary from place to place. Similarly, Rubenstein (2003) defines agriculture as a deliberate act aimed at modifying the earth's surface through the cultivation of crops and the raising of livestock for sustenance or economic gain.

USDA (2012) defines agriculture as the practice of making use of biological processes on farms to produce food and other products needed by man. Therefore, agriculture is both a “way of life” and a “means of life” for its stakeholders. The FAO (2011) provides a definition which broadens the scope of agriculture beyond plants and animals to include fisheries and forestry.

These definitions indicate that agriculture is a purposeful practice by man based on the prevailing elements of nature, aimed at satisfying human needs. Furthermore, these definitions indicate that the practice of agriculture may be interwoven with other practices; therefore agricultural practice is an art, science and a business.

2.2.2 Indigenous agriculture

As it is with the various definitions of agriculture, indigenous agriculture has also been viewed in varied ways. According to Pace (2015), indigenous agriculture or farming is the conduct of agricultural activities based on people’s cultures that are deeply connected to particular places.

According to Jha (2008), indigenous agriculture is an extremely chance-dependent agricultural system in which the practices of the people are dependent on natural occurrences, some of which the people have difficulties in predicting. By this definition, Jha (2008) argues that farmers engaged in indigenous agriculture depend largely if not entirely on nature.

From a practice-learning perspective, Waters-Bayer (1992) defines indigenous agriculture as farming and land use practices of a people based on generations of experience, informal experiments and intimate understanding of the biophysical and socio-cultural environment in which they operate.

It is evident from these definitions that the connection between culture and land shapes indigenous agriculture by creating practices that are environment- and context-specific, and that work with existing natural processes.

2.2.3 Potato

According to the FAO (2009), potato (*Solanum tuberosum*) is a vegetable, an edible tuber of a cultivated plant. There are basically two types of potatoes, namely Irish potatoes and sweet potatoes. As stated by FAO (2009), sweet potatoes (*Ipomeabatatas*) belong to a botanical family called *Convolvulaceae* while Irish potatoes belong to the botanical family *Solanaceae*. Though both are called potatoes, Irish potatoes are tubers, while sweet potatoes are simply regarded as swollen storage roots (Denham, 2013). Denham (2013) stresses that the major difference between Irish potato and sweet potato is that Irish potato tubers grow from eyes or buds that form from within the potato, while sweet potato grows through its stem. The current research focuses on Irish potato. Irish potato has many types which include russet, red, white, and yellow. In this study, the researcher has focused on the white type of Irish potato.

2.2.4 Postharvest / postharvest loss

In agriculture, the term “postharvest” denotes the sequence of activities and operations that are carried out after the crop has been removed from its original state in the field or farm (FAO, 2010). According to the FAO (2009) and Bourne (1977), these activities and operations are either technical (field drying, threshing, cleaning, additional drying, storage, processing) or economic (transportation, marketing, quality control, administration and management).

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Building from his definition of postharvest, Bourne (1977) defines postharvest loss as any loss occurring after harvest and before consumption. De Lucia and Assennato (1994) add to this view that postharvest losses can be measured both quantitatively and qualitatively within the postharvest system.

Some studies (see Parfitt, Barthel & Macnaughton, 2010; Lundqvist, Fraiture, & Molden, 2008; Stuart, 2009; FAO, 2010) have defined postharvest losses from two perspectives, classifying the losses as either food loss or food waste occurring in the postharvest food chain.In these studies, food losses refer to the decrease in edible food mass that originally was intended for human consumption, while food waste refers to the discarded quantities of food appropriate for consumption.

In the present study, the researcher agrees with the views of the above-mentioned scholars and defines postharvest losses as losses that occur due to physical damage to crops and consequently financial losses to farmers.

2.3 SECTION B: POTATO FARMING AS AN INDUSTRY

Potato is one of the world's most important root and tuber crops (FAO, 2009). According to the FAO (2009), potatoes are cultivated in over 125 countries and consumed by over a billion people worldwide. In the developing countries, millions of people depend on potatoes for survival. The ease of cultivation of potatoes and its nutritional value has been noted to be responsible for the expansion of potato production in developing countries, although production in these countries is still low when compared with developed countries (FAO, 2009). In Cameroon, potato is an important crop and ranks among the major crops produced in tons after cassava, plantain, cocoyam, and maize, with the majority of its production being done by smallholders, predominantly women, with most of its marketing being done locally (FAO, 2014).

In the following section, the researcher reviews relevant literature in the context of potato farming. The section begins by capturing the nature of potato production as practised worldwide and then examines the history of the evolution of potato farming in Cameroon.

2.3.1 Nature of potato farming

Most research works (Spencer & Kaindaneh, 1998; FAO. 2009; Fawole, 2007) have identified two main types of potato farming in the world, namely intensive and subsistence agriculture. According to the FAO (2009), the choice of the farming type applied in different parts of the world is dependent on several factors, which include socioeconomic, policy and institutional as well as technical factors.

2.3.1.1 Subsistence potato farming

Tony (2007: 28) asserts that subsistence agriculture is agricultural practice carried out by "subsistence peasants who grow what they eat and live without making regular purchases in the marketplace". .According to this view, subsistence agriculture is a farming system in which the crops produced are mainly for the farmer and his family consumption, but surpluses may be sold in the local market. Further, Tony (2007) describes subsistence agriculture as a hand-to-mouth type of farming where the farmers focus on growing a range of crops and animals needed by the family to feed and clothe themselves during the year. Family needs and traditional norms, customs and values dominate planting decisions.

Generally, subsistence agricultural practice has been closely associated with a low level of economic development. As argued by Brüntrup and Heidhues (2002), subsistence agriculture – which is a dominant agricultural practice in

developing countries – was also widely practised in the developed countries during their early stages of industrialisation. This association of subsistence agriculture with the level of economic development has caused literature on agricultural economics to view subsistence agriculture negatively (Seavoy, 2000).

Brüntrup and Heidhues (2002) define subsistence agriculture as agricultural production devoted to family consumption using rudimentary tools, with high dependence on family labour and natural factors for success. This is very visible in potato farming in developing countries. Concurring with these views on subsistence agriculture, FAO (2009) highlights lack of quality seeds and high prevalence of diseases as being common in subsistence potato farming.

Similarly, Tantowijoyo and De Fliert (2006) report that lack of healthy seed, and many other challenges such as attacks by late blight, bacterial wilt, viruses, and leaf-miner fly have determined that potato farming in Indonesia is largely subsistent in nature. Other important constraints for farmers include potato tuber moth, weeds, unfavourable weather, low soil fertility, inadequate postharvest management, and poor marketing.

2.3.1.2 Intensive potato farming

Intensive agriculture involves a system of farming using high inputs of labour and capital on a relatively small piece of land in order to ensure high outputs per unit area. The techniques used include planting multiple crops per year, reducing the frequency of fallow years, and improving cultivars.

Scholarly works (Brüntrup & Heidhues, 2002; Garnett &Godfray, 2012) have shown that intensive agriculture, including potato farming, is not yet very common in the developing world. According to Brüntrup and Heidhues (2002), intensive agriculture deals with agricultural production which is devoted to commercial

purposes, using adapted machines, with less dependence on human labour and a high utilisation of chemical additives. According to this view, intensive agriculture has been highlighted as depreciating the natural environments where it is practised (Brüntrup & Heidhues, 2002).

As a result of increasing food needs, intensification of agricultural activities has been and is currently being promoted in Cameroon (MINADER, 2014; MINADER 2015). Despite the measures put in place to promote intensive agriculture in Cameroon, it is still largely inferior and unsustainable (MINADER, 2014). According to Garnett and Godfray (2012), with intensive farming systems, current crop yields are maintained thanks to the heavy application of fertilisers. However, Garnett and Godfray (2012) and Duncan, Osborne, Horton and Sinclair(2015), highlight that fertilisers destroy the soil, causing a decline in soil organic carbon, and that the crops produced have negative impacts on health.

Based on such arguments, the question arising is how can potato production be increased to meet global food demands? Seemingly, the disadvantages of too much intensification and preservation using chemical additives point to the need to revisit indigenous techniques that are environmentally friendly and pose fewer health risks.

2.3.2 Historical evolution of potato farming in Cameroon

According to Spooner et al. (2005), potato farming started in Latin America specifically in Southern Peru and in North-Western Bolivia. This crop was later taken across the Atlantic and to Europe in about 1538 (Pitrat & Foury, 2003). As a consequence of the scramble for Africa, the colonial masters then introduced the crop in Africa, with the Germans bringing it to Cameroon (Foncho, 1982; Horton, 1987). As was the case across Africa, the cultivation of potatoes was first resisted by local farmers in Cameroon who believed they were poisonous (Williams, 2007).

In the 1940s, the introduction of new potato types by the British and Dutch governments resulted in widespread cultivation of potatoes in Cameroon (Foncho, 1982; Horton, 1987; Aighewi & Lyonga, 1989). The rich volcanic soils of the western highlands favoured the cultivation of the crop, encouraging farmers in this area to become more interested in the crop (Kemgni, 1973).

As from the 1960s, research programmes on crops in Cameroon began with the objective of introducing new varieties. The Potato Project, established in 1988 under the joint coordination of the Institute for Agricultural Research for Development (IRAD) of Cameroon and the International Potato Centre (CIP), released several potato varieties of potential value. While western-orientated research was being conducted, indigenous farmers through interaction with the community, were also developing their own ways to tackle the challenges inherent to potato farming such as susceptibility to blight.

Reported data over the years by the FAO indicated an increase in potato production in Cameroon from 1980 to 1981, and very erratic fluctuations over the following years (FAO, 2000). However, from 1995 to 2004, FAO data indicates much higher average yields of potato production in Cameroon, with the western highlands accounting for more than 75 percent of the total production thanks to its fertile soils and the farmer-based approach to varietal evaluation (Demo, Njualem & Koi, 2000).

Although the optimal size of seed tubers for efficiency of basic seed production has been investigated and noted to have a significant effect on production (Demo et al., 1998), potato seed from the formal research sector is still very limited in quantity. The result has been the continuous practice of a farmer-based seed system where farmers get seeds from other farmers (Takoutsing et al., 2012). Based on the standpoint expressed by Takoutsing et al. (2012), it appears

vitally important to enhance indigenous practices. Accordingly, there is a need to study the indigenous knowledge systems as utilised by farmers, to be able to identify good seeds for use in the absence of sufficient seed from formal research centres.

2.4 SECTION C: INDIGENOUS AGRICULTURE

It has been reported that the use of western-orientated technical solutions has brought about very little success in the development of Africa, especially in agriculture which is largely smallholder in practice (Chambers, 2008; Briggs, 2005; Pottier, 2003; Briggs & Sharp, 2004). This has led many scholars to attempt an explanation on why smallholder farmers who practise indigenous agriculture have been unable to take advantage of Western technologies in agricultural production. In this light, the FAO (2003) and Beckford, (2002) point out that the nature of indigenous agricultural production systems which are based on survival and subsistence have made smallholder farmers reluctant to take the risk of using technologies that have not proven to be effective.

In the next section, the researcher begins by examining the concept of indigenous knowledge. This is followed by a review of literature on the nature of indigenous agriculture. The researcher also discusses the characteristics of indigenous agricultural systems, their effectiveness and their challenges.

2.4.1 The concept of indigenous knowledge

There is evidence that indigenous people have a range of knowledge which has evolved over time and continuous to evolve. Some of this knowledge has been learned from their ancestors, and some has been arrived at as a mechanism to

meet up with environmental conditions (Barasa, 2007; Owuor, 2007; Johnson, 1992).

Barasa (2007) defines indigenous knowledge as holistic tradition, scientific knowledge of a people, land, natural resources and environmental development over time resulting from the inter-relationship of the people and their natural environment. This implies that the term “indigenous knowledge” can be used to refer to knowledge that identifies with a specific ethnic group, hence unique to a given culture or society and forming the basis for decision-making in the community. Rouse (1999) and Gyekye (1996) stress that in reality, indigenous knowledge is used to manage all the sectors and subsectors of the traditional economy with established distinct systems of knowledge, innovations, practices and strategies to use, protect, conserve and sustain resources. Thus indigenous knowledge as a concept expresses knowledge as being typical and belonging to specific places with common cultural and social ties, hence reflecting how different communities make sense of the world, conceptualise communal problems and develop solutions that are context-specific (Owuor, 2007).

On the basis of intellectual property rights, indigenous knowledge denotes the traditional understanding of a people who have originated from and lived in a community. Such knowledge which is naturally possessed by the particular community, may be as wide as the history and experience of the people, with this knowledge being validated through its use and usefulness in the real world hence indigenous knowledge is a way of life (Johnson, 1992).

The World Intellectual Property Organisation (WIPO, 2001) views indigenous knowledge from a multidimensional perspective. According to them, indigenous knowledge encompasses the traditions, artistic works, inventions, performances, designs, marks, names and symbols of a people. Therefore, categories of traditional knowledge could include agricultural knowledge, scientific

knowledge, ecological knowledge and medicinal knowledge (WIPO, 2001: 25). Further, WIPO (2001) stresses that indigenous knowledge is an adaptable, dynamic system based on skills, abilities and problem-solving techniques that change over time depending on environmental conditions.

According to Warren (1991), indigenous knowledge is the local knowledge that is unique to a given society and provides the basis for local level decision-making in agriculture, healthcare, food preparation, education, and natural resource management. This viewpoint suggests that there are specificities and variations in indigenous practices across communities. Flavier, De Jesus and Mavarro, (1995)support this view, explaining that indigenous knowledge is a society's information base which facilitates communication and decision-making; such knowledge is dynamic, continually influenced by internal creativity and experimentation as well as by contact with external systems. In the same light, Woodley (2004) observes that the concept of indigenous knowledge represents indigenous knowledge as emerging from a system made up of three subsystems: context, practice and belief (CPB). The use of CPB by Woodley (2004) gives some order to the numerous ecosystem variables that influence indigenous knowledge.

Johnson (1992) defines indigenous ecological knowledge (IEK) as the body of knowledge built up by people through living in close contact with nature over generations. Drew (2005) adds that indigenous communities, who use traditional knowledge as a conservation mechanism, usually develop and have a long-term efficacy in resource management. The close linkages between nature and culture, as well as long-term interaction with the local environment, provide most of the indigenous communities with holistic understanding of the processes in the environment where they dwell (Nabhan, 2000; Vogt et al., 2002), hence their ability to manage them.

Despite the fact that scientific research has used IEK to understand ecological processes, changes, population and evaluate habitat impacts, the wider application of IEK remains very low due to the fact that the information is rarely documented (Huntington, 2000). Also, quite often studies of IEK are full of conflicting information about indigenous people and the assumption that the knowledge they possess is simple, savage and static (Berkes, 2012) – which disturbs the use of this body of knowledge.

However, IEK has undergone multitudes of change since indigenous people constantly reflect in an effort to understand environmental changes within and outside their communities. Indigenous people accumulate IEK through trial and error as they interact with their environments (Berkes, Colding & Folke, 2000; Davis & Wagner, 2003). Therefore, their continuous use of their traditional practices is a reflection of their resilience to environmental and cultural changes over time (Ellis &West, 2005; Sayles & Mulrennan, 2010). This implies that there is need for integration and enhancement of IEK practices with modern practices in preservation.

It is clear that traditional ecological education transmitted orally from generation to generation concentrated on preserving the sacredness of life and whatever needs enhancement. Modern ecological education should therefore draw insights from it (Battiste, 2002). Farming practices among different indigenous communities in Bui Division, as is the case with other communities, bear witness to the fact that indigenous knowledge can be harnessed to combat environmental degradation and to minimise postharvest losses. Intercropping and crop rotation as a practice to improve soil fertility and as a pest control mechanism has been used by farmers from time immemorial and this has worked effectively (Misiko, 2007).

2.4.2 The nature of indigenous agriculture

To effectively examine the nature of indigenous agriculture, the researcher now discusses the characteristics of indigenous agricultural systems, the effectiveness of such systems, and their challenges and impacts.

2.4.2.1 Characteristics of indigenous agricultural systems

Scholars (Ghale & Upreti, 1999) have identified major characteristics of indigenous agricultural systems ranging from input source and utilisation, coping strategies and adjustments to adverse conditions ,to the type of technology used. Dependence on external inputs is very low in indigenous agricultural practice and even where external inputs are used, they are merely to ensure production potential. In this light, Altieri (1994) explains that the intercropping and mixed cropping with legumes practised by indigenous farmers increases soil fertility, thus reducing the need for external nitrogen and further helps in pest management as well reducing the demand of external pesticides.

Maximum use of local resources has also been identified as a major characteristic of indigenous knowledge application in agriculture. Reijntjes, Bertus and Ann (1992) and Pretty (1995) believe that the production practices that exist and have existed in resource-poor agricultural systems – such as integrated pest management, multiple cropping system, integration of livestock, water harvesting and conservation, and selection and breeding of crop and livestock based on maximum local resource use – have helped to make the resource-poor agricultural systems viable and sustainable as they prevent the over-exploitation of natural resources and enhance food production in rural communities.

Research has also identified the development, use and dissemination of local technologies in indigenous agricultural practice. According to Altieri (1994), in

developing countries, smallholder farmers have been involved with different indigenous technologies such as terracing, slicing terrace risers, flood water harvesting, application of organic matter, and inclusion of legumes in crop rotations. These are all built-in agronomic practices to secure food production and sustain ecological dynamics over centuries. Accordingly, local techniques of farm management are environmentally adapted and rely on the local resources base of the community. Therefore, the development and dissemination of local technology is the basis for indigenous agricultural practices.

Pretty (1995) notes that indigenous agricultural systems are regenerative and that the diversified indigenous farming systems have helped smallholder farmers cope with scarce resource situations in most rural communities in Africa. The use of renewable products is a common characteristic found in indigenous agricultural practices and has made the system more sustainable. In the opinion of Ghale and Upreti (1999), the existing interdependence between crops, livestock, forests, and fodder is a significant issue in indigenous farming systems. Once this interconnectedness and interdependence is disturbed by external technologies, the indigenous agricultural systems of developing countries are endangered.

Ostrom (1990) maintains that indigenous people have strategies and mechanisms which are shaped by institutions to cope with uncertainties within their indigenous agricultural systems. These institutional setups have existed in indigenous agricultural systems from time immemorial and inherited through generations. Ostrom (1990) indicates that indigenous agricultural systems are well-structured social institutions to enforce rules and regulations for common decision-making about resource use and food issues.

2.4.2.2 Effectiveness of indigenous agricultural techniques

In most developing countries including Cameroon, a majority of farmers practise low input agriculture which is an indication of the potential of indigenous knowledge for agricultural development (Mella, Kulindwa, Shechambo&Mesaki, 2007). As noted by Hart and Vorster (2006), about 50 per cent of the world's population depends on indigenous knowledge-based agriculture for food supply. Several examples show that indigenous knowledge has supported agricultural practice and subsequently agricultural development.

Evidence from studies conducted in Tanzania shows that the traditional sector accounts for about 90 per cent of the country's cattle, poultry and seeds planted (Hill, 2003; Mushi, 2008). Additional empirical studies in Ghana, Benin, Niger and Togo (Kaboré & Reij 2003), Samoa (Tikai & Kama 2004), Tanzania (Kauzeni & Madulu 2003), have shown that indigenous knowledge has been of great value in contributing to agricultural production in developing countries. Similarly, Bhagawati et. al., (2015) explains how the indigenous practice of *Jhum* (shifting cultivation)has been helpful to small holder farmers in north-eastern India in preserving soil fertility and ensuring high yields. Furthermore, in the western highlands of Cameroon, Takoutsing et al. (2012) note that the indigenous system of obtaining crop seeds has been practised for centuries by small-scale farmers. In the same light, Kaihura, Kaitaba, Kahembo and Ngilori (2003) observe that in Pakistan, lack of appropriate crop and seed varieties have forced resource-poor tribal farmers to develop and conserve location-specific indigenous paddy varieties to cope with climate changes and meet their food security needs. Therefore, it can be ascertained that indigenous knowledge has been and continues to be successful in promoting agriculture in the developing countries and ensuring food availability across the world.

Failures recorded with the utilisation of Western agricultural techniques in some agro-ecological zones where indigenous agricultural practices have been successful, indicate the effectiveness of indigenous agricultural techniques and have resulted in attention being given to these techniques (Hart & Mouton, 2005). For example in Ogun State of Nigeria, Adedipe, Okuneye and Ayinde(2004) found that the high cost, adulteration and health hazards that came as a result of the use of agro-chemicals in cowpea production forced farmers to go back to their indigenous methods of cultivating their cowpeas. This buttresses the strength of indigenous agriculture as being environmentally friendly as well as healthwise.

Equally, a study by Osunade (1994) explained that in Swaziland, farmers determine soil fertility by feeling the soil with their hands as well as identifying the presence of fauna and flora with earthworm casts on nutrient-rich soils, but never on acidic soils. Further, Laekemariam, Kibret and Mamo (2017) found out that in southern Ethiopia farmers have the potential to differentiate soils and establish soil fertility based on soil colour and texture. These innovations are peculiar to specific environments and have been of great value to the indigenous people. Such indigenous practices of determining the suitability of soils for specific crops have contributed immensely to biodiversity and food security in the communities and have proven their worth in enduring agricultural practice among the resource-poor smallholder farmers.

Further, indigenous techniques of forecasting weather to determine when planting can begin and also when other aspects of farm operations can be done, have also proven effective over the years in rural communities in Africa. The use of such indigenous techniques has been largely attributed to lack of Western technology for weather forecasting. For example, Nwonwu (2008) highlights the way in which Tanzanian farmers in the districts of Mbinga, Njombe and Mbeya forecast the beginning of the rainy season following the cry of a certain bird, the appearance of a particular type of weed, butterflies flying in droves from west to

east and the appearance of certain types of mushrooms among other indicators. Similarly in Nigeria, the appearance of the kite bird in the sky is noted to be an indication that the onset of rain is imminent; farmers then begin preparing their farms for the farming season (Nwonwu, 2008). IFAD (2016) further projects the effectiveness of indigenous knowledge drawing from experience in Peru. According to IFAD (2016), in the Puno region of Peru, indigenous people have used the frequency of rains, flowering of certain plants, appearance of certain animals, incidence of pest infestations among others to determine when planting and harvesting of their crops should be done. With the successes registered by these people as they have been carrying out their activities for decades, it can therefore be confirmed that the continual use of these indigenous techniques is an indication that they are effective in supporting the agricultural practices of resource-poor smallholder farmers.

The United Nations Conference on Trade and Development (UNCTAD, 2009) observes that organic agriculture builds on and keeps alive farmers' heritage of traditional knowledge and traditional agricultural varieties and offers a wide range of benefits in terms of food security and environmental protection. This necessitates an understanding of the indigenous practices of the people of Bui Division with specific reference to the widely cultivated and eaten potato tuber.

Because organic farming relies on local renewable resources instead of external inputs like pesticides and fertilisers, resource-poor smallholder farmers experience more yields and incomes, enhancing food security, considering that with indigenous practices they are less vulnerability to external price volatility (UNCTAD, 2009).

According to Gorjestani, (2000) and Mascarenhas (2004), indigenous knowledge is an important resource which could contribute to increased efficiency, effectiveness and sustainability of the development process especially in areas

pertaining to agricultural production and food security. In same light, Abukutsa-Onyango's (2009) study on indigenous agriculture in Kenya found that about 80 per cent of crops are grown in arid lowlands with increasingly unreliable rainfall. The study also observed that any long-term remedy for drought and crop failure must be addressed by reducing dependence on Western-style agriculture in favour of indigenous agricultural practices and indigenous crops. Thus, Briggs and Sharp (2004) assert that in such situations when scientific interventions have failed, indigenous techniques of the people have proven to be an invaluable alternative. This is an indication of the effectiveness of indigenous techniques.

Reijntjes et al. (1992) explain that indigenous methods to manage rainfall developed by farmers have been helping agricultural production, especially during floods. Similarly, Nwonwu (2008) notes that in the Yatenga Region of Burkina Faso, farmers use an indigenous technique called *zay* (holes in which manure and grass are mixed with earth) located in-between rock bunds to prevent runoff. Nwonwu (2008) notes that in the Eastern Province of Kenya, the undulating nature of the terrain has resulted in farmers using trenching as a method of erosion control and water conservation. Further, studies conducted by Ajani, Mgbenka and Okeke (2013) also show that farmers in sub-saharan Africa have been using their indigenous knowledge in adapting and fighting climate. These indigenous techniques are known to have been effective in checking erosion, conserving water, increasing the infiltration of water into the soil and helping vegetation growth in fallow lands.

Mushi (2008) argues that the use of indigenous knowledge in agricultural practice is very necessary in Africa and explains that the dominance of the traditional sector as the agricultural seed source is a clear indication of the potential of indigenous knowledge in improving agricultural production. However, Moyo (2010) has found that in developing countries, external agricultural knowledge receives more attention and investment than indigenous knowledge

systems. Without an interconnected approach to managing knowledge, the efforts of the poor to take advantage of their indigenous innovations and skills in order to improve on their farming activities are fruitless (Lwoga & Ngulube, 2008).

As noted by Moyo (2010) despite the fact that more attention is given to external knowledge system as far as agriculture in Malawi Africa is concerned, the adoption rate of external technologies among small holder farmers is still low. Studying and understanding the efficacy of indigenous knowledge systems in relation to agricultural production, and integrating best practices with external technologies, may improve on the adoption rate and go a long way to minimise postharvest losses – especially of perishable crops.

Some indigenous food production systems have been found to contribute significantly to household food and nutritional security (Warren 1991). Therefore there is need to enhance indigenous knowledge in an attempt to reduce food losses and wastage through processing and storage systems. DeWalt and Barkin (1991) suggest that increasing agricultural production only by introducing agricultural technologies will not solve food and nutritional problems in developing countries. As a result, locally produced, nutritionally rich food sources need to be explored and evaluated for their nutritional impact on households 'indigenous food production systems. Therefore, indigenous knowledge needs to be identified, analysed, preserved, and disseminated.

According to Warren (1991), the efforts and contributions of poor smallholder farmers to agricultural production can largely be attributed to indigenous knowledge. Thus smallholder famers have a strong reason to stay with their indigenous knowledge practices in agricultural production (Okuneye, 2004). Therefore it can be ascertained that the continuous dominance of indigenous practices in agriculture by small-scale farmers means that such methods to some extent have been successful. Hence to improve the situation, such indigenous

practices should be identified and enhanced with modern techniques so as to minimise postharvest losses, especially in Africa where the resource situation is a serious constraining factor to adoption of Western knowledge.

Indigenous agricultural techniques are effective and relevant owing to the fact that traditional farming systems are based on biodiversity with genetic diversity, which is a key to manage risk and reliance on agro-chemicals as well as helping to prevent genetic erosion (Altieri, 2004). Thus encouraging genetic diversity may be helpful in providing adaptation to environmental changes. Since indigenous traditional farming is usually rich in biodiversity, there is need to sustain traditional farming practices in order to preserve agricultural biodiversity for generations to come, hence supporting food security in the process.

Scholars like Kumar, Jain and Garg (2010) and Fellows (2009) confirm that indigenous technical knowledge for minimising postharvest losses are effective to a significant degree. It is thanks to such methods that farmers in rural areas have been able to feed themselves. In addition, they assert that sun drying is an old established indigenous agricultural technique used in food preservation and has been very successful in preserving perishable crops in the developing world. This clearly indicates that indigenous knowledge practices have been and continue to be effective in enhancing agricultural production and ensuring food security around the world.

Okon, Uko and Amalu (2004) highlight the effectiveness of indigenous knowledge-based techniques utilised in preservation. They explain that when pumpkin and amaranth leaves are bunched up and dipped in a bucket of water, with the tips of the stems steeped in the water, they can remain fresh for up to six days. Further, Okon et al. (2004), confirm that when waterleaf and bush okra are sprinkled with water, covered and kept in a cool place, the leafy vegetables remain

fresh for about six days. These are examples of the effectives of indigenous knowledge techniques in preserving perishable crops.

Moos (2010) referred to evidence in South Africa where the practice of traditional agriculture using indigenous knowledge has played an important role in providing livelihoods and reducing poverty. The author observes that indigenous knowledge systems make significant contributions to socioeconomic growth. Therefore, it can be concluded that, if promoted and encouraged, indigenous knowledge techniques applicable in agricultural production and preservation of crops can significantly increase production and minimise postharvest losses.

The International Federation of Organic Agriculture Movements (IFOAM, 2007) highlights organic farming as an indigenous agricultural practice which has been very effective in enhancing agro-ecosystem health. It has been ascertained that the high organic matter content in the soil prevents nutrient and water loss, thus making soils more resistant to drought, thereby supporting agricultural production (IFOAM, 2007). In the same light, the FAO (2008) explains that the indigenous practice of using organic manures, legume production and crop rotation maintains soil fertility. In Ghana study results presented by Omari et.al., (2018) also clearly show how indigenous farmers have used their Indigenous Knowledge of Soil Quality and Fertility Management Practices in conducting their agricultural activities in Farming Communities of the Guinea Savannah Agro-Ecological Zone of Ghana.

Hassan and Nkemechena, (2008) explain that with climate change, smallholder farmers relying on indigenous knowledge for their agricultural practice have developed climate change adaptation strategies that are proving to be successful. The strategies perceived by farmers as appropriate include crop diversification (by making use different crop varieties and planting crops that are drought-tolerant), varying the planting dates, harvesting dates, increasing the use

of irrigation, increasing the use of water and soil conservation techniques, using shading and shelter, shortening the length of the growing season and multi-cropping. These indigenous practices that draw on farmers' knowledge and farming experience have helped to reduce the risk of crop failure as different crops are affected differently by the effects of climate change. These techniques have continued to ensure that rural communities have food, hence indicating the effectiveness of indigenous knowledge in the face of climate change and variability (Benhin, 2006).

Hart and Vorster (2006) further illustrate the effectiveness of indigenous techniques, referring to sorghum farmers in Msinga, KwaZulu-Natal who use a traditional method of protecting seed heads from being damaged by birds. Hart and Vorster (2006) explain that seed heads are wrapped with grass before they start to ripen and this prevents the birds from eating the seed heads. The widespread use of this indigenous technique in this area affirms that the application of the practice is effective in securing the crop. Additionally, Hart and Vorster (2006) show how farmers practising indigenous agriculture in Nkwalini in KwaZulu-Natal have been able to increase the sizes of pumpkins through pruning of the pumpkin plants.

2.4.2.3 Challenges of indigenous techniques in agricultural production

The nature of acquisition and practice of indigenous knowledge, its embeddedness in community practices, institutions, relationships and rituals – and the fact that it is commonly tacit and orally transmitted – all pose a serious challenge to its recognition and utilisation (Beckford & Barker, 2007; Sen & Khashmelmous, 2006; Muwanga-Zake, 2009). This has limited the potential of indigenous knowledge techniques in contributing to development as they are often regarded as inferior to Western scientific knowledge (Muwanga-Zake, 2009). The nature of acquisition and the isolated use of indigenous knowledge itself, together with its associated myths and rituals, pose a challenge to its contribution to

agricultural production and minimisation of postharvest losses (Kilongozi, Kengera & Leshongo, 2005)

Groetnfeldt (2004) notes that local irrigation systems used in indigenous farming systems are not strong enough to support high agricultural production across vast hectares of land. Further, Rutatora (2000) highlights the labour-intensive nature of indigenous agricultural techniques, relying mostly on household labour and women. This leads to low output and ultimately food insecurity. Against this backdrop it can be established that agricultural practice purely on indigenous knowledge may not satisfy the food needs of the increasing world population. This suggests that indigenous agricultural techniques as practised should be enhanced for optimal productivity.

Mark et al. (2008) argue that lack of adaptive capacity by indigenous farmers to access to appropriate forecasting of weather or improved seed varieties are some of the difficulties facing indigenous agricultural practice. In the same light, with climate change and variations, the Centre for Environmental Economics and Policy in Africa (CEEPA, 2006) declares that lack of adequate information about climate change is a major challenge hindering farmers using indigenous techniques in agricultural production across Africa. Similar evidence from the Nile Basin in Ethiopia as reported by Molden (2009), confirms that lack of information, in addition to lack of and poor potential and techniques for irrigation in indigenous farming are great challenges faced by those involved in and practicing indigenous agriculture. These challenges have seriously constrained the potential of the indigenous farmers; it may be worthwhile to find enhancement measures to ensure that agricultural production levels do not fall drastically.

FAO (2014) notes that land degradation resulting from nutrient depletion, soil erosion, salinization, pollution, overgrazing and deforestation are further challenges facing African indigenous agriculture. This implies that the inability of

indigenous farmers to apply sufficient manure to soil deprives the soil of large quantities of nutrients and depletes soil fertility. This has been aggravated by the increasing population, which reduces the fallow period that was a major indigenous technique of regenerating soil nutrients and soil fertility (FA0, 2010). The increasing population coupled with the poor state of services, input markets and underdeveloped rural financing (difficulty faced by indigenous farmers in getting access to credit) also present challenges to indigenous agriculture (Binswanger-Mkhize, Hans & McCalla, 2009). In addition, a significant proportion of smallholder farmers utilising indigenous knowledge lack adequate postharvest storage and handling capabilities that result in substantial levels of spoilage and loss of harvested produce (Binns, 2012). On this basis, it can be stated that land degradation, soil nutrient depletion and the lack of appropriate capability to minimise postharvest losses is a serious challenge to indigenous agricultural practice.

Neglect of indigenous practices and the perception that indigenous knowledge is inferior have also been highlighted as problems facing indigenous agricultural systems (Battiste, 2002). The colonial view presented indigenous knowledge systems as inferior to Western knowledge systems (Muwanga-Zake, 2009). This conception has continued to dominate in the minds of stakeholders in agricultural systems, even where Western knowledge systems are not effective.

2.4.2.4 Impact on agriculture of the challenges of indigenous techniques

The challenges of indigenous agricultural techniques have varied impacts, affecting individual smallholder farmers, the agricultural sector and the economy of the country. Ziervogel et al. (2006) argue that indigenous agricultural practices have been unable to deal with climate change. This has adversely affected food production using indigenous techniques (Zoellick, 2009; UNFCCC, 2007).

Urama and Ozor (2010) maintain that by 2020, between 75 million and 250 million people across Africa will be exposed to serious stress in finding water for agricultural practice; this will negatively affect livelihoods for the resource-poor smallholder farmers. This implies that the erratic rainfalls with high spatial variations will affect the agricultural system which is a source of livelihood for over 70 per cent of Africa's population (Strzepek & McCluskey, 2007). Challenges to indigenous agricultural practice have been mentioned to likely result in a significant decline in farm output. For example, as a result of water challenges faced by farmers practising indigenous agricultural techniques, projections show up to a 50 per cent decline in agricultural production in Africa associated with the water challenge resulting from climate change and variations (Ringler et al., 2010). For crop-specific situations, Ringler et al. (2010) contend that in sub-Saharan Africa, negative yield impacts will be highest with wheat, followed by sweet potatoes.

Furthermore, the manifestations of challenges such as decreases in the length of growing seasons and yield potential have profound effects on childhood malnutrition levels. In this light, Ringler et al.(2010) argue that in sub-Saharan Africa particularly where indigenous agricultural practices are widely used, up to 585,000 children will be facing the risk of malnourishment by the year 2050. On this basis, it can be argued that there is an urgent need to enhance indigenous agricultural techniques in order to counter these likely negative consequences.

Kader (2002) notes that in some African countries where indigenous practices for preservation are widely used, postharvest loss especially among perishable crops are still very high at about 50 per cent, with losses occurring in the field during transportation, storage and processing. Such high losses in food, in an era when the entire community is calling for an increase in agricultural production to ensure food security, necessitate enhancing indigenous agricultural postharvest management practices. It is noteworthy that,to a large extent, most Western postharvest management practices are not cost-effective and also are not

adapted to the realities of the resource-poor smallholder farmers in Bui Division, Cameroon.

2.4.2.5 Measures to overcome challenges of indigenous techniques in agriculture

The challenges posed by indigenous knowledge techniques in agriculture have resulted in the development of innovative measures by farmers, governments and research institutions. In this light, Waters-Bayer (1992) explain that to overcome the challenges of indigenous agricultural knowledge, attention should be given to new technologies developed by farmers through their local activities. This same opinion has been upheld by Waters-Bayer, Van Veldhuizen, Wongtschowski and Wettasinha (2006) who stressed the need for recognising and enhancing local innovative processes of indigenous people in Africa. Such measures may lead to the enhancement of indigenous techniques. Accordingly, if the indigenous techniques utilised by the people of Bui Division in potato farming are enhanced, there may be improvements in cultivation of potatoes. Strengthening local innovations implies that policy should pay attention to and give the indigenous people a chance when considering overcoming the challenges of indigenous knowledge in agriculture (Waters-Bayer, 1992).

Empirical evidence from South Africa shows that innovative ideas pioneered by smallholder farmers have contributed to the development of measures to overcome the challenges of some indigenous practices. For example, Letty, Shezi and Mudhara (2011) note that in the rural Ukhahlamba District of KwaZulu-Natal, the challenge of high labour needs and difficulty in managing potatoes forced farmers to initiate alternative potato production practice. With this alternative technique, potatoes are planted under mulch, which has proven to be improving soil fertility (Letty et al., 2011). This measure has an impact as it improves socioeconomic livelihood conditions of the resource-poor smallholder farmers.

Thus it can be assumed that studying and enhancing indigenous techniques for specific crops will bring about significant impacts on agricultural practice worldwide.

Agricultural research, extension and advisory services are now using the bottom-up approach to facilitate learning and farmer formation as a measure to overcome the challenge of lack of interest by indigenous farmers in adopting Western knowledge (Asenso-Okyere & Davis, 2009). Such an approach will result in the recognition of farmers' efforts and thus will maximise the participation of farmers in agricultural innovations. Also, as times change, indigenous farmers are reported to be evolving and developing strategic measures through constant experimentation to cope with the challenges they are facing daily with their indigenous farming techniques (Kaplowitz, 2000). For example, Singh (2003) as well as Kaihura et al. (2003) explain how indigenous farmers have developed and conserved indigenous paddy varieties as a measure to cope with and meet food security needs.

As a measure to overcome the challenges of indigenous agricultural practice, some scholars have suggested that both indigenous knowledge and Western knowledge practices that can improve agricultural production should be recognised and collaborative action promoted (Agrawal, 1995; Pretty, 1995; Guye, 2014). Such collaborative action will surely be helpful, considering that the knowledge systems will be complementary to each other (Gadgil, Berkes&Folke, 1993; Guye, 2014). Acknowledging these viewpoints, it can thus be argued that the integration of Western and indigenous techniques can result in the development of effective methods that can be used as measures to overcome the challenges facing indigenous agricultural techniques.

2.5 SECTION D: POSTHARVEST LOSSES

This section provides insights concerning postharvest losses. The researcher begins by discussing the concept of postharvest losses, noting that they occur at various stages of the food supply chain. The researcher then examines the nature of postharvest losses and provides a literature review to show the impact of postharvest losses as well as measures employed to overcome postharvest losses.

2.5.1 The concept of postharvest loss

To Bourne (1977), any loss occurring after harvest and before consumption is postharvest loss, and such loss can be measured quantitatively and qualitatively within the postharvest system (De Lucia & Assennato, 1994). As noted by World Bank (2010), with the case of grains in sub Saharan Africa, post harvest losses are largely due to climatic conditions, political situations, farmers' cultural practices, market potential, road infrastructure development, and knowledge possessed by those involved Because crops undergo varied postharvest activities, the importance of factors that contribute to postharvest losses vary by commodity, season as well as the conditions under which the crops are grown, harvested and stored (Hodges, Buzby & Bennett, 2011).Therefore there is the need to study crop-specific systems and develop frameworks that are most suitable to minimise postharvest losses.

Some scholars have explained the concept of postharvest losses from two perspectives, classifying the losses as either food loss or food waste occurring in the postharvest food chain (Parfitt, Barthel, & Macnaughton2010; Lundqvist, de Fraiture, & Molden, 2008; Stuart, 2009; FAO, 2010). To these authors, food losses refer to the decrease in edible food mass that originally was intended for human

consumption, while food waste refers to the discarded quantities of food appropriate for consumption.

Other scholars define postharvest loss as including quality and quantitative losses (Kader, 2002; Kitinoja & Gorny, 2010; Parfitt et al., 2010; Hodges et al., 2011; FAO, 2013). According to them, quality losses are those that affect the nutrient/caloric composition, the acceptability and the edibility of a given product – while quantity losses refer to those that result in the loss of the amount of a product. FAO (2013) notes that at the global level, quantities of lost and wasted food in high-income regions are higher in downstream phases of the food chain, whereas in the low-income regions, more food is lost and wasted at the upstream phases of the food chain.

2.5.2 Nature of postharvest losses in indigenous farming

As noted by scholars, postharvest losses are both qualitative and quantitative losses occurring after crops have been harvested (Bourne, 1977, De Lucia & Assennato, 1994). Typically such losses occur at different stages in the postharvest chain and are caused by varied factors. To clearly look at the nature of postharvest losses, the researcher has discussed the issue at the various postharvest stages.

2.5.2.1 On-farm postharvest losses

At the farm level, postharvest losses are evident. In indigenous farming, postharvest activities include sorting and on-farm preservation. Research has shown that farm-level challenges result in qualitative and quantitative losses. For example as noted by World Bank (2010) the nature of on-farm postharvest losses are linked to prevailing climatic conditions as well as to farmers' cultural practices. Qualitative losses such as texture, flavour and appearance are usually very high in

fresh fruits and vegetables (Kitinoja & Kader, 2002), presumably because of lack of adapted storage facilities on farms.

According to the World Bank (2010), postharvest losses around the farm are higher than at other levels in the food chain in developing countries. This is largely the result of the types of crop varieties grown, harvesting methods and tools used as well as lack of proper on-farm packaging and preservation facilities. It is thus clear that lack of temperature management, poor handling, poor packaging material and lack of education on the need to maintain product quality at the farm level, results in both quantitative and qualitative postharvest losses at the farm level (Kitinoja et al., 2011).

2.5.2.2 Off-farm postharvest losses

When crops are effectively harvested, they continue to move in the food supply chain. There are usually a series of activities involved such as transportation, processing, packaging and sorting. The performance of these activities by stakeholders both in the traditional or the mechanised food chain results in postharvest losses.

As noted by Kitinoja et al. (2011), poor handling and poor packaging result in qualitative and quantitative postharvest losses. This has been reported to be very evident in the developing world. Research indicates that in the developing world, crops are poorly handled and packaged for transportation. Kitinoja et al. (2011) indicate that in developing countries there are many problems related to roads, and more especially to whether roads connect farms and markets. A lack of farm-to-market roads significantly increases postharvest losses (Kitinoja et al., 2011; FAO, 2013). Similarly, FAO (2013) highlights that poor handling and packaging in less developed countries, coupled with transportation on very bad roads using inappropriate means, increases postharvest losses. Furthermore,

World Bank (2010) observes that the kind of material used for packaging increases the risk of both qualitative and quantitative losses during the postharvest management chain.

For all crop types, off-farm preservation can either increase or decrease postharvest losses. According to Hodges et al. (2011), poor preservation results in biological spoilage in developing countries as insects, rodents or micro-organisms facilitate bio-deterioration. Although roots and tubers are generally less perishable than other vegetables, Hodges et al. (2011) maintain that if not properly preserved, postharvest losses will still be high. With vegetables, lack of adapted preservation facilities in markets where crops are displayed for sale, seriously contribute to both qualitative and quantitative losses.

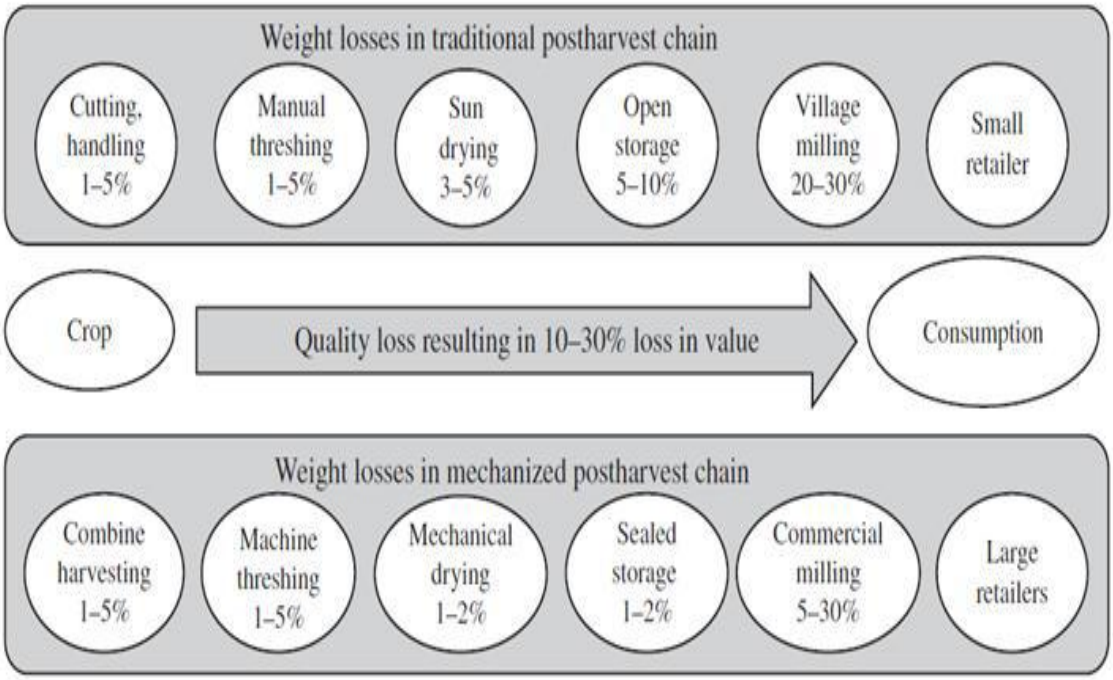
During sorting and grading, the use of a poorly trained labour force, especially in developing countries, has been reported to cause qualitative postharvest losses. As observed by Kitinoja and Kader (2002) and Saeed and Khan *(*2010), during grading, untrained labour may cause skin damage to the crop, allowing contamination which results in qualitative and quantitative losses.

The practices of indigenous farmers of relying on a CPB view is geared to improving production and ensuring food availability during off seasons (Woodley, 2004). In this light, Hodges et al*.* (2011) provide a framework which can be helpful in examining postharvest losses occurring along the traditional and the mechanised agricultural chain, beginning on-farm with harvesting, through to the stage when the products reach the end-users.

Hodges et al*.* (2011) indicate clearly that weight (volume) losses are occurring along both the traditional and mechanised chain from the farm level to the consumption stage. Although technological advancements have been geared towards minimising postharvest losses, little success has been attained in

minimising postharvest losses at the farm level (Hodges et al., 2011; Kitinoja et al.,2011). This implies that there is a serious problem, noting that in developing countries like Cameroon, significant postharvest losses occur at the farm level as a consequence of harvesting and packaging methods (World Bank, 2010).

FIGURE 2.1: TRADITIONAL VERSUS MECHANISED POSTHARVEST CHAIN



Source: Hodges et al. (2011)

2.5.3 The impact of postharvest losses

As noted by the FAO (2009), a significant quantity of the food produced in developing countries is lost after harvest. These postharvest losses have been attributed to several factors such as poor harvesting, premature excessive exposure to rain, drought or extremes of temperature, contamination by micro-

organisms and physical damage. With these high losses, the impact on individual households and governments is considerable.

Postharvest losses aggravate hunger and pose a threat to food security (FAO, 2011). This is very common with small-scale farmers in developing countries. Postharvest losses have also been reported to increase the poverty of farmers, especially in developing countries (Ahmed, 2013). Although the majority suffers, it has also been observed that high postharvest losses can result in a few individuals with excess food for sale benefitting from high food prices (FAO, 2011). However, in relative terms, such gains arising from high prices as a consequence of shortages resulting from postharvest losses are insignificant.

The livelihoods of farmers, economic development and global competitiveness of countries that are dependent on agriculture suffer when there are postharvest losses. As noted by Patrick (2013) based on evidence from Nigeria, there is an unprecedentedly high level of food importation as a consequence of postharvest losses. Such importation makes the economy less competitive and vulnerable when compared to other economies.

The effects of postharvest losses can also be seen from an environmental perspective in relation to soil degradation and the emission of gases. As stated by Patricia Woertz, during the World Economic Forum in 2010, “Preserving what is already grown is critical to reaching those who need crops most and to making the most of the land, water, energy, and other inputs already used to grow crops”. By implication, the environmental cost of producing food that ends up being wasted in reoccurring postharvest losses, is staggering.

As highlighted by Chege and Carson (2017), the amount of food lost each year due to postharvest loss (PHL) is so high that if prevented could help in feeding

the undernourished people globally. Further they highlight that economic losses associated to postharvest losses may be as much as US$940 billion per year.

2.5.4 Measures to overcome postharvest losses

As stated, postharvest losses occur both on and off the farm. These losses are posing a serious threat to global food security, especially with smallholder farmers who live on the margins of food security. In the face of postharvest losses, farmers, governments, NGOs as well as other stakeholders in the food chain have, in different ways, been making efforts to minimise the losses. Despite these efforts, the issue of food insecurity remains high across the world (FAO, 2010; International Fund for Agricultural Development [IFAD], 2012; FAO, 2012), largely because significant quantities of food are lost to spoilage and infestations on the journey to consumers (FAO, 2011; Stuart, 2009; FAO, 2002). This is worst in African countries, as tropical weather and poorly developed infrastructure contribute to the problem (SPORE, 2011). One of the major ways of strengthening food security is by reducing these postharvest losses.

A study by Hodges et al. (2011) has identified that postharvest losses begin in the field once crops are harvested. These authors argue that improvements in on-farm activities such as harvesting techniques and in the tools used, may reduce postharvest losses and likelihoods of contamination. Furthermore, ensuring that crops are harvested at the correct time will also reduce postharvest losses as the postharvest life of crops will be lengthened (Kitinoja & Kader, 2002).

According to Sparks (2013), standards have been established for commodities as indicators of crop maturity, to help farmers harvest their crops at the appropriate time. There is a need for training of farmers to master the maturity indicators to help reduce postharvest losses. In vegetables such as potatoes,

external colour and appearance of the leaves are common maturity indicators (Sparks, 2013).

Avoiding contact between crops and the soil or manure can also reduce postharvest losses as the postharvest washing step may be reduced. As noted by Shewfelt and Prussia (2009), the effect of abrasion from brushes during washing may cause qualitative losses, which may further enhance crop decay. Therefore, when harvesting, care should be taken to avoid the crops coming into contact with farmyard manure.

As already noted, tools used in harvesting and packaging materials may have an effect on postharvest losses. World Bank (2010) observes that in postharvest handling, packaging provides protection around the product. Proper packaging can provide better protection, thereby preventing crops from going bad. Variations in crop characteristics demand crop-specific improvements in packaging. Evidence from Kitinoja and Kader (2002), who studied postharvest losses in vegetables, indicates that packing vegetables too tightly can result in compression which leads to postharvest losses.

Practically speaking, the constrained resource setting in Africa may pose a serious challenge to improving on packaging, especially when it entails the use of chemical additives to increase crop postharvest life. Though indigenous techniques may provide a solution, they are still not widely known or accepted. To cope with the resource constraints, indigenous knowledge techniques need to be valorised. For example, Kitinoja and Kader (2002) mention wooden poles which can be used to construct thatched field warehouses; such structures will help reduce postharvest losses as crops will be stored there during harvesting, avoiding direct contact with both rain and sun.

Transportation methods, systems and infrastructure should be analysed to reduce postharvest losses. In most production zones, lack of farm-to-market roads have forced farmers to forgo some of their crops postharvest in the fields. As observed by the World Bank (2010), there is a need to improve on existing transportation and infrastructure in sub-Saharan Africa so as to reduce postharvest losses. Similarly, Kitinoja and Kader (2002) contend that improvements to the loading techniques of fruit and vegetables – by allowing for circulation and removal of respiration heat – will seriously reduce postharvest losses.

Considering that reducing postharvest losses is urgent, Adam (2014) building from research evidence in Cameroon argued that there is need to renewed efforts so as to scale up the domestic availability of food beyond present levels, if not rural Cameroonians will continue to have deficient access to adequate food. This thus points to the necessity of enhancing indigenous agricultural techniques utilized by smallholder farmers in Cameroon.

2.6 SECTION E: RELEVANT THEORIES TO ADDRESS THE CHALLENGE OF POSTHARVEST LOSSES

In recent years, there has been increasing concern expressed regarding the food needs facing the international community and regarding an extensive range of environmental problems hampering global efforts to increase and sustain food production. This concern has an international dimension in four respects. First, estimated global postharvest losses are very high at about one-third of global food production (FAO–World Bank, 2010; Prusky, 2011). Second, global food needs are increasing to an extent that threatens food security (FAO, 2010). Third, smallholder farmers who use indigenous techniques live at the margins of food security (IFAD, 2012; FAO, 2012). Fourth, the impact of climate change on indigenous agricultural production is huge. Accordingly, collaborative efforts need to be promoted to

handle the issue of postharvest losses. However, such collaboration needs to recognise crop-specific and community realities as they exist.

In this section of the study, the researcher reviews two theories – the systems theory and the activity theory. These theories have been chosen because of their relevance to the study subject, which is enhancing indigenous knowledge for agricultural development. These theories and their application to indigenous agriculture are discussed below.

2.6.1 The Activity Theory

Engeström (1987) developed the activity theory in which he asserts that an activity consists of interdependent elements. The interdependent elements he identified were subject, object, instruments, rules, community and division of labour. According to Engeström (1987), the object – which includes both given material and non-material entities – drives an activity. It is in the object that the motive of an activity is embedded. Therefore, the motivating capacity of an object gives a direction to an activity and shapes its development. This implies that an activity and its object are constantly in dynamic movement

.

In the activity theory, the subject refers to the individual or sub-group whose agency is chosen for analysis. The object refers to the “raw material” or “problem space” at which the activity is directed and which is moulded or transformed into outcomes with the help of physical and symbolic, external and internal tools which form mediating instruments and signs. The community comprises multiple individuals and/or sub-groups sharing a common object. Division of labour refers to both the horizontal division of tasks between the members of the community, and to the vertical division of power and status. Finally, rules refer to the explicit and implicit regulations, norms and conventions that constrain actions and interactions within the activity system (Engestrom, 1987).

The current study employs the activity theory, viewing the diversity in nature, the challenges in the practice and the potential in object construction, in the application of indigenous knowledge techniques to potato farming activity in Bui Division, North-West Region of Cameroon. Engeström (1987) explains that an activity system is in constant imbalance; hence contradictions form an inevitable feature of an activity. Thus new forms of activity emerge as solutions to the contradictions recorded in the preceding stage of form.

As noted by Engeström (1987), the instruments of an activity provide a societal meaning to individual perceptions and experience. According to Leont'ev (1978), individual actions results in collective human activity. The present study examines how the individual actions of the indigenous people of Bui Division have been used and continue to be used in the practice of potato farming as an activity with a focus of minimising postharvest losses. Although actions form part of work processes, Engeström (1987) notes that neither actions nor the local explanations given to them can deal with the contextual characteristics of an activity.

In the context of this study, the activity theory as advanced by Engeström (1987), is applicable in understanding indigenous potato farming and the best practices that can be advanced to minimise postharvest losses. In this light, the activity level consists of the general potato farming practices as well as those particular practices performed in particular conditions as systems of activities. The farming activity, which includes both on- and off-farm pre/postharvest activities, consists of practices as groups of actions for operations.

In this study, the researcher's main interest is in the potato farming activity and the indigenous practices and actions utilised to minimise postharvest losses. The potato farming activity consists of practices and actions that are carried out by individuals or groups of individuals. These practices and actions are based on the

indigenous knowledge of the people and include activities related to seed selection, farm preparation, soil nutrient management, crop health-care management, crop processing and preservation. The activity of potato farming is viewed as being in a temporal changing process, making it possible for the efficacy of various indigenous techniques utilised to be identified and advanced to minimise postharvest losses and ensure food security.

2.6.2 The General Systems Theory

The general systems theory was developed by Von Bertalanffy (1973), to understand not only elements but also the interrelations that exist among elements. The relevance of the systems theory prompted other scholars to build their arguments on it. Currently, systems theory has been applied to a variety of study areas.

According to Von Bertalaffy (1973), a system is acomplex of interacting elements; systems theory provides a theoretical perspective that analyses the phenomenon as a whole. With systems theory, focus is on the interactions and relationships between parts in order to understand functioning and outcomes. Basically, there are three approaches to systems theory, which focus on:

(1) system relations to determine the nature of relationships between various components of a system,
(2) system effectiveness to judge how satisfactory relationships are among various systems for the essence of the survival of the whole system, or
(3) system dynamics to investigate what forces a system to change and the direction of change.

The systems theory is very relevant in the study of indigenous knowledge and agricultural development as it enables one to identify clearly demarcated and defined relationships in the utilisation of indigenous knowledge practices in minimising postharvest losses. It is necessary that indigenous farmers be empowered to make maximum use of their potential in minimising these losses. For example, trends in agricultural development in the past have witnessed impressive increases in production through increased use of land, labour, fossil resources, technological developments and farmers' ingenuity. However, these achievements are marred by concerns about unequal food distribution at local, regional or global level as a result of high postharvest losses, declining biodiversity and the side effects of technology (Schiere, 2004). Apparently, one of the major ways of strengthening food security is by reducing these postharvest losses. Considering the resource setting in Africa especially the situation of smallholder farmers, the best option appears to be understanding the CPB of farmers and promoting such traditional practices.

Conversely, ensuring a long postharvest life and providing enabling conditions for crops to move along the postharvest chain may be beyond the capacity of indigenous farmers and it may be better to enhance best practices with Western technology. However, it is also important to assess how comfortable the indigenous people are with the enhancement moves. The force and the direction of enhancement of indigenous agricultural practices should be carefully weighed to maintain the optimum balance. This calls on the need to understand issues related to the practices of indigenous people and the potential of such practices in minimising postharvest losses and ensuring food availability.

2.7 DISCUSSION OF THE LITERATUREREVIEW

A review of relevant literature has shown a global debate concerning the validity of indigenous knowledge in different fields of life. Generally, literature has shown that indigenous knowledge techniques, just like Western technology, have deficiencies that demand continuous improvement and adaptation. Indeed, as highlighted by Mella et al. (2007) and Hort and Vorster (2006), the potential of indigenous knowledge in agricultural development is significant, in that about 50 per cent of the world's population depends on smallholder indigenous knowledge. However, this dependence is not without challenges. As noted by Kaihura et al. (2003),in Pakistan for instance, the dependence of agricultural practice on indigenous knowledge has been constrained by lack of appropriate crop and seed varieties.

Some scholars (Kumar et al., 2010; Fellows, 2009) have simply argued that the indigenous technical practices used for food preservation by smallholder farmers have been helping to reduce postharvest losses. These scholars maintain that the food needs of smallholder farmers and their households have been met thanks to indigenous technical preservation knowledge. However, this view fails to recognise that, by and large, smallholder farmers live close to poverty, with high postharvest losses recorded with the use of indigenous techniques.

As noted from literature, indigenous knowledge continues to evolve and adapt to change thanks to continual experimentation by farmers (see Letty et al., 2011). Surely this process of experimentation generates knowledge and skills that are passed on to younger generations. Consequently, as experimentation continues, the notion of indigenous knowledge as being static and backward – as argued by some scholars (see Battiste, 2002; Muwanga-Zake, 2009) – becomes unfounded. In fact, indigenous knowledge can be superior in particular circumstances. For example, intensive agricultural practice which depends so

much on Western technology has been reported to contribute significantly to environmental degradation when compared to indigenous agricultural practice (see Report of the World Economic Forum, 2010).

Judging from literature, postharvest losses remain a major challenge negatively affecting food security (FAO, 2010; IFAD, 2012; FAO, 2012). In Africa, the situation of postharvest losses is more intense owing to tropical weather and poor infrastructural development (SPORE, 2011: Aujla et. al., 2011). This implies that even Western technology-based infrastructure has not been sufficiently developed to prevent postharvest losses. Considering the resource condition of smallholder farmers, especially those in Africa including Cameroon, makes the situation even more challenging. It could be that a solution may be found through enhancing indigenous knowledge techniques that are less costly. Such enhancements will need to have a crop-specific dimension, and will definitely reduce the magnitude of postharvest losses currently recorded especially in perishable crops like potato. This will go a long way to positively impact the livelihoods and will also support the agricultural industry.

In addition, innovative ideas pioneered by smallholder farmers have shown that indigenous knowledge is dynamic and not static (see Letty et al., 2011). Indigenous farmers do not only rely on past performance but on observations, especially in Africa where climatic changes routinely create seasonal variations. For example, variations in start dates of the rainy season are an important issue in agricultural production, as these variations influence planting times as well as harvest time. The nature of indigenous agricultural practice demands continuous observation to ensure that yields are good enough to satisfy food needs and other requirements. The way in which such inherent uncertainties in agricultural activities are managed by smallholder farmers indicates the worth of indigenous knowledge. Continual efforts made by farmers to prevent waste from agricultural production need to be studied so that weaknesses may be identified.

Despite the arguments for and against indigenous knowledge and agricultural development by scholars, the researcher argues that the purpose of scholarly interest in indigenous knowledge should be to widen it. Where the benefits are clear, the direction of focus should be on finding how indigenous knowledge can contribute to science, or how it can be enhanced by science, basically to prevent postharvest losses.

Given the successes registered with the use of indigenous knowledge across the world, there is a paramount need to understand relevant aspects and processes of indigenous knowledge. This study argues that an understanding of how practical and useful indigenous knowledge is and has been to farmers on a day-to-day basis will significantly reduce postharvest losses in potato farming, revive the agricultural industry and contribute to food security. Negative views of indigenous knowledge should then be ignored in favour of advancing practices that contribute effectively to agricultural development and minimisation of postharvest losses.

Overall, acknowledging that both indigenous knowledge and Western knowledge have failed to completely put an end to postharvest losses (see Hodges et al*.,* 2011), the researcher stresses that there is need for continuous advancement. In this light, the need to study, identify and advance indigenous knowledge-based techniques to prevent postharvest losses in crop-specific contexts becomes crucial and forms the basis of this study.

2.8 SECTION F: CHAPTER SUMMARY

In this chapter, the researcher has reviewed a range of theoretical underpinnings of agriculture, with particular reference to the use of indigenous knowledge in agricultural practice. Important findings and theoretical arguments advanced by scholars who have made significant contributions to the body of knowledge in indigenous agriculture have been highlighted.

The arguments advanced and the different theories discussed in this chapter have been focused on understanding the study problem and the stated study objectives. For a clearer view, the researcher presents the chapter summary by highlighting the principle focus of each of the sections.

In Section A, the researcher focuses on identifying and defining the key concepts of the study, namely agriculture, indigenous agriculture, potato, postharvest and postharvest loss. It is important to highlight that the majority of the definitions examined in this section appreciate the fact that the practice of agriculture is primarily influenced by the interest and the immediate environment of the people engaged in the practice. Although different authors have different ways of defining the identified concepts, the researcher was able to identify and adopt some of the definitions for this study.

In Section B, the researcher reviews literature relevant to the context of potato farming. The researcher commences by capturing the nature of potato production as practised worldwide, followed by a historical review of the evolution of potato farming in Cameroon. It is important to highlight that the majority of studies examined in this section appreciates the fact that different farming systems, including potato farming, applied in different parts of the world are dependent on specific socioeconomic, policy and institutional, and technical factors (FAO, 2009; Brüntrup & Heidhues, 2002; Kemgni, 1973).

In Section C, the researcher examines a wealth of literature on indigenous agriculture, beginning with the concept of indigenous knowledge and moving to the nature of indigenous agriculture as viewed by different scholars. The researcher examines literal works and carefully discusses the characteristics of indigenous agricultural systems, their effectiveness and challenges. The impact of the challenges of indigenous knowledge techniques in agricultural production, as well as the measures indigenous people take to overcome the challenges and cope with their increasing food demands, are examined.

In Section C, the researcher also highlights some of the experiences of farmers as reported by researchers, to demonstrate the degree of efficacy of indigenous knowledge techniques utilised in agricultural production. Although the literature reviewed shows that indigenous agriculture faces serious challenges, its continuous use is an indication of its resilience to environmental and cultural changes over time (Ellis & West, 2005; Sayles & Mulrennan, 2010) and its ability to support agricultural development. Further, the reviewed literature agrees that a collaborative action between Western and indigenous knowledge will be helpful in improving agricultural practice since the knowledge systems complement each other (Gadgilet al., 1993; Agrawal, 1995; Pretty, 1995).

Section D provides insights into postharvest losses. The researcher introduces the concept of postharvest loss, followed by an examination of the nature of postharvest losses in indigenous agriculture. Literature is reviewed to show the impact of these losses as well as the measures employed to overcome postharvest losses. The literature indicates that postharvest losses occur at different stages in the postharvest chain and are caused by varied factors. It is also highlighted that in indigenous agricultural systems, both quantitative and qualitative losses are relatively high when compared to Western farming systems. However, the successes recorded in indigenous farming systems indicate that if these

systems are enhanced, postharvest losses will be significantly reduced. The literature in general also suggests that improving on transportation facilities, and training farmers on harvesting and handling techniques will significantly reduce postharvest losses and positively impact the socioeconomic livelihood conditions of stakeholders, especially smallholder farmers (World Bank 2010; Kitinoja & Kader, 2002; FAO 2010; Sparks, 2013; Shewfelt & Prussia, 2009). Some effort was also made in this section to provide crop-specific scenarios in relation to postharvest losses.

In Section E, the researcher focuses on the theoretical framework of the study. Two main theories are examined: the systems theory and the activity theory. Activity theorists advocate farming as an activity with interdependent elements such as the subject, object, instruments, rules, community and division of labour. Systems theorists focus on the interactions and on the relationships between parts in order to understand functioning and outcomes.

This researcher recommends that scientific research should rigorously test and measure theories in order to ascertain reliability and validity. This study also argues that policy makers need an observed understanding (rather than making assumptions) of exactly what the indigenous farmers are doing. Only once this understanding has been achieved can proper enhancement of indigenous knowledge-based agricultural practices (especially crop-specific practices) be effective and maximum gains achieved in relation to minimising postharvest losses.

CHAPTER 3

METHODOLOGY OF THE STUDY

3.1 INTRODUCTION

This study seeks to examine indigenous knowledge based agricultural techniques and their efficacy, in order to identify those that can be enhanced in a bid to reduce post-harvest losses in potato farming in Bui Division, North West Region of Cameroon. The methodological approach was qualitative with emphasis on interviews, observations and focus group discussions. According to Nouria (2007), qualitative research is characterized by its aims, which relate to understanding some aspects of social life, and its methods which (in general) generate words. Therefore the qualitative approach was very relevant in this study given that the study seeks to understand the experiences and attitudes of stakeholders involved in indigenous potato farming with the focus of answering questions on how and what indigenous practices can be advanced to minimize post harvest losses in potato farming in Bui Division.

In this chapter, the researcher presents an elaborate description of the research strategy. It also presents the study area and states the justification for selecting the area as a good field laboratory for the study. Further, this chapter describes the study population, the sampling method and sampling frames, the data collection and analyses methods and the techniques that were used to ensure validity and reliability of the results.

3.2 GENERAL OVERVIEW OF THE AGRICULTURAL SECTOR IN CAMEROON

Cameroon, often referred to as “Africa in miniature”, is highly diversified with respect to agro-ecology when compared to other countries in sub-Saharan. The agro-ecology of Cameroon ranges from a Sudano-Sahelian North to humid forests

in the Centre, South and East Regions. The diverse nature of the agro-ecology of Cameroon makes it possible for major crops grown in other African countries such as rice, wheat, barley, maize, cassava, potatoes, plantains/bananas, yams and also cocoa and coffee to be grown in Cameroon. As noted by GoC-FIDA (2010), agriculture remains a priority sector in the growth and poverty reduction drive of the Government of Cameroon. This implies that there is need for the development of the sector.

With the diverse agro – ecology and the need to make good use of it, the researcher in the following paragraphs explains the structure of the agricultural sector in Cameroon, the techniques of farming, challenges to increased production as well as government policies to minimize challenges to small scale agricultural production.

3.2.1 The structure of the agricultural sector

The agricultural sector in Cameroon is generally under the Ministry of Agriculture and Rural Development and the Ministry of Livestock, Fisheries and Animal Development. These ministries have national coordinating offices located at the administrative head quarters in Yaounde, Regional Delegations at the regional headquarters, Divisional and Sub-divisional Delegations at the Divisions and Sub-divisions respectively. Within sub-divisions, there are agricultural post offices that are coordinated by the sub-divisional delegation.

From the practical dimension, agriculture in Cameroon is both intensive and subsistence in nature. Intensive agriculture in Cameroon is under the control of the state and / or private ownership. As noted by Nguiffo and Sonkoue Watio, (2015), intensive agriculture in Cameroon focuses more on the production of cash crops. Subsistence agriculture in Cameroon is controlled by small holder farmers who produce both food crops and cash crops. As observed by Achancho (2013), in

Cameroon, food-producing agriculture which is small holder in nature continues to be the main source of food and survival for people. This implies that food crops for local markets are mainly produced by small holder farmers in Cameroon.

TABLE 3.1: MAJOR AGRO-INDUSTRIAL COMPANIES IN CAMEROON

Company	**Share holding**	**Location**	**Crop**	**Approximated area (hectares)**
CDC	Parastatal	Various locations in the South West Region	Oil palm, rubber and banana	102,000
PAMOL	Parastatal	Various locations in the South West Region and Littoral	Oil Palm	41,000
SOCAPALM	Parastatal	Various locations on the coast and in the south	Rubber and Oil Palm	66,663
HEVECAM-Golden Millennium Group (GMG)	Private	Ocean Division (South)	Rubber	41,000
Upper Noun Valley Development Authority (UNVDA)	Parastatal	North West (Ndop)	Rice	136,700
Société sucrière du Cameroun (SOSUCAM)	Private	Mbandjock and Nkoteng	Sugar cane and processing into sugar	12,000
Ndawara Tea Estate	Private	North West Region	Tea	Not Known
Ndu Tea Estate	Private	North West Region	Tea	Not Known

Source: Nguiffo & Sonkoue Watio (2015)

3.2.2 Techniques of farming

Generally speaking, farming techniques will depend on the type of crop and the climatic conditions of a place. In Bui Division, the farming techniques in small holder farming are the same. As observed by Shende and Lifeter (2017), the farming techniques in small holder agriculture in Bui Division include mixed cropping, monoculture, crop rotation and multiple cropping. It is worth mentioning as highlighted by researchers that in Bui Division, ridge formation is the most popular technique of ploughing (see Shende and Lifeter 2017).

3.2.3 Challenges to increased production

In the study area, increasing small holder agricultural production is challenged by several factors. Some of these challenges include bad roads, pest, mildew and blight aphids (see Shende & Lifeter , 2017). Furthermore, the difficulty in accessing quality seeds which has resulted in seed exchanges between farmers in the study area also challenges efforts to increase agricultural production (see Takoutsing et al. 2012).

3.2.4 Government policies to minimize challenges to small scale agricultural production

The agricultural sector especially the food producing sector is still fragile. According to Achancho, (2013), the fragility of the agricultural sector especially with regard to food crops can be associated to weak national policies related to promoting food producing agriculture. As highlighted by Bokagne, (2006), up to the year 2000, national agricultural policy as concerns food crops (cassava, yam, potato, maize, sorghum, groundnuts, beans) was focused on giving technical advice to small holder farmers. Judging from scholars like Achancho (2013), Bokagne (2006), it is clear that up to the year 2005, the agricultural policy in

Cameroon did not give great attention to the food production sector and this resulted in the food riots in 2008.

As from the year 2010 with the emergence 2035 vision, the new agricultural policy in relation to food crops has not significantly changed (Achancho, 2013). Achancho (2013) maintains that Cameroon's Agricultural policy for food crop production is still not visible as production continues to be traditional and extensive using little or no input.

It is worth mentioning that till date, the new agricultural policy referred to as the Second General Agricultural Policy in Cameroon focuses more on cash crop production with great encouragement given to the development of large scale and small scale plantations for cash crop production (Nguiffo & Sonkoue Watio, 2015).

However, the government of Cameroon has put in place some programmes which support the food crop sector (Agricultural Value Chain Development Support Program (PADFA), Roots and Tubers Development Program, Maize Sector National Support Program (PNAFM), National Program for Food Security (NPFS), Grassfield Participatory and Decentralized Development Project (GP-DERUDEP), Competitiveness of Agricultural Operations Improvement Program (ACEFA). These programmes mainly contribute to building basic rural infrastructure namely: warehouses, water points, irrigation schemes, providing advisory services, with minimal direct financial support to small scale farmers (see Achancho 2013; MINADER 2016).

3.3 Research setting

This study was carried out in Bui Division, North-West Region of Cameroon. Bui Division is subdivided into six areas: Kumbo, Oku, Jakiri, Noni, Nkum and Mbiame. Socio-cultural and economic life is fairly evenly distributed throughout the

division although there is a concentration of business life in the divisional headquarters. Specifically, this study was conducted in rural areas within five of the six subdivisions of Bui Division, namely Kumbo, Oku, Jakiri, Mbiame and Nkum, and covered the rural village areas of Simonkoh, Vekovi, Dzeng, Jikejem. Ichim, Manchok, Tadu, Kevu, Nseh, Takijah, Meluf, Ngondzen, Sop, Melim, Mbogkeghas. These are villages where potato farming is practised intensively owing to favourable climatic conditions.

Geographically, Bui Division is hilly; Mount Oku, which is the second-highest mountain in West Africa, is found in this region. The hilly nature of the study area provides watersheds and wetlands in the lowlands areas which are utilised in the dry season for agricultural production, especially for the cultivation of vegetables.

Climatically, Bui Division has two seasons: the dry and the rainy seasons. The dry season runs from November to February while the rainy season runs from March to October. Recently, as a consequence of climate change, there have been noticeable fluctuations in rainfall. Evidence shows (Table 3.3) that the highest rainfall is usually recorded in August and September; the hottest months are January and February. Available data (Table 3.2) shows the annual average temperature over a period of 15 years (1998 to 2012) as 24.43°Celsius. The soils in this area are rich volcanic soils thanks to the presence of the volcanic Mount Oku (Bui Divisional Delegation of Agriculture and Rural Development [DDARD], 2016). The infrastructural network in terms of farm-to-market roads is poorly developed and most roads are seasonal. During the rainy season, the inaccessible nature of the road network means that farmers must store some of their products on-farm (DDARD, 2016).

Administratively, Bui Division is headed by a senior divisional officer assisted by subdivisional officers who head the six subdivisions. Traditional authorities also play very significant roles in the administration of the division. The

traditional authorities have more influence over the people and are highly respected by all (MINATD - Ministry of Territorial Administration and Decentralisation - Bui, 2016).

Land ownership is still very traditional with customary land tenure engagements highly utilized and respected by the people. This land tenure system accounts for the small farm sizes owned by the farmers in Bui. In addition, indigenous farming practices in such small-sized holdings rely on traditional knowledge of the people which have been developed over a long period of time.

The study area has an agrarian profile and is therefore a reasonably representative sample of Cameroon as a whole. Agriculture in this area is organised at the household level, with the community playing supportive roles such as in seed exchanges, and in taking decisions on when planting and harvesting should begin. The smallholder nature of farming activities based on indigenous knowledge makes the area a suitable choice as a field laboratory to explore the interplay of indigenous experiences and interventions which affect local farming practices with respect to reducing postharvest losses.

TABLE 3.2: AVERAGE MONTHLY TEMPERATURE FIGURES FROM 1998 TO 2012 (IN DEGREES CELSIUS)

MONTH	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
JAN	29.5	23.2	23.4	24.2	25.5	21.9	25.0	35.9	22.5	23.9	21.3	21.4	22.6	22.9	22.6
FEB	23.8	24.5	24.1	24.5	26.3	26.8	27.1	36.9	23.1	22.1	22.9	23.1	23.6	23.6	23.6
MAR	24.5	27.0	23.5	25.6	26.3	27.7	26.3	36.4	21.8	23.6	24.0	24.3	24.05	23.8	24.0
APR	25.1	23.8	23.3	23.8	24.0	24.8	24.2	35.9	24.2	24.8	23.5	22.0	24.0	23.6	24.0
MAY	22.9	25.2	22.8	24.7	24.0	24.1	22.2	35.1	23.1	22.1	22.7	22.7	22.9	22.9	22.9
JUN	23.2	24.5	22.2	23.1	22.8	21.9	23.1	35.1	22.7	22.5	23.0	23.0	23.0	23.0	23.0
JUL	22.5	25.6	22.1	21.0	20.4	22.1	21.6	34.9	32.1	22.2	21.8	21.8	21.8	21.8	21.8
AUG	22.0	24.0	22.5	22.9	22.0	21.5	20.3	35.1	23.1	22.0	21.8	22.3	21.8	21.8	21.8
SEP	23.3	23.3	22.5	22.2	24.2	22.6	21.0	35.4	23.5	21.4	23.6	23.6	24.0	24.0	24.5
OCT	24.0	23.0	22.8	23.0	23.5	23.8	23.3	34.6	21.3	22.6	23.4	23.4	23.4	23.7	23.4
NOV	24.7	24.2	24.9	25.2	25.7	24.6	26.2	35.0	21.8	21.9	23.5	24.4	24.0	24.1	24.0
DEC	26.0	25.7	26.1	26.8	27.0	27.6	26.0	36.5	23.7	21.7	24.3	24.8	24.7	24.9	24.7

Source: Divisional Service for Agricultural Surveys and Statistics (2016)

TABLE 3.3: MONTHLY RAINFALL FIGURES FROM 1998 TO 2009 (IN MILLIMETERS)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL
1998	24.2	00.0	66.8	20.7	97.4	195.5	314.5	267.8	334.2	196.5	34.2	00.0	1758.1
1999	00.0	00.0	52.4	100.5	85.0	92.5	165.1	245.0	97.0	356.4	84.9	13.2	1292.4
2000	00.0	00.0	00.0	192.4	198.9	299.0	234.5	234.7	61.2	79.0	28.2	00.0	1336.9
2001	00.0	00.0	02.7	45.3	175.4	339.9	119.9	378.9	291.1	149.1	00.0	00.0	1444.3
2002	00.0	00.0	66.5	109.5	46.0	222.5	276.2	350.8	298.2	343.0	93.3	11.2	1817.0
2003	06.4	11.2	27.9	117.3	79.3	301.4	203.1	285.1	41.0	266.0	87.6	00.0	1597.3
2004	04.9	00.0	51.7	114.4	126.8	185.3	391.3	310.7	259.0	169.4	103.4	00.0	1716.9
2005	00.0	36.2	61.8	159.3	146.3	257.5	316.1	376.9	400.0	124.5	82.5	00.0	1961.1
2006	0.4	58.5	44.3	128.3	264.3	251.8	275.1	249.6	352.1	246.9	09.9	00.0	1881.2
2007	00.0	00.0	76.3	156.4	164.1	166.0	329.2	256.8	310.0	213.9	59.2	00.0	1731.9
2008	04.6	00.0	106.3	207.1	161.5	266.1	289.5	293.0	363.6	148.8	25.0	28.5	1894.0
2009	00.0	7.5	81.0	132.7	253.9	207.5	185.3	255.9	299.0	289.7	39.1	00.0	1751.6

Source: Divisional Service for Agricultural Surveys and Statistics (2016)

Furthermore, Bui Division has been chosen for this study because it is totally void of major manufacturing industries, so the main source of income for the people is peasant agriculture (practiced mostly by women), cattle rearing and trading. Due to the fact that agriculture (with numerous peasant and smallholdings producing palm products, coffee and food crops like potatoes, beans and maize) is the main source of livelihood in the division, the agricultural industry is the focus of the study. Within the agricultural industry, potato production is wide spread (produced for home consumption and also like a cash crop), perishable with a likelihood of high postharvest losses and for that reason, the study intends to focus on potatoes.

Of great consideration also is the fact that Bui Division in the North West Region of Cameroon is reported to be the highest potato producing zone in the country (MINADER, 2015). The constrained resource setting in Cameroon thus necessitated the choice of Bui as the study area to understand the indigenous practices as utilized in potato farming by the indigenous of the highest potato production area in Cameroon. Also, noting that in developing countries like Cameroon, significant postharvest losses occur at the farm level as a consequence of harvesting and packaging methods (World Bank, 2010) necessitated this study to be conducted in Bui Division. (see Figure 3.1: Traditional versus mechanised postharvest chain)

3.4 RESEARCH DESIGN

The research design is descriptive. A descriptive study depicts participants in an accurate manner. Descriptive research examines a phenomenon the way it is thus focusing on understanding experiences and attitudes as obtained within a particular context. This makes descriptive research suitable for the study as the study aims at examining indigenous practices of farmers within the context of potato farming and in the specific location of Bui Division in the North West Region

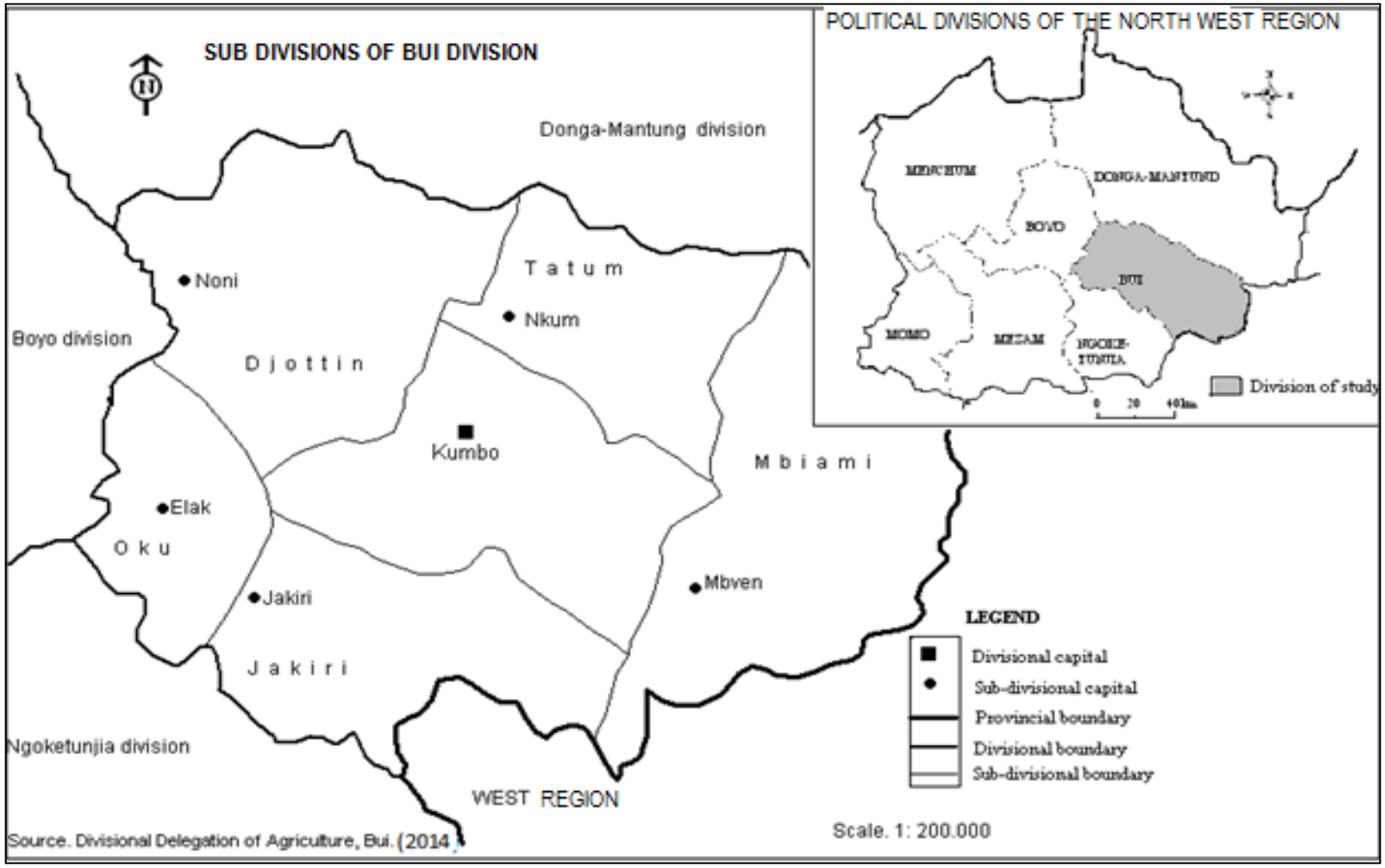
of Cameroon. Two main descriptive methods were adopted: study- observation, defined as a method of viewing and recording the participants and case study, defined as an in-depth study of an individual or a group of individuals.

According to Willig, (2001), the case study design provides the researcher with an opportunity to study a phenomenon of interest in order to explore how the phenomenon exists within a particular context. The general characteristics of a case study research design as highlighted by Hayes, (2000) are:

- Emphasis on description of behaviour, experience and processes within a specific context in which they occur.
- The researcher combines both subjective and objective data as bases for inferences within the specific context, thus achieving in-depth understanding.
- Case study designs are process oriented, enabling the researcher to explore and describe the nature of processes which have occurred over time and which may be continuing.

In this research, the case studied was the Potato Farmers in Bui Division. Potato farmers in Bui Division are small holder farmers (male and female) practicing small holder farming. In this study the small holder farmers were very important because their agricultural practice is purely based on indigenous knowledge. They carried out potato farming for both consumption and for commercial purposes. The high value they place on potato farming makes them to hold a mastery of their indigenous processes which forms the basis of this study.

FIGURE 3.1: MAP OF BUI DIVISION



Source: Divisional Delegation of Agriculture, Bui (2014)

3.4.1 Reasons for adopting the qualitative approach in this study

The following reasons motivated the researcher to adopt the qualitative approach in this study:

- The qualitative approach is designed to reveal a target audience's range of behaviour and the perceptions that drive it with reference to specific topics or issues. This was practically what this study was doing as its audience was potato farmers using indigenous knowledge.
- Qualitative approach is about finding out not just what people think about an issue or topic but why they think in a particular direction. Thus, using the qualitative approach makes participants more involved as they talk about their opinions so that the researcher understands their motivations and feelings.
- Furthermore, the researcher made used of the qualitative approach because it systematically uses a predefined set of procedures to answer the question and thus permitted the researcher to collect in-depth evidence from the field.
- Also, with the qualitative approach, the research can produce findings that were not determined in advance and that can be applicable beyond the immediate boundaries of the study.
- Finally, because the qualitative approach provides information about the "human" side of an issue –behaviours, beliefs, opinions, emotions and relationships of individuals, - the researcher was motivated to adopt it for this study.

3.4.2 Study population

According to Christensen and Burke, (2010), a sample is a representative portion or set chosen from a population for investigation. Therefore, samples are usually selected with the intention of investigating something about the total

population from which the sample is drawn. As noted by Russel (2006); Guest (2012) and Christensen and Burke, (2010), the quality of the sample retained for investigation plays a significant role in defining the quality of the outcome of a study. In this regard, the researcher was careful in selecting participants and thus adopted the purposive sampling technique (defined as a sampling technique in which participants are selected because they are versed with the study focus) to ensure that the participants had in-depth knowledge of the purpose of the study. This was done with the aim of ensuring reliability and a deeper understanding of data collected.

Information gotten from the Bui Divisional Delegation of Agriculture and Rural Development indicated the sub divisions in which potato farming was highly practiced by all households. In these sub divisions, the specific communities where potato farming was widely practiced were identified and then subjected to selection on the basis of proximity.

A total of 405 participants took part in the study. The participants hailed from 5 of the 6 Sub Divisions in Bui division namely: Jakiri Sub Division, Oku Sub Division, Nkum Sub Division, Mbiame Sub Division and Kumbo Sub Division. These sub divisions according to the researcher's observations and confirmation from the Divisional Chief in charge of the Roots and Tubers Project in Bui Division are those where potato production is practiced.

Four types of sample population were used in this study namely farmers (small holder farmers) involved in potato farming, officials working for the Ministry of Agriculture and Rural Development; and other stakeholders like NGOs and other small holder initiatives serving farmers as well as traditional authorities. These categories were selected because their activities involve small holder farmers in the communities of Bui Division.

In the following paragraphs, the researcher explains why and how each sample was important for the study.

3.4.3 Farmers

A total of 360 farmers took part in this study. These participants hailed from 6 villages in 5 sub divisions of the 6 sub divisions in Bui Division namely: Vekovi and Sop in Jakiri, Sub Division, Simonkoh, Jikejem, Mbogkeghas, Manchok and Kevu in Oku Sub Division, Nseh, and Takijah in Nkum, Tadu and Meluf in Kumbo sub division and Dzeng in Mbiame Sub Division. Out of the 360 farmers, 300 of them constituted the sample that participated in the personal interviews. The remaining 60 farmers were grouped and twelve focus group discussions were conducted in the selected villages. Each focus group discussion was made up of five participants. The youngest study participant was 35 years old while the eldest was 68 years old.The majority of the farmers were less than 45 years old. A total of 215 participants were female and 145 were male. This was simply due to the fact that the majority of small holder farming activities was carried out by women. The discussions were held on non farming days (based on the tradition of the people of Bui namely *"Ngongkse, Nsaimnen"* (non farming days for Oku Sub Division) *and "Ngoilum and Kilovii"* (non farming days for Kumbo, Mbiame, Jakiri and Nkum Sub Divisions)which made it possible for the farmers to have enough time to freely discuss with the researcher.

Farmers from the 13 villages (Vekovi and Sop in Jakiri, Sub Division, Simonkoh, Jikejem, Mbogkeghas, Manchok and Kevu in Oku Sub Division, Nseh, and Takijah in Nkum, Tadu and Meluf in Kumbo Sub Division and Dzeng in Mbiame Sub Division) were very important to the study in the following ways:

- These villages according to the researcher's observations and confirmation from the Divisional Chief in charge of the Roots and Tubers Project in Bui Division were the dominant villages in potato production.
- In the selected villages, agricultural practice was very dependent on traditional knowledge. The participants were thus very knowledgeable in indigenous practices.
- Potato farming was grown for commerce and for home consumption thus traditional practices used in minimizing postharvest losses to benefit from higher prices during off season could easily be studied.
- Since agricultural practice in the selected villages was still practiced with a high influence of customary laws, the farmers interacted among themselves and thus their practices were likely to be with less variation. This was intended to help ensure that the data collected was accurate and relevant to the study. Therefore differences in their farming practices could result from the individual farmers' preferences and perceptions and thus provide a wider scope for a deep understanding of the different indigenous practices and the reasons for their adoption by various farmers.

It is worth mentioning that the farmers were purposively selected such that only farmers carrying out potato farming with the help of indigenous knowledge techniques were selected. Thus mainly small holder farmers were selected and constituted the sampling frame of farmers.

3.4.4 Officials of the Ministry of Agriculture and Rural Development

In November 2015, a meeting was held with the Divisional Chief of Agricultural Statistics to arrange in advance and identify the agricultural extension workers / officials who were to be interviewed during the study. This made it possible for extension workers and agricultural staff working in the six major potato producing villages in Bui Division to be identified. A total of fifteen officials were

interviewed. It is worth mentioning that agricultural extension workers are officials of the Ministry of Agriculture and Rural Development who are expected on daily basis to advice farmers in the field.

The sampling of officials of the Ministry of Agriculture and Rural Development working in the 13 selected villages was very important in this study because:

- They had close contact and interacted often with farmers. Through such interactions, they had gathered information on why and how the indigenous farmers practice potato farming. They were also very necessary in the study as they helped gave some insights to the researcher and could also easily explain some details that the farmers had difficulties explaining to the researcher.
- They had deep knowledge of the study site and therefore could direct the researcher on the major potato production areas. This helped the researcher to concentrate on areas where accurate and relevant information could be acquired.

Therefore, the sampling of officials of the Ministry of Agriculture and Rural Development working in the Roots and Tubers Project was very important for the study and greatly helped in the collection of data as well provided insights.

3.4.5 NGOs and Institutions that promote farming

Some institutions directly involved in the promotion of agriculture in the Division equally contributed significantly to the realization of the purpose of the study. These included NGOs like CAMGEW (Cameroon Gender and Environmental Watch) , SOPISDEW (Society for the Promotion of Initiative in Sustainable Development and Welfare) and small holder support projects like the

ATP (Agricultural Training Project), ACEFA (Programme for the Improvement of the Competitiveness of Agro-pastoral Farm Families), and PACA (Agricultural Competitiveness Project). A total of 8 NGO staff were interviewed that is 4 staff from CAMGEW and 4 staff from SOPISDEW. Concerning institutions with small holder agricultural support programmes in the communities, a total of 7 staff were interviewed, 2 from ATP, 3 from ACEFA and 2 from PACA.

The sampling of NGOs and institutions that promote agriculture in the study area was very important in this study because:

- These institutions had poverty alleviation as their motive for operating and dwelled their activities on alleviating poverty through supporting agriculture. Their activities thus entailed a lot of interactions with farmers. Through such interactions, they gather information on why and how the indigenous farmers practice potato farming. They were therefore very necessary in the study as they gave some insights to the researcher on the indigenous practices that could be promoted to minimize postharvest losses in potato farming and improve on the living conditions of the farmers.

3.4.6 Traditional authorities

The role played by traditional authorities in the realization of the study cannot be overemphasized. Traditional authorities are the custodians of the traditions and cultures of a people. A total of fifteen traditional authorities took part in the study. They provided deep insight on the traditional farming practices of the people in the division.

3.4.7 Sampling technique

Data collection is of crucial importance in research, as collected data is meant to contribute to a better understanding of the issue under study. Therefore participants should be carefully selected to ensure that they provide accurate data for the study.

In order to adequately address the stated research objectives, purposive sampling of the participants was done. According to Tongco (2007), purposive sampling technique is a type of non-probability sampling that is most effective when one needs to study a certain cultural domain with knowledgeable experts within. In this study, the researcher made a deliberate choice of informants due to the qualities the researcher deemed necessary for the study.

This study was carried out in Bui Division, North West Region of Cameroon. Bui division is made up of six sub divisions: Kumbo, Oku, Jakiri, Noni, Nkum and Mbiame. By employing purposeful sampling technique, 15 villages namely: Simonkoh, Vekovi, Dzeng, Jikejem. Ichim, Manchok, Tadu, Kevu, Nseh, Takijah, Meluf, Ngondzen, Sop, Melim, Mbogkeghas were selected to be areas where study data was to be collected. These villages were those where potato farming was highly practiced due to favourable climatic conditions, fertile soils and abundant rain fall with two seasons (dry and rainy).

The use of this technique also made it possible for respondents to be truly people engaged in indigenous farming with wide experience in potato farming. Three groups of respondents were purposely sampled in the study. These include: small holder farmers involved in potato farming, some officials working in the Ministry of Agriculture and Rural Development; and officials working in NGOs and other institutions involved in rural agriculture.

3.4.8 Sampling criteria

The sampling criteria were as follows. For farmers:

- The participant had to be an indigene of any of the villages in Bui Division except Noni. Noni was excluded because potato is not grown there.
- He/she had to be at least 25 years old. Twenty years was selected because it was considered that at this age, an individual in the study area must have been involved in potato farming and hence will be versed with the indigenous potato farming practices.
- He/she had to be in a good mental state in order to consent to participation. The mental state was considered necessary for appropriate responses.
- He/she had to have been actively engaged in potato farming, owning a farm or working in their family farm.
- He/she had to have been into potato farming for over five years. Five years was considered as time long enough to be versed with the indigenous potato farming practices.

For the Officials of the Ministry of Agriculture and Rural Development:

- The participant had to be at least a trained agricultural technician.
- He/she must have worked in Bui Division for at least 5 years.
- He/she had to be actively involved in rendering advisory services to potato farmers in the study area.

For the staff of NGOs and Institutions that promote farming:

- The participant had to be an employee working for such an institution.
- The institution had to have been actively involved in promoting agriculture and especially potato farming in Bui Division for at least 5 years.
- Participants selected from the institution had to be those engaged in activities linked to potato farming.

For the Traditional Authorities:

- Participants had to be from one of the 13 villages selected for the study. Further, he must have been in power for at least 5years. Five years was considered as time long enough for him to have observed occurrences related to traditional activities and potato farming in the study area.

3.4.9 Data collection

The methodological framework of this study was qualitative. As noted by Chambers (1994), Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) are the most appropriate ways of collecting data when conducting a qualitative study. This is because these methods make it possible for the researcher to participate in the activities in the study area thus making it possible for salient issues that might be ignored by study participants to be uncovered. The qualitative context of this study made data to be collected in the form of words and through observations. Also, secondary data sources were used in the development of the study objectives as well as in understanding indigenous practices as utilized in agricultural production across the world. Therefore, in order to collect adequate and accurate data, different data collection instruments and procedures were used in the field. These included structured personal interviews, participant and field observations and focus group discussions. These instruments and the procedures used are discussed below.

3.4.9.1 Semi-structured interviews

In the following paragraphs, the researcher discusses the reasons for using semi structured interviews and how it was used in this study.

3.4.9.2 Reasons for using structured interviews in this study

The following reasons motivated the researcher to make use of structured personal interviews in this study:

- The researcher used structured interviews because with it, questions are prepared ahead of time.
- The researcher used structured personal interviews because these allow informants with the freedom to express their views in their own terms and this makes it possible for reliable qualitative data to be collected as the interviewee is given the latitude to clearly and freely express his/her thoughts.
- Furthermore, the nature of the study which was based on peoples experiences necessitated that for appropriate data to be collected, data collection should be interactive and communication should be two way in nature. Structured personal interviews encourage two-way communication since it allows interviewees to ask questions to the researcher so as to better understand the questions posed by the researcher.
- More still, the researcher used structured personal interviews in this study because information obtained from structured interviews provides not just answers, but the reasons for the answers.
- The researcher also used personal interviews because they provide for face-to-face discussions which allows for participants to easily discuss sensitive issues.

With the above considerations, the researcher thinks that he was able to collect appropriate data for the study. In the next section, the researcher presents the process of data recording using the structured interviews.

3.4.9.3 Semi-structured interview process

As noted by Lado (2004) personal interviews involve face-to-face discussion with respondents. Semi structured interviews were done to have a deeper understanding of how the respondents see the world around them, that is, their lives, experiences and realities as stakeholders in the potato farming value chain. Interviews were conducted with farmers, Officials of the Ministry of Agriculture and Rural Development, staff of some institutions that promote agriculture (potato farming) and traditional authorities. Based on the specific issues that the researcher could get from the different sample populations, the interview guide was divided into different sections.

Interview with local farmers

Interviews with farmers were conducted on weekly non farming days namely *"Ngongkse, Nsaimnen"* (non farming days for Oku Sub Division) *and "Ngoilum and Kilovii"* (non farming days for Kumbo, Mbiame, Jakiri and Nkum Sub Divisions)**.** The interview venues were at the respective homes of the farmers. During interviews with farmers, the researcher obtained information on their day to day practices in potato farming, indigenous methods they employ to minimize post-harvest losses, challenges they face in potato farming and the impacts of such challenges on them as well as what they could desire be done to improve on their indigenous practices so as to minimize post harvest losses. To attain this, the interview guide was divided into parts.

The first part of the guide dealt with demographic information of the interviewee. The demographic information was necessary because for example the age of the respondents could be an indication of how long he/she has been involved in using indigenous knowledge in potato farming and thus through such an interviewee much data could be collected and indigenous knowledge evolution

identified if any. This section thus gathered information relating to interviewees age, source of labour for farm activities, average farm size, village of origin, level of education, sex, length of time spent in potato farming, family size, seed source among others.

The next section of the interview gathered information on the nature of potato farming in Bui Division. Key data collection variables included seed source, technology utilized in preparing fields, types of potato species grown, method of soil nutrient replenishment, type of agricultural practice (mono-cropping or intercropping) among others. This helped in providing a deeper understanding of the indigenous nature of potato farming in Bui Division, North West Region of Cameroon.

Next, the interview tried to gather data so as to ascertain the efficacy of indigenous techniques of farming, processing and preservation. In this regard, open ended questions were posed relating to how farmers determine: when to start planting, when the potato is ready for harvest, when, where and how to store their potatoes. Further questions were asked to understand the indigenous techniques used in determining good seeds, how long (farming seasons) are the seeds used, the level of success rate of using either mono-cropping or intercropping. Also, to further ascertain efficacy, questions were asked relating to the indigenous methods of potato processing and preservation. These included questions such as what quantity of harvest (estimated in tins) is loss when the various processing and preservation methods are used, what factors are responsible for the losses, what are the requirements or things needed to use any of the listed preservation and processing techniques, and also which technique the farmers would like to be enhanced to help minimize postharvest losses in potato farming among others. Also, data was collected to ascertain if there existed any difference in storage / preservation methods between potato seedling and the potato meant for consumption.

Furthermore, the interview guide focused on establishing the challenges faced in the utilization of indigenous knowledge for potato production, processing and preservation in Bui Division. To achieve this, the interviewees listed out the challenges and explained them together with the factors to which they could be attributed. The impact of the challenges and the measures being adopted to overcome the challenges by the farmers were also listed. This helped establish the evolution of indigenous knowledge thus being in same light with the spatial dimensions of indigenous ecological knowledge as presented by Woodley (2004).

More still, the interview guide collected data on the impact of the challenges faced by farming in utilizing indigenous knowledge based techniques in potato farming. The farmers were guided to identify impacts and relate them to specific challenges. This helped determine the potential benefits to be experienced by the agricultural industry and the entire economy of Cameroon should new ways be advanced.

Interviews were conducted while sitting in the farmer's house. This was basically between the interviewee and the researcher though in some cases elderly children of the farmer and at times the husband were also present. Great success was registered because the farmers were the key target of the study. Information gathered from the interviews contributed greatly in attaining the purpose of the study as farmers narrated their experiences. This greatly helped in understanding the situation of indigenous knowledge practices in potato farming and their efficiency in minimizing postharvest losses. On average, interviews lasted about 45minutes and were conducted either in "pidgin English" or in the local languages which the researcher was also versed with.

Interview with staff of the Ministry of Agriculture and Rural Development

Interviews with staff of the Ministry of Agriculture and Rural Development were conducted during normal working days and hours of the week from Monday to Friday. The interview venues were at their respective offices. During interviews with staff of the Ministry of Agriculture and Rural Development, the researcher obtained information on their day to day practices in potato farms, indigenous methods they employ to minimize post-harvest losses, challenges they face in potato farming and the impacts of such challenges on potato farming in the area. Also, the researcher interviewed the agricultural extension workers to give their suggestions on what they think based on their experience working with the farmers could be done to advance the indigenous practices so as to minimize post harvest losses in potato farming. To attain this, the interview guide was divided into parts.

Open ended questions were used to gather data from agricultural authorities and coordinators of small holder support programmes, operating in Bui Division. According to Gill and Phil (2010), open ended questions are questions that do not impose limitations and leave the respondents free to answer in their own terms. Using open ended questions made it possible for data to be extracted with greater depth and meaning, as such revealing relevant issues. It was assumed that prior to implementing potato farming programmes, the agricultural officials and the coordinators of such programmes conducted baseline surveys to understand the existing practices of the people so as to best develop such programmes. With this assumption, questions were posed to get their description of the indigenous practices of the people in relation to potato farming, processing and preservation, the existing challenges of the indigenous methods as noted by them as well as the consequences of the challenges. Further, the opinions of these officials as to which indigenous methods they think could be enhanced were sought. Noting that the nature of the roles played by experts can affect a programme delivery system and its effectiveness (Chambers, 1994), these officials were asked questions

requesting they suggest ways by which indigenous knowledge of the people of Bui Division as they have seen being practiced could be enhanced.

In the study area, the number of government agricultural extension workers was few. A total of fifteen individual interviews were conducted with 15 government agricultural extension workers serving in the concerned villages. During interviews, the agricultural extension workers played the principal role of informant providing in-depth information as they have seen interacting with the farmers in relation to potato farming. The information gotten from them was very useful in developing the framework for the enhancement of indigenous knowledge practices of the people of Bui Division so as to minimize postharvest losses in potato farming. More still, their participation in the study contributed in understanding the past and current practices of small holder potato farmers in Bui Division and thus helped in the development of recommendations for consideration by the different stakeholders.

Furthermore, data collected from the agricultural officers on climatic conditions in Bui Division (temperature and rainfall) and road network, the agricultural market information system in place helped in understanding the magnitude of the effect of climate change and its impact on potato farming as well as postharvest management challenge. More still, the agricultural market information system in place helped in understanding the challenges linked to marketing especially as potato was grown not just for consumption but also for commercial purposes.

Interview with NGOs and institutions that support farming

Some institutions that support farming in Bui Division were interviewed. The interviews were conducted during normal working days and hours of the week from Monday to Friday. The interview venues were at the respective institutions. During these interviews, the researcher obtained information on their day to day

involvement with potato farmers. These included the types of activities they carry out with the potato farmers, their understanding of the indigenous practices employed in potato farming, their weaknesses and strengths. Also, the researcher gathered the opinions of these staff on what based on their experience working with the farmers could be done to advance the indigenous practices so as to minimize post harvest losses in potato farming.

Furthermore, during interviews with staff of institutions that support farming, the researcher gathered information to understand if and how western methods of potato farming, processing/preservation have been blended and used with the indigenous techniques of the people in this locality so as to improve on productivity and minimize postharvest losses.

The interview process followed a predefined semi structure guide which started with generalities such as asking questions on the indigenous nature of potato farming, the indigenous techniques of processing and preservation, and then went onto the specificities such as the efficacy of such indigenous techniques and what could be done to enhance them. The questions were followed with probes for a clearer understanding and to ensure that more in-depth data be collected. To attain this, the staff of these institutions played a key role during the interview explaining examples from their experience in the Division.

A total of 15 staff were interviewed from some NGOs and Institutions that support agriculture in Bui. These included four staff from CAMGEW (Cameroon Gender and Environmental Watch) with interviews held at Kumbo, four staff from SOPISDEW (Society for the Promotion of Initiative in Sustainable Development and Welfare) with interviews held at Oku, two staff from ATP (Agricultural Training Project) with interviews at Kumbo, three staff from ACEFA (Program for the Improvement of the Competitiveness of Agro-pastoral Farm Families) with

interviews held at their Divisional Coordination office in Kumbo, and two staff from PACA (Agricultural Competitiveness Project) with interviews held at Kumbo.

Significant success was registered from these interviews. The participants provided information which helped supplement the information gotten from farmers. These included issues like why the farmers were highly involved in seed exchanges, the impact of potato farming on agriculture and on the people of Bui Division. Such information helped in the development of the framework for the advancement of the indigenous knowledge of the people so as to minimize postharvest losses in potato farming.

Some institutions directly involved in the promotion of agriculture in the Division equally contributed significantly to the realization of the purpose of the study. These included NGOs like CAMGEW (Cameroon Gender and Environmental Watch), SOPISDEW (Society for the Promotion of Initiative in Sustainable Development and Welfare) and small holder support projects like the ATP (Agricultural Training Project), ACEFA (Program for the Improvement of the Competitiveness of Agro-pastoral Farm Families), and PACA (Agricultural Competitiveness Project). A total of 8 NGO staff were interviewed and 7 staff working within small holder agricultural support programmes in the communities.

These institutions had poverty alleviation as their motive for operating and based their activities on alleviating poverty through supporting agriculture. Their activities thus entailed a lot of interactions with farmers. Through such interactions, they gather information on why and how the indigenous farmers practice potato farming. They were thus very necessary in the study as they gave some insights to the researcher on the indigenous practices that could be promoted to minimize postharvest losses in potato farming and improve on the living conditions of the farmers.

Interview with traditional authorities

Interviews with traditional authorities were held during the week except on these day *"Ngongkse, Nsaimnen"* (non farming days for Oku Sub Division) *and "Ngoilum and Kilovii"* (non farming days for Kumbo, Mbiame, Jakiri and Nkum Sub Divisions). These non farming days are days on which the traditional authorities carry out rituals and thus could not be available for interviews. The interviews were held in their respective homes. The information gotten from them was basically on traditional practices and how they relate to farming. Information was thus obtained on traditional practices that are done before planting and harvesting begins. Also, the relationship between those practices and yields and possible postharvest related losses were asked from the traditional rulers. This information helped the researcher in developing a better understanding of indigenous knowledge practices and how they impacted on agricultural performance with reference to potato farming in Bui Division.

A total of fifteen interviews were held; three per sub division. Traditional authorities are the custodians of the traditions and cultures of a people and their role in this study was basically to provide the relationship(s) between those traditional beliefs and farming. They thus provided information which could not be known by the farmers.

3.4.9.4 Process or procedure / method(s) of data recording during field interviews

A case study protocol should be well thought-out so that data recording should be in depth and comprehensive. In this study, the researcher ensured that the field procedures emphasized on adequately collecting data. Prior to commencing the data recording process the researcher ensured that:

- He has gained access to key organizations and interviewees needed in the study by knowing their locations and having their contact numbers.
- Resources needed in field data recording were available – a personal computer, writing instruments, paper, pens, pencils, note book, and pictures.
- A clear schedule of the data collection activities was made with provisions for unanticipated events, including changes in the availability of interviewees (study participants).

Once the above 3 issues were ensured, the researcher then engaged in data collection using the interview guide. One day to the scheduled interview day, concerned participants were contacted by phone to remind them and ascertain their availability. Recording of data during personal interview consisted of field notes taken in field notebooks. Some audio recordings were also done. The data recording was conducted following the interview guide. This thus ensured a chronology in the responses and eased the process of data analysis.

Discussions with each interviewee were recorded separately in the notebook and his /her contact details were noted. At the close of each day, the researcher expanded the recorded notes. During the notes expansion, where there was need for details, the researcher contacted the participant by phone. In some situations, the sketch a map of the participants' area was done. This helped marked where certain activities were taking place and places where follow-up interviews were needed.

For staff of the Ministry of Agriculture and Rural Development, NGO Staff and officials of institutions that support agriculture, interviews were conducted during the working week and during working hours and the interviews with traditional authorities were conducted in other days except on *"Country Sunday".* The language used during field data collection was Pidgin English which is common and known by almost everybody. However, some participants spoke in

the dialect. The use of the dialects did not create any negative effect because the researcher was versed and have mastery of the local languages of the study area. However in some situations, the researcher was assisted by interpreters who work at the Local Language Centers in the respective study villages. These interpreters helped clarify some jargons and parables in the local languages. This was done in confidentiality as the researcher extracted the jargons and parables and gave to the interpreters without discussing the source.

3.4.9.5 Participant and field observations

According to Gill and Phil (2010), participant and field observation is a technique of gathering data in qualitative research where by the researcher participates fully in the activities related to the study. Participant and field observations enable the researcher to share the experiences by not merely observing but also feeling it emotionally. In this study, the researcher adopted the participant and field observations in order to gather more data. The researcher took part in farming activities with farmers such as in making ridges, weeding and harvesting potatoes with farmers. Involvement in this chain of activities made it possible for more data to be collected on how farmers handled and managed the crop. Specifically, details like grading during harvesting to identify seeds, identifying matured potatoes for harvesting, preparing on and off farm storage places were discovered. These observations were conducted throughout the research, especially during peak periods for the various farming practices. This made it possible for variations in practices between potatoes grown during the dry season and that grown during the season to be identified and noted.

During participant and field observations the researcher visited thirty farms and postharvest storage facilities in the study area and made observations at all stages of crop production and preservation. The selection of the thirty farms was such that 15 were those that had no on farm preservation facilities and 15 were

those that had both on and off farm preservation facilities. Farms visited were those of some farmers who participated in the study. Detailed data on planting dates, pests, diseases, cropping pattern, determining when the potatoes are ready for harvesting, soil nutrient regeneration methods and general potato indigenous postharvest management practices were gathered. Photographs of the farms, farming practices, farming tools, preservation and storage facilities were taken to record issues observed in the field.

Participant and field observations took place in both farming days and non-farming days. During farming days, activities were carried out in the farms and during non-farming days, activities were carried out in off-farm preservation facilities.

3.4.9.6 Reasons for conducting participant and field observations in this study

Participant and field observations enable the researcher to share the experiences by not merely observing but also feeling it emotionally. This was very important in this study as it made the researcher to be able to share in the indigenous practices in potato farming. This helped in the uncovering of some details that could have been neglected by study participants if only interviews were conducted. As noted by Beckford and Barker (2007), participant observation establishes good relationship with farmers and makes them more open to the researcher. Furthermore, through participatory observation, activities that the respondents might have hidden or even forgotten were thus studied making it possible for the indigenous practices of the people to be captured as they are.

Also, this method of field participatory observation helped in generating data about the indigenous farming techniques and postharvest practices which respondents could not clearly elaborate verbally, but which through observations could be learnt, such as the identification and grading of potatoes during

harvesting. Thus thanks to participation in the field, the researcher had the opportunity to learn and discover important issues in agriculture as practised by the indigenous people of Bui Division.

3.4.9.7 Procedure of recording data during participant and field observations

Participant and Field observations were carried out by going to farms with farmers during farming days as well as by visiting farmers' preservation facilities off farm during non-farming days. Participant and field observations were structured in order to capture all the activities the indigenous people are engaged in as regards potato farming. This was structured such that observations followed the potato farming calendar making it possible for all the activities to be observed. In the farms, the researcher was actively involved with the farmers carrying out their farm activities.

The first part of participant and field observations was carried out during the dry season from December to February. Observations at this period were focused on gathering information as concerns farm preparations for the rainy season potato farming season. The research observed the farmers as they carried out their activities. Issues observed included how clearing was done, how the cleared grass was packed in the farms, how ridges were constructed, the type of tools used, among others. During this observation process, the researcher asked the farmers questions to understand why they were doing what they did.

Off farm during this period, observations were through visits to preservation facilities. Issues observed were the storage of the potatoes. Also, the researcher observed how indigenous farmers carried out their seed selection activities in preparation for planting in March.

Challenges faced during this first phase of observations included the hilly nature of the place with farms located in far off inaccessible areas. It was not easy for the researcher to satisfy the farmers who started requesting that he goes to the farm with them on a daily basis. At off farm preservation facilities, the greatest challenge was having access and spending time at the preservation facilities. Traditional beliefs in the place were such that some farmers even refused the researcher from accessing their preservation facilities for fear that what they had in their storerooms could disappear. It is worth mentioning that a good number of the participants accepted to be observed but refused the researcher from touching their seeds for fear that their yields may be transferred mystically, - a widely believed issue.

Documentation of participant and field observation data at this stage consisted of field notes recorded in field notebooks and photographs taken. Video recording was not done because the study participants rejected it. The data was records of what the researcher experienced, what he learned through interaction with farmers, and what he observed. Thus field notes included an account of events, how the study participants behaved and reacted, what was said in conversation, physical activities, the researcher's subjective responses (and interpretations) to what was observed, and all other details and observations necessary to make the participant observation experience complete.

Field notes were written tactfully during participant observation and also following the activities as observed in the field. The collected notes were expanded on a daily basis when the researchers' memory was still fresh with the details as were observed and shared in the field.

Audio recordings were done when the participants were unable to express themselves in pidgin English. Pidgin English is locally coined from the English language and focuses more on passing a message. These recordings were later

on transcribed with the help of workers in the language centres in the study communities. High confidentially was ensured such that the identity of the respondents was not revealed. Sketch maps of some observation sites where follow-up observation was needed were done. Ethical considerations were made and informed consent obtained before conducting observations. The researcher explained to the participants why the study was carried out and indicated to them that it had no harm on them.

The second part of observations was from March to June. During this period, the researcher was able to observe and participate in potato planting, mulching, and harvesting activities. As was the case in the first phase, some farmers did not approve of the researcher participating in planting. According to the farmers, planting was an activity which involves only members of the family and very close friends. They explained that there are some people who are not gifted and so if they assist you in planting, your crops may not germinate or may germinate and yields will be low. However, everybody accepted the researcher participating in mulching and harvesting. According to the farmers, mulching and harvesting were open activities needing no secrets and everybody could participate in them.

Again, at this stage, documentation of participant and field observation data consisted of field notes recorded in field notebooks and photographs taken. The field notes included an account of events, how the study participants behaved and reacted, what was said in conversation, physical activities, the researchers subjective responses (and interpretations) to what was observed, and all other details and observations necessary to make the participant observation experience complete.

Unfortunately, audio and video recordings were not accepted by the farmers in the second stage of observations and this was respected by the researcher. This

was due to fear of disclosure of identity. Fortunately, they authorized the researcher to take some pictures.

July to September was another period for participant and field observations. During this period, the researcher was opportuned to visit preservation facilities both on farm and off farm. The researcher observed how the farmers dried the potatoes using saw dust, in shelves and the daily activities carried out to ensure the circulation of air in the storage rooms and minimize postharvest losses. These activities were for the potato that was harvested in June. At this same period, the researcher observed farm activities in preparation for the dry season potato farming season.

As in the previous periods, data documentation consisted of field notes recorded in field notebooks and photographs taken. The field notes were an account of events, how the study participants behaved and reacted, what was said in conversation, physical activities, the researcher's subjective responses (and interpretations) to what was observed, and all other details and observations necessary to make the participant observation experience complete.

This period was very challenging as the roads were very muddy and even inaccessible in most cases. This period is the peak period for the rainy season and places are usually cold. This made it possible for the research to see on-farm preservation activities and the state of such on farm facilities.

It is worth mentioning that during the period October to December, farm preparations for the next rainy season farming is ongoing. At this same time, farm activities for eventual harvesting of the dry season potato are on-going. In this way, potato farming is carried out throughout the year.

3.4.9.8 Focus group discussions

Twelve focus group discussions were conducted in the selected villages with farmers who had not been interviewed. Each group was made up of five participants. The selection of participants for focus group discussion was purposefully done. In consultation with the farmers in the respective villages, the venues for the focus group discussions were chosen. The venues in some cases like in Nseh and Vekovi were in another farmer's house that was considered as central to ease movement of the participants. In other villages, the house of the village head was used.

Contrary to participant and field observations that were mostly conducted on farming days, focus group discussion were carried out exclusively on non-farming days namely *"Ngongkse and Nsaimnen"* (non farming days for Oku Sub Division) *and "Ngoilum and Kilovii"* (non farming days for Kumbo, Mbiame, Jakiri and Nkum Sub Divisions).

During pre-arrangement for the focus group discussions, farmers were notified about the topics to be discussed, such as the nature of potato cultivation, how they determine when planting and harvesting should begin, methods of preservation/storage, effectiveness of the various indigenous postharvest preservation methods, challenges faced by them using indigenous methods in potato production, processing and preservation. During the focus group discussion, the researcher acted as a facilitator and made probes to let the participants give much information. The researcher also recorded the conservations as well as took detailed notes. Thanks to the fact that the researcher was versed with the local languages, the focus groups discussions were conducted both in the local language and in pidgin English. This made it possible for the participants to freely express their minds with details. Therefore the level of participation was high and accurate data was gathered and transcribed.

The fact that the focus group discussions were held on non-farming days gave farmers enough time to discuss since they were using the days as resting days and thus the discussions were very lively and open. These discussions made it possible for much data to be generated as the probes resulted in more detail being given by the farmers, as such reflecting respondent's knowledge as closely as was possibly practiced by them. Therefore, through the frank discussions during focus groups meetings, the research was able to get much data about what farmers do and why they do what they do as the farmers told their life stories just the way it occurred day in day out.

However, it was not easy moving to the villages due to the bad road network in the study area. The situation was very chaotic during the rainy seasons as the roads were very muddy and almost inaccessible. Another challenge faced by the researcher was that some farmers were expecting to be motivated for their time. Fortunately, after explanations during the arrangements period, the farmers accepted to participate freely.

3.4.9.9 Secondary data

Secondary data was also utilized in this study. Secondary data was obtained by consulting published research works and documents about the study area. Because there was no meteorologicalstation in the study area, the Divisional Delegation of Agriculture and Rural Development provided data on the past rainfall and temperature averages in the study area. Secondary data played a great role in the development of the objectives of the study, the development of the methodological framework, the theoretical framework, data analysis and interpretation. The following points explain how secondary data was thus used in the study:

A. The review of publications and reports from the Ministry of Agriculture and Rural Development of Cameroon, the United Nations, the Food and Agricultural Organisation, The International Potato Center, helped in the researcher in the development of the study background and the problem statement. Furthermore from the development of the problem statement, other research works in agricultural development across the world especially those focused on indigenous knowledge helped in the development of the objectives of the study. These objectives were developed and stated within the crop specific situation of potato farming in Bui Division.

B. The wealth of knowledge gotten from reviewing literature on indigenous knowledge and agriculture from literal works published by the Food and Agricultural Organisation, MINADER as well as other scholars helped in the development of conceptual framework for this study. Specifically, the review of published works such as those of Brüntrup and Heidhues, 2002; Garnett and Godfray, 2012; Spencer,and Kaindaneh. 1998; Fawole, 2007; Foncho 1982; Horton 1987; Pitrat and Foury, 2003; MINADER 2014 among others helped in understanding the nature of agriculture as practiced across the world and the evolution of potato farming. Furthermore, the works of Ringler *et al.* 2010; Rutatora, 2000; Kilongozi, Kengera and Leshongo, 2005; Beckford and Barker, 2007, Barasa, 2007; Owuor, 2007; Johnson, 1992; and many others provided insights for the development of the concept of indigenous knowledge. The works of many scholars some of which include Parfitt *et al*., 2010; Lundqvist et al., 2008; Stuart, 2009; Brüntrup and Heidhues, 2002; Garnett and Godfray, 2012; Reijntjes *et., al*., 1992; Warren 1991; Hodges *et al.*, 2011; Beckford and Barker, 2007; Bourne, 1977; De Lucia and Assennato, 1994 helped in the development of the concept of postharvest loss for the study. The review of this literature thus helped in buttressing the study argument as the researcher read reported experiences from other parts of the world.

C. The wealth of knowledge based on experiences as reported by other researchers and NGOs in relation to conducting activities especially reports on rural agriculture published by the United Nations, The Food and Agricultural Organisation, International Fund for Agricultural Development play a significant role in developing the methodological framework of the study (the qualitative methodological framework which adopts a case study design was selected for this study). This was because the study participants were generally non literate and thus feel more comfortable providing data in an interactive and participatory mode than filling in questionnaires.

D. Data on how the indigenous people had been carrying out their activities was obtained from the reports of the NGOs and the coordination units of support programs operating in Bui Division. Extensive literature review was done so as to establish the theoretical foundations of indigenous knowledge practices in agricultural development carried out worldwide and more specifically in Bui Division.

E. Finally, secondary data helped in the analysis and interpretation data. This was achieved after in-depth review of qualitative approaches used in data analysis from the works of scholars like Guest et al. (2012); Braun and Clarke (2006); Gill and Phil (2010) and Tongco (2007).The reviewed resulted in the adoption of the thematic network analysis as the analytical technique in this study.

It is worth mentioning that secondary data supplemented the collected primary data. This then was analysed to establish the efficacy of the indigenous practices of the people as utilized in potato farming and to give explanations to why the people make use of such practices. Further, the analysis made it possible for the suggestion of a framework for the enhancement of indigenous practices to minimize postharvest losses in potato farming.

3.4.10 Method of data analysis

This study adopts the thematic network analysis method in analysing the qualitative data generated from participant and field observations, personal interviews and focus group discussion sessions. As noted by Guest et al. (2012), the thematic network analysis method emphasizes pinpointing, examining, and recording patterns within data that are important to the description of a phenomenon.

Generally, the choice of the data analysis method used in a study must be based on some motivating factors and the ability of the method to adequately analyse the collected data in relation to the stated research questions and objectives. In this study, the thematic network analysis was utilized is because of the following reasons:

- The thematic network analysis methods enabled the researcher to establish links between causes and effects and then make more objective evaluation. Thematic network analysis was conducted which resulted in the generation of topics that were combined into themes.
- This research was focused at studying a phenomenon existing in a community which focuses on human experiences, perceptions and way of living. Thus as noted by Guest et al. (2012), thematic network analysis is related to phenomenology and focuses on the human experience, the researcher deemed it important to use this method in the study.
- Further, the fact that the thematic network analysis approach emphasizes participants' perceptions, feelings and experiences as the paramount object of study motivated the researcher’s choice in adopting it as the analytical method.
- Also thematic network analysis allowed the researcher to precisely determine existing relationships between concepts and to compare them

with the generated data. This made it possible for the researcher to associate the various concepts comparing them with the data gathered in different villages at different times during the conduct of field activities in this study.

- Finally, the researcher adopted the thematic network analysis because the study focused on getting interpretations of why the people make use of crop specific methods in minimizing postharvest losses (Nouria, 2007).

3.4.10.1 The Thematic Network Analysis Process

A thematic analysis is one that looks across all the data to identify the common issues that recur, and identify the main themes that summarise all the views you have collected Guest et al. (2012). Applying thematic networks is simply a way of organising a thematic analysis of qualitative data.

Thematic analyses seeks to unearth the themes salient in a text at different levels, and thematic networks aim to facilitate the structuring and depiction of these themes Thematic network is simply a technique for breaking up text, and finding within it explicit rationalizations and their implicit signification.

Drawing from Guest et al. (2012), the key stages in a thematic analysis are:

A. Read and annotate transcripts:

This is the most basic stage. Here you do not provide an overview of the data, but make preliminary observations. This is particularly useful with the first few transcripts, where you are still trying to get a feel for the data.

B. Identify themes:

The next step is to start looking in detail at the data to start identifying themes, Summaries of ‘what is going on here’. In the margins of each transcript or

set of notes, start to note what the interviewee is referring to. Try to make these as abstract

There are three categories of themes in thematic network analysis, namely basic, organising and global themes.

A basic theme is the basic or the lowest order theme that is derived from the textual data. Basic themes are simply premises characteristic of the data, and on their own they say very little about the text or group of texts as a whole. In order for a basic theme to make sense beyond its immediate meaning it needs to be read within the context of other basic themes. Together they represent an organising theme.

An organising theme is a middle –order theme that organises the basic themes into clusters of similar issues.

Global Themes are super-ordinate themes that encompass the principal metaphors in the data as a whole. A global theme is like a claim in that it is a concluding or final tenet. Global themes group sets of organising themes that together present an argument, or a position or an assertion about a given issue or reality.

Furthermore, global themes are macro themes that summarize and make sense of clusters of lower order themes abstracted from and supported by the data. Thus global themes tell us what the texts as a whole are about within the context of a given analysis. A set of texts may well yield more than one global theme, depending on the complexity of the data and the analytic aims. However, these will be much fewer in number than the organising and basic themes.

Each global theme is the core of a thematic network; therefore an analysis may result in more than one thematic network. They are clusters of signification that summarize the principal assumptions of a group of basic themes, so they are more abstract and more revealing of what is going on in the texts.

Thus, organising themes simultaneously group the main ideas proposed by several basic themes and dissect the main assumptions underlying a broader theme that is especially significant in the texts as a whole. in this way a group of organising themes constitute a global theme**.**

3.4.10.2 Validation of data collection instruments and techniques

According to Cooper and Schindler (2003), validation of an instrument is the degree of effectiveness with which a measuring instrument designed for a particular purpose measures that designed purpose. This study employed the face and content validity tests to ensure that the data collection instruments measured the study stated objectives. To ensure face validity, the proposed interview and focus group discussion guides were first given to some University lecturers who read through and made some corrections and suggestions. The guides were then given to the research supervisor who scrutinised and checked for clarity and the appropriateness of language. When due suggestions and corrections from these collaborators were attended to, the interview guides were considered to have attained face validity.

According to Innoisili (1996), content validity is the extent to which an instrument is appropriate in another situation. Cooper and Schindler (2003) add to this view, stating that content validity deals with the extent to which the measuring instrument provides adequate coverage of the stated research questions and objectives. This implies that content validity lays emphasis on covering the scope of the research topic.

To attain content validity, the research interview and focus group discussion guides were developed based on the objectives of the study. The interview guide therefore had four sections reflecting the various objectives and arranged to collect appropriate and adequate data from the study participants. The interview guide was reviewed by the study supervisor and approved as being suitable for the stated objectives of the study. To guarantee validity during field data collection, the researcher continuously communicated the data he had collected to respondents as the research work unfolded. This help check for perceived accuracy and thus made it possible for corrections to be made to misunderstandings where noted.

Considering that this study employed the qualitative technique, efforts at ensuring face and content validity centred on making the study results trustworthy. In the following paragraphs, the researcher explains how the trustworthiness of the study was ensured in this study stating clearly how the issues of credibility, transferability, dependability and conformability of study results were addressed.

3.4.10.3 Trustworthiness of the study

According to Akinyoade, (2012), trustworthiness of qualitative data analysis is all about ensuring that interpretations are credible, transferable, dependable and confirmable. Credibility is about ensuring belief in the study findings. This was ensured in this study through prolonged engagement with participants, considering that they had a mastery of their indigenous practices. Also, the use of triangulation further established credibility.

Transferability deals with the degree to which study results can be generalized or transferred to other context or settings (Learn Higher and MMU, 2008). The researcher achieved transferability by describing the study context,

processes and its central assumptions and criteria used in detail which makes it possible to understand if the results can be applied to other settings.

Concerning dependability, the researcher made an effort to account for the ever-changing context within which the research was carried out establishing how these changes affected the study. For example, rainy season made movements very difficult and in some cases study participants were unable to meet up with schedules. Through meticulous record keeping with clear decision track and ensuring consistency and transparency in the interpretation of data the researcher ensured dependability. This was done by recording interview notes in a chronological manner as different participants were interviewed. Through member checking, transparency in the interpretation of data was ensured thus increasing study credibility.

As noted by Akinyoade, (2012), confirmability is the degree to which study results could be confirmed or corroborated by others. In this study the researcher made efforts to achieve this by documenting. In this way, the researcher searched for instances that contradict prior observations. In such instances, the researcher revisited the respondents for further explanations. Through seeking out for similarities and differences across accounts as presented by participants, the researcher was able to ensure that different perspectives are represented. This helped enhanced the credibility and conformability of the study.

3.4.10.4 Other methods used to ensure validity

Other methods of ensure data validity include member checking and triangulation.

Member checking

Member checks were also used to ensure study credibility. Some of the checks relating to the accuracy of the data were done on the spot in the course of data collection, and some at the end, of the data collection sessions. This was done by reading the transcripts of dialogues to participants in which they participated. The emphasis was to get the participants consider whether their words (the notes taken) match what they actually intended.Also, Nouria (2007), mentions that another element of member checking involved verification of the emerging issues and inferences as were formed during the discussion session. In some cases, participants were asked to offer explanations for particular patterns observed by the researcher.

In addition, the researcher demonstrated clarity in terms of reflection processes during data analysis and subsequent interpretations. This was accompanied with inviting study participants to comment on the interview transcript in order to ascertain that themes created sufficiently reflected the phenomena being investigated.

Triangulation

According to Nouria (2007), Triangulation is a method used to increase the validity of findings in a qualitative study, through deliberately seeking evidence from a wide range of sources and comparing the findings with those of different sources. In this study, the researcher also made use of triangulation to ensure validity. This was done by combining multiple methods and perspectives with

various types of data sources so as to cross-check the results. Basically, the triangulation process in this study involved:

I. Using different methods to measure indicators and then comparing the results. The methods used in this study include focus group discussions, structured personal interviews and observations to measure indicators related to indigenous techniques utilized to minimize postharvest losses in potato farming. In this way, where results are similar it indicates high accuracy and hence validity.

II. By comparing the themes gotten during participant observations (written in field notes) with the themes gotten during field interviews and noting any changes over time, the researcher ensured validity. Where changes were noted, the researcher asked participants to give further explanations to such changes. This further ascertained the credibility of the study.

III. Also, by checking the consistency of what the participants said on the same issue over time helped ensure validity. This was done by revisiting some of the study participants and re-interviewing them using the same questions and then checking to see if there were changes. The lack of changes on the same subject over time was thus an indication of the validity of their responses and hence the validity of the study results.

IV. Finally, “Site Triangulation” was used by the researcher. “Site Triangulation” simply entails involving people from different locations within the study area where the activity under study is carried out. The researcher did this by selecting study participants from all the villages in Bui Division where potato farming is carried out. This helped reduce the effect on the study of particular local factors peculiar to certain villages. The emergence of similar findings from different sites gave greater credibility to the study results.

Finally, the researcher ensured credibility by basing his conclusions on supporting evidence. By visiting and participating in farming activities with the

farmers, the researcher gathered much evidence which helped him to make comparisons with the responses given during focus group discussions and personal interviews.

3.5 REFLEXIVITY AND LIMITATIONS OF THE STUDY

In conducting this research, a number of challenges were faced by the researcher which if fully considered by future researchers some of these may be avoided or mitigated.

Primarily, some of the farmers who had earlier indicated interest were later on not fully interested in the study and either decided to participate partly or not at all. Faced with this situation, the information given by such partial participants was not considered in this study. This was done so as to ensure data reliability and validity.

Also, some of the respondents had difficulties in understanding the interview questions. The researcher did everything possible so that the questions were clear to the respondents. In certain situations, the researcher posed the questions in the local dialects for easy understanding.

Another challenge faced by the researcher had to do with getting institutions that promote agriculture in the study area to participate. The managers of these institutions were initially reluctant to accept participating in the study. The researcher had to visit the institutions several times before they finally accepted the researcher's request.

Furthermore, the researcher faced a great difficulty accessing context specific data for the development of the study literature review and the introductory chapters. Studies related to indigenous knowledge practices in Cameroon were not

readily available in most libraries visited. In some online libraries where some literary works could be gotten, heavy financial obligations were demanded.

The lack of up to date research facilities was another challenge faced by the researcher. Due to financial constraints, the researcher was unable to buy good audio recording devices with microphones. However, the researcher managed to rent some audio devices which were used during data collection in the field.

Finally, the lack of adequate financial resources delayed the study. For example some farmers refused to participate in the study because they demanded some payment which was not readily available.

3.6. ETHICAL CONSIDERATIONS

In research, ethical considerations are critical. Ethics are general norms or standards for behaviour that make a distinction between what is right and what is wrong. According to Tom and Jim (1983), ethical considerations in research aim at respecting the rights of the study participants, doing good and not doing harm and ensuring justice particularly equity.

To achieve these ethical issues, consent and confidentiality must be considered. According to Rocha, (2004) consent deals with ensuring that everyone who participates in a study should have freely consented to participation, without being coerced to do so. This means they should be well-informed about what participation entails, and reassured that declining will not affect any services they receive. Regarding confidentiality, Rocha, (2004) explains that it is essentially about protecting the identity of the study participants. To ensure the respect of ethical issues, the following mechanisms were used by the researcher:

A. Primarily, the researcher provided clear information about himself, including the school where he was studying and how study participants could reach him.

B. The purpose and significance of the research was explained to the study participants. This encouraged them to freely participate in the study.

C. The researcher clearly explained to the study participants what they will be doing and the time period. This made them to know that the study was not infringing into their privacy. Furthermore, the researcher made it clear to the participants that they were free to withdraw from the study at anytime they wished.

D. The potential benefit that the research could bring to the society (including the participants) was explained to the participants. This made the participants to judge if the potential benefit was worthy enough to make them participate in the study.

E. The researcher presented to the study participants how their privacy will be protected during and after the research. For example the researcher explained and agreed with the study participants that their names, locations and other issues found in their preservation rooms shall not be disclosed to other study participants. Also, the reporting of study findings made mention of only one name which makes it difficult to associate to a particular person since there are many people in those same communities bearing such names. This guaranteed the privacy of the participants and thus did not breach any ethical issues.

F. By visiting the Ministry of Agriculture and Rural Development, discussing with the divisional delegate and getting approval for the research, helped make their workers to freely participants.

G. At the level of NGOs, the consent of the coordinators was sought, and the criterion of the type of staff needed to participate was given to them. This resulted in making NGO staff to freely participate since they were aware that their Coordinators were informed about the study.

Basically, on the part of the researcher, ethical considerations were made to avoid bias, by using appropriate research methods, reporting findings without falsification and to ensure the appropriate use of confidential information gathered during the research effort.

3.7 CHAPTER SUMMARY

In this chapter, the researcher discussed the methodological approach used in acquiring, interpreting and analysing the findings that established the efficient indigenous knowledge techniques that can be advanced to increase production and minimize postharvest losses in potato farming in Bui Division, North West Region of Cameroon. The methodological process has been discussed in detail indicating how the research process was conducted. The sample used in this study was purposively selected based on some stated criteria. This was done so as to ensure that the sample selected was versed with what the study was investigating.

The procedure used in designing the research instrument and collecting the data involved several people. Firstly, the research had discussions with the supervisor prior, during the data collection phase. This helped ensure that the research instrument was adequate to collect data which when analysed will address the stated research objectives. Once the instrument was corrected, it was then used in collecting primary and secondary data.

Primary data was obtained from interviews, participant and field observations, and focus group discussions. These were administered to farmers, officials of the Bui Divisional Delegation of Agriculture, coordinators of small holder agricultural support initiatives, staff of NGOs promoting potato farming in the study area and traditional authorities who are the custodians of the people's tradition.

The acquisition of secondary data looked at a review of a wealth of literature in the area of the study. Secondary data greatly assisted the researcher especially in defining the study problem, study background, study objectives and the methodological framework of the research.

The collected data was analysed using thematic network analysis. This data analysis method emphasized the pinpointing, examining, and recording of patterns within data that are important to the description of a phenomenon. Themes were used in identifying the patterns as they occurred and re-occurred. The statistical procedures used to analyse the data involved generating codes, themes and messages that summarized all the views collected. The three categories of themes in thematic network analysis namely basic, organising and global were identified and utilized in analysing data.

Study validity and reliability has also been discussed in this chapter. The researcher made sure that issues related to validity and reliability were well considered so as to ensure the trustworthiness of the study. Techniques like member checking, conclusion based on evidence and triangulation were employed to ensure validity and reliability and hence the trustworthiness of the study. The ethical guidelines of the research, reflexivity and limitations of the study have also been explored in this chapter.

CHAPTER 4

RESULTS AND ANALYSIS

4.1 INTRODUCTION

In the previous chapter, the data has been analysed using Thematic Network Analysis to address the stated research questions and objectives.Thematic analysis is a technique of analysing qualitative data by looking across all the data to identify the common issues that recur, and identify the main themes that summarise all the views collected. This technique was very relevant to this study because this study primarily focused on conducting research with an applied focus on enhancing indigenous techniques to minimise postharvest losses in potato farming. In these analyses, the researcher has systematically presented outcomes based on the interview guide.

To ensure a deeper and clearer understanding of the study findings, this chapter is divided into six sections. Section A presents the demographic characteristics of the study participants; section B looks at the nature of potato farming in Bui Division while section C discusses the impacts of postharvest losses. Section D is concerned with indigenous potato postharvest loss prevention methods and in section E, the researcher presents an analysis of indigenous practices of postharvest prevention methods that can be advanced to minimise postharvest losses. Finally in section F, the major conclusions of the research findings are discussed.

4.2 SECTION A: DEMOGRAPHIC CHARACTERISTICS OF STUDY PARTICIPANTS

In this section, the researcher analyses the findings on the demographic characteristics of the participants in the study. Table 4.1 shows the demographic composition of the respondents. It is worth mentioning that ordinary level means having completed five years of secondary education, advanced level means having completed seven years of secondary education, university level means having earned at least a bachelor's degree.

Table 4.1 reveals that the sample of famers consisted of 215 (59.7%) females and 145 (40.3%) males. Most of these sample farmers (213; 59.2%) fell within the 40 to 45 age group followed by the 46 to 50 age group (66; 18.3%), the 35 to 39 age group (52; 14.4%) and 50-plus age group (29; 8.1%). This is a true reflection of the demographic composition of the Cameroonian farmers, consisting of more females than males and generally between the ages of 35 to 50.

Most of these farmers received primary (208; 57.8%) and ordinary level (112; 31.1%) education, while only 37 (10.3%) and 3 (0.8%) received advanced and university levels of education respectively. Most of the respondents (75.6%) had more than 10 years of farming experience, while 88 (24.4%) indicated 10 and fewer years of experience.

Further, the sample of officials of the Ministry of Agriculture and Rural Development consisted of 6 (40.0%) females and 9 (60.0%) males; the majority, 5 (33.3%) are within the 40 to 45 age group, followed by 4 (26.7%) who are within the 35-39 age group. Three (20.0%) were within the age group 46 to 50 and 3 (20.0%) 50+ age group.

Most of these officials 9 (60.0%) were senior agricultural technicians, 3 (20.0%) were agricultural technicians and 3 (20.0%) were agricultural engineers.

Majority (80%) of the agricultural officials had more than 10 years working experience, while 3 (20.0%) indicated 10 and fewer years of experience.

Table 4.1: DEMOGRAPHIC COMPOSITION OF STUDY RESPONDENTS

Farmers			**N=360**	
Age(in years) – Range	**35 – 39**	**40-45**	**46-50**	**50+**
Frequency	52 (14.4%)	213 (59.2%)	66 (18.3%)	29 (8.1%)
Gender	**Male**	**Female**		
Frequency	145 (40.3%)	215 (59.7%)		
Education	**Primary Education**	**Ordinary Level**	**Advanced Level**	**University Level**
Frequency	208 (57.8%)	112 (31.1%)	37 (10.3%)	3 (0.8%)
Farming Experience (in year) – Range	**5-10**	**11-15**	**16-20**	**21+**
Frequency	88 (24.4%)	102 (28.3%)	105 (29.2%)	65 (18.1%)
Officials of the Ministry of Agriculture and Rural Development				**N=15**
Age(in years) – Range	**35 – 39**	**40-45**	**46-50**	**50+**
Frequency	4 (26.7%)	5 (33.3%)	3 (20.0%)	3 (20.0%)
Gender	**Male**	**Female**		
Frequency	9 (60.0%)	6 (40.0%)		
Education	**Agricultural Technician**	**Senior Agricultural Technician**	**Agricultural Engineer**	**Masters Degree**
Frequency	3 (20.0%)	9 (60.0%)	3 (20.0%)	0 (0.0%)
Working Experience (in year) – Range	**5-10**	**11-15**	**16-20**	**21+**
Frequency	3 (20.0%)	4 (26.7%)	6 (40.0%)	2 (13.3%)
Staff of NGOs and other Institutions that Support Agriculture				**N=15**
Age(in years) – Range	**35 – 39**	**40-45**	**46-50**	**50+**
Frequency	8 (53.3%)	4 (26.7%)	2 (13.3%)	1 (6.7%)
Gender	**Male**	**Female**		
Frequency	6 (40.0%)	9 (60.0%)		
Education	**Agricultural Technician**	**Senior Agricultural Technician**	**Agricultural Engineer**	**Masters Degree**
Frequency*	11 (78.6%)	2 (14.3%)	1 (7.1%)	0 (0.0%)
Working Experience (in year) – Range	**5-10**	**11-15**	**16-20**	**21+**

Frequency	12 (80.0%)	3 (20.0%)	0 (0.0%)	0 (0.0%)
Traditional Authorities N=15				
Age(in years) – Range	**35 – 39**	**40-45**	**46-50**	**50+**
Frequency	0 (0.0%)	4 (26.7%)	5 (33.3%)	6 (40.0%)
Gender	**Male**	**Female**		
Frequency	15 (100.0%)	0 (0.0%)		
Education	**Primary Education**	**Ordinary Level**	**Advanced Level**	**University Level**
Frequency	11 (73.3%)	3 (20.0%)	1 (6.7%)	0 (0.0%)
Appointment tenure	**5-10**	**11-15**	**16-20**	**21+**
Frequency	2 (13.3%)	3 (20.0%)	3 (20.0%)	7 (46.7%)

*Note: One respondent did not indicate her education level

Staff of NGOs and other institutions that support agriculture consisted of 9 (60.0%) females and 6 (40.0%) males. Eight (53.3%) were withinthe35 – 39 age group, 4 (26.7%) within the 40-45 age group, two (13.3%) within the 46 to 50 age group and 1 (6.7%) was more than 50 years old. Most of these 11 (78.6%) were agricultural technicians, two (14.3%) were senior agricultural technicians and one1 (7.1%) was an agricultural engineer. A majority (80.0%) of them had more than 5 to 10 years working experience, while 3 (20.0%) indicated 10 to 15 years of experience.

The sample of traditional authorities consisted of 6 (40.0%) within the 50 years plus age group, 5 (33.3%) within the 46-50 age group and 4 (26.7%) within the 40-45 age group. All the 15 (100.0%) traditional authorities were male. Most of these traditional authorities had received primary (11: 73.3%) and ordinary level education (3: 20.0%) while (1: 6.7%) had received education up to advanced level. Most (86.7 %) of the traditional authorities had more than 10 years of appointment tenure, while 88 (13.3%) indicated 10 and fewer years of appointment tenure.

4.3 SECTION B: FARM SIZE AND NATURE OF POTATO FARMING IN BUI DIVISION

This section reports the empirical findings with regard to farm size and the nature of potato farming in Bui Division.

4.3.1 Farm size

Traditional land ownership practices were noted to influence the farm sizes of the different farmers who participated in the study. Participants who were members of the royal family in the respective villages had larger farm sizes than the rest of the farmers. This is because the royal family manages the village lands. Thus members of the royal family normally benefit from large portions of land. The study found that most members of the royal family owned over five (5) farms which when summed together could be between 1 and 2 hectares. Their farms were quite many and larger than those of farmers who were not members of the royal family. Averagely, most farmers not belonging to the royal family owned a very small piece of land. In the study area, farm sizes are very small in most cases less than a quarter of a hectare.

It is worth mentioning that 78 respondents who participated in this study were members of the royal family. Also, it should be noted that traditional authorities who participated in the study were not members of the royal family.

4.3.2 Types of farming

Discussions with farmers, agricultural officers and officials of institutions that support farming revealed two types of farming to be characteristic of the nature of potato farming in Bui Division. These two farming systems were mixed farming and mono farming of potato.

4.3.2.1 Mixed cultivation

According to Tony (2007) mixed cultivation is a type of subsistence agriculture whereby the farmers focus on growing a range of crops and animals needed by the family to feed and clothe themselves during the year. This pertains to the fundamental nature of potato farming as portrayed in the study area. According to discussions with farmers, mixed cropping was indispensable as concerns potato farming in Bui Division. Farmers highlighted that seasons, soil nutrient needs, seed source, farming tools, labour source and crop health care practices made mixed farming to be widely practiced. This exactly ties with the view point Brüntrup and Heidhues (2002), express on agricultural production which is devoted to family consumption using rudimentary tools, with high dependence on family labour and natural factors for success.

To further highlight the necessity of mixed farming, a middle aged male potato farmer in Oku sub division remarked: "*we have only two seasons with potato lasting maximum 3 months and then it is matured and thus it will be waste of time to cultivate farms and plant only potato during the rainy season"*. He went further to explain that "*mixed farming helped build soil nutrient and made farms fertile as crops like beans were capable of regenerating soil fertility"*. An elderly female participant, added: "*with mixed cropping, the same labour is used to produce different crops at the same time"*. Drawing from these assertions by farmers, mixed cultivation is highly cherished by these farmers and thus it may be necessary to encourage.

Similarly, during focus group discussions in Nseh village, an elderly woman highlighted *"I have only 4 small farms, all in places far from water. I therefore must mix all crops and plant them in my farms during the rainy season so that I will be sure to have different kinds of food to feed myself, my husband and our 4 grandchildren living with us".* By implication therefore, access to farm land contributed to mixed cultivation. This could be vital for consideration noting that in

the study area, members of the royal family had more farms with relatively larger sizes. Literature holds that agricultural production practices like the multiple cropping system has enhanced food production in rural communities (Reijntjes*et. al.,* 1992; Pretty, 1995).

Field observations revealed that mixed cropping of potatoes with other crops like maize, beans, cocoyams and huckleberry was done. During field observations, it was noted that in addition, some farmers cultivate marijuana alongside with potatoes.

4.3.2.2 Mono cultivation

Mono cultivation is an exclusive cultivation practice wherein only one crop is grownon a farm. Mono cultivation of potato was also mentioned by participants during focus group discussions and also seen during transect walks. According to discussions with officials of the Ministry of Agriculture and Rural Development for Bui, mono cultivation of potato was not practiced by all households. Farmers explained that mono cropping of potatoes was practiced during the dry season in relatively marshy areas and was purposely for commercial motives.

Study participants explained that potato farming during the dry season which was exclusively mono cultivation was tedious but lucrative when compared to the rainy season farming. This was highly linked to the fact that postharvest losses are minimal as the roads are dry, few people produce and hence the market demand is usually more than the market supply thus keeping prices relatively high. During participant observation to farms in Vekovi village, a middle age man engaged in the mono cultivation of potatoes remarked: "*I must crop potato in this farm in the dry season because in the rainy season this farm is completely taken over by water. So potato cannot do well here in the rainy season. I have to feed my children and my other farms are less fertile when compared to this one".* Similarly,

an elderly man in Tadu village said: " *I am not employed and my wife too is not employed. I depend on this small farm to cater for my family. I have 7 children and I am struggling to send them to school. I raise money for their school fees thanks to the cultivation of potato in the dry season because the little harvest is usually sold at higher prices when compared to the rainy season harvest".* The picture below shows mono cropping of potato in the village of Kevu in Bui Division.

PICTURE 4.1: MONO-CROPPING OF POTATOES

Photo Source: The Researcher in Kevu Bui Division

Generally, it was evident that mono cultivation was less practiced when compared to mixed cropping of potatoes. Although income motives were highly highlighted as the motivating factor, the need to make use of farm land that cannot be used during the rainy season was also identified as contributing in dry season mono – farming of potatoes.

4.3.3 The potato farming process

Study participants were asked to describe the potato farming process. Discussions revealed that the farming process was the same for both the dry

season and the rainy season farming period. According to the participants, the potato farming process has basically five stages namely: Farm preparation, seed selection, sowing, continuous crop management and harvesting. This five stage process was applicable in both mixed and mono-cultivation of potato.

4.3.3.1 Farm preparation

Farmers were asked to explain how they prepared their farms prior to planting. *A woman of Jikejem who is engaged only in mixed cropping of potato in the rainy season explained that "farm preparation begins in December with clearing of the farms. Clearing is usually for two Months notably December and January although some few cases may be noted in February. After clearing, the farmers start tilling the soil and making ridges by covering the cleared grass with soil. Tilling usually runs from December to February".*

Similarly, for the dry season a male farmer in Manchok village who farms potato for commercial purposes explained *that, "for the dry season mono cultivation, farm operations usually begin in July with clearing of the farms. Clearing is usually for three Months ending in September although some few cases may be noted in October in marshy lands and along the bounds of streams. Once clearing begins, tilling the soil and making ridges by covering the cleared grass with soil also begins and continues till October".*

By implication, the making of ridges by covering the cleared grass with soil is meant to regenerate soil fertility as the cleared grass will later on decompose. Literature says that these farm management practices have sustained ecological dynamics for centuries in developing countries (Altieri, 1994), thus a need to incorporate such techniques to ensure sustainable agriculture with respect to different agro-ecological areas (Altieri et.al., 2017). Hence, local techniques of farm management are environmentally adapted and rely on local resources base of

the community. Pretty (1995) notes that indigenous agricultural systems are regenerative and the diversified indigenous farming systems have helped small holders farmers cope with scarce resource situation in most rural communities in Africa.

4.3.3.2 Seed selection

Indigenous potato seed selection technique as utilisedby farmers was noted to be highly sensitive. As mentioned by officials of the Delegation of Agriculture during interviews, seeds are a key determining factor on yields. For instance *a potato farmer in Oku said there are two categories of seeds I usually select with size and physical characteristics as the determining factor. These are: well matured and sizable potato tubers that were not injured during the harvesting process, and those with multiple buds commonly called "eyes".*

The various indigenous seed selection techniques identified were based on:

- the physical characteristics of the tuber and its size
- the number of times that the same potato seedlings have been cycled in the same farms
- the number of dormant buds

Farmers explained that during harvesting, well matured and sizeable potato tubers are usually selected and kept separately as seeds. The potato selected as seeds are usually those not injured during the harvesting process and with multiple dormant buds or "eyes". Farmers explained that multiple dormant buds were an indication that sprouting was likely to be possible. The sizeable potato seeds are commonly used in farms that are very fertile and where the farmers grow potato for commercial purposes as well as non-marshy areas and for dry season farming. Further, the second grade seeds are those that are small in size. These small size potato seeds are used in farms that are not for commercial purposes as well as

during the rainy season and in marshy areas. The table below summarizes the different grades of seeds and the places where they are grown as uncovered by the study.

TABLE 4.2: PHYSICAL CHARACTERISTICS OF POTATO SEEDS

Local classification	**Description**	**Area where it is grown**	**Period when it is grown**	**Purpose of cultivation**
First grade	Large size	Very fertile farms non-marshy areas	Predominantly dry season	Commercialisation
Second grade	Small in size	Marshy areas	Predominantly rainy season	Non-commercialisation

Source: Researcher's fieldwork, 2016.

During the study period, farmers explained that not all farmers are capable of selecting good potato seeds. Very elderly farmers were noted to be those with high skills and knowledge on determining and selecting good seeds. The farmers also explained that potato seeds from hot areas could not be used in cold areas.

Another indigenous technique of selecting potato seeds was based on the number of times that same potatoes has been cycled in the same farms. The farmers explained that after every 3 to 4 years, new seeds were brought in to the farm. These seeds are usually new in the sense that they are seeds selected from a different farm, usually from a more fertile farm in the same ecological zone and taken to other farms in similar ecological zone.

The indigenous technique of selecting seeds based on the existence of multiple buds was mentioned as the most efficient technique of determining good seeds. Farmers concluded that where the selection was carried out by an elderly female farmer, results were generally good as sprouting and yields were usually high.

The difficulty in preserving seeds has made farmers to develop small seed farms. During the dry season, farmers grow potatoes along the streams and also in marshy/swampy areas commonly called *"Shaah",* purposely as a way of ensuring the availability of seeds for cultivation in the rainy season. Farmers who have no land along streams either beg for land from those with land or join them to cultivate so as to preserve seeds for their own farms. During field walks, an elderly woman with land along the streams in Vekovi held: "*I do not have energy to go to my far off farm to work during the rainy season so as to have seeds during the dry season. Now I give the farm to the young women who work the farms. When they harvest they give me some of the harvest which I use as seeds in my farm during the rainy season.*" This explained why there were a lot of potato seed exchanges among farmers when it was planting season.

4.3.3.3 Sowing

In February and March, there is planting of potato for the rainy season farming. During focus group discussions, a middle aged male participant explained the reason for planting in February and March as he said*: "I usually plant in February and end in early March so that when the rains come, my potato will germinate and start growing. If you plant late, when the rains are already there, your potato may rot in the soil and you will not have a good harvest".* This implies that indigenous farmers are aware that weather conditions affect crop growth.

Sowing was explained to be done by burying the selected seeds in the ridges that had been formed. The burying is done in such a way that the seeds are covered with the soil such that it is not exposed to direct sun rays. For the dry season farming, planting usually begins in September in farms that are in slopes and relatively dryer areas and ends in October in low lying farms and marshy areas. In very marshy fields, planting is done in November.

4.3.3.4 Continuous crop management

After planting has been done and the tuber germinates, continuous management of the crop as it grows is crucial. As explained by the study participants, continuous crop management entails basically two activities - weeding and mulching. He explained that weeding is first done so that grass does not grow and cover the potato in the farm. Then mulching follows which softens the soil and adds more soil beneath the stem of the tuber so that yields will be high. The weeding and mulching operations are usually carried out in April and May for the rainy season cropping and in November and December for the dry season cropping. In the dry season farming, there is usually no second weeding.

4.3.3.5 Harvesting

. Harvesting, sorting, grading and preservation is usually from January to March, although early harvesting may be noted in some cases in December for the dry season farming and from May to June for the rainy season farming. Harvesting is done by digging the soil ridges and removing the potato tubers.

During focus group discussions, farmers noted that proper preparation and continuous management of the farm was crucial to ensure high yields. As asserted by one of the female participants at a focus group discussion in Simonkoh; "*managing the farm is usually important especially cultivating the farm at the right time*. She maintained that *when the farms are cleared and ridges made early enough, the grass will decompose well, the soils will be very dry and yields will be high"*. A similar opinion was stated by the members of staff of the Ministry of Agriculture and Rural Development who maintained that because the nature of agriculture was dependent on soil fertility, leaving the cleared grass to decompose (as opposed to burning) will increase soil fertility since the farmers do not make use of fertilizers.

4.3.4 Farming tools and labour

Rudimentary tools like the hoe and cutlass are utilised in tilling the farms. The majority of farm labour was reported and observed to be family labour while in some cases farmers organized themselves into groups wherein they go around working on members' farms on rotatory bases. For instance, a young female participant explained how farm activities are shared among family members as follows: "*I have seven children – three boys and four girls. The boys are the ones that clear the farms together with my husband. I and the four girls till the farm as well as do the weeding and mulching. During harvesting, the boys again transport the potato to the house as we harvest. So we do not pay anybody. We depend on our family labour only".*

Similarly, a male participant explained that he belongs to a group as they provide group labour and work in members' farms. The male participant explained: "*we usually work from one member's farm to the other and when we are going to a member's farm, the person provides food and drinks for us. We are not paid"* (see pictures in the Appendix). This practice was reported to have greatly helped in providing labour for the intensive work needed in potato farming. Further, considering the perishable nature of potatoes, farmers explained that when they go to harvest as a group, they were able to harvest much and transport home. This minimised the amount of postharvest losses that might have been incurred as a result of the inability to transport the potato tubers to storage facilities at home or to near-by markets for sale.

4.3.5 Soil nutrient management techniques

To ensure soil fertility, farmers usually clear the grass in their farms and place it orderly and then construct ridges covering the grass on the ground. The

sizes of the ridges are usually not measured but they generally range from about 40 to 70cm wide. Given that Bui Division is hilly, these ridges are constructed across the slopes in order to prevent soil erosion. According to officials of the Delegation of Agriculture and those of NGOs that support farming in the study area, the old practice whereby some farmers usually burn grass on the farms has been abandoned for it reduces long term soil fertility. The use of manure especially house waste, fowl droppings and animal waste was highly practiced by the indigenous farmers as a way of boosting soil fertility. Further, the application of farm yard manure, household kitchen waste, crop rotation, mixed cropping with leguminous plants like beans, intercropping, 'Ankara' and rotational bush fallowing were indigenous practices to improve soil fertility.

4.3.5.1 Crop rotation and mixed cropping

Crop rotation, mixed cropping and bush fallowing were also highlighted by farmers as techniquesutilised in increasing soil nutrients. Farmers explained that during the rainy season, they carry out mixed cropping of potatoes with beans, maize and huckleberry. According to the farmers, the leguminous beans crop greatly increased soil fertility. As the huckleberry with short lifespan decomposes, the soil nutrient is further enhanced. Later on, in July, farmers plant tomatoes and cabbages in farms where they intend to grow dry season beans. As the tomatoes and cabbages grow, the soil continues to be aerated and as some of the tomatoes and cabbages decompose, the soil gains more nutrients. The picture below depicts mixed cropping of potatoes with cocoyams, maize and beans in Nseh, one of the villages in Bui Division, North West Region of Cameroon.

PICTURE 4.2: MIXED CROPPING OF POTATOES WITH COCOYAMS, MAIZE, BEANS IN NSEH BUI DIVISION

Photo source: The Researcher

4.3.5.2 Bush fallowing

Bush fallowing as a technique of managing soil nutrient for potato farming was said to be practiced mostly in farms where dry season potatoes is grown. Farmers explained that because the dry season potato farming season is usually at high risk of crop failure for farms located in non marshy areas should the rains disappear earlier, farms utilised need to be allowed to regain sufficient soil nutrient by fallowing. In practice, it was revealed that dry season farms are usually fallowed on average after 3 years of consecutive farming.

4.3.5.3 The “Ankara”

The “Ankara” was another indigenous technique utilised in soil nutrient management. With the “Ankara” technique, virgin land is cleared and the grass laid down in heaps on the farm and allowed to dry over a period of about one to two or more months, and then set on fire. Usually, the burning takes place on a sunny day to create optimum conditions necessary for successful burning. The ash resulting is then integrated fully in the soil by tilling the land and covering it up. Farmers during focus group discussions explained that such soils are usually very fertile for potato farming. However, the farmers stated that the “Ankara” was an old method utilised to improve soil fertility and was not a cost effective method because it improved soil fertility for one farming season and depleted the soil fertility requesting more years for fallowing or more manure for soil nutrient replenishment.

Farmers explained that the prevalence of certain grass species in their farms was equally an indication of whether or not the piece of land is fertile. For example the prevalence of elephant grass, was an indication that the land is not fertile. As a result, such farms are allowed to fallow for more years than others. On the other hand, the prevalence of water bearing grasses was an indication that the soils are fertile.

4.3.6 Crop health care techniques of potato farming

The indigenous farmers in Bui Division deploy agricultural management practices that help improve on crop health and ensured high yields. It was observed that these practices were employed in the farm about three (3) weeks after the potato crop had germinated. The first practice is usually weeding which goes with mulching typically done using a small hand-held hoe. Farmers explained that the weeding activity removes grass from the farm, makes the soil soft and

aerated thus allowing the crops with much nutrient for better productivity. Farmers also explained that potatoes grow healthier in airy soils that are weed free.

As the potato is growing, wood ash is later applied to fight potato blight. Should insects and ants attack and start eating the potato leaves, a traditional pesticide produced by grinding pepper, tobacco leaves, onion and mixing together with water is used. This traditional pesticide is sprayed on the affected areas in the farm.

The efficiency of the sprayed traditional pesticide and the wood ash was reported to be greatly dependent on how much time elapsed before rain fell after spraying. Farmers explained that when there is rainfall it is not effective as the rains wash it off the plant and when there is no rainfall, this pesticide is more effective. Further, based on discussions with farmers, timely and effective mulching 3 weeks after planting maintained plant health and subsequently resulted in good yields if no blight attacked the plants. Mulching was thus highlighted as an efficient way of managing plant health.

In the study area, potato is a food crop and at the same time a cash crop. Potato farming activities were noted to be done throughout the year. There is deliberate selection of potato seeds based on the nature of the farm where they will be grown. It is interesting to highlight the importance of indigenous knowledge essentially to differentiate which seeds could be used in which farms as well as when clearing, tilling and planting was done based on such characteristics as the humidity and soil moisture level of the area where fields were located.

4.3.7 Farming calendar and crop maturity indicators

Determining when planting and harvesting begins depended on the traditional belief system as well as some natural symptoms. Field observations and

discussions with farmers indicated that for the rainy season potato farming, when the sky is cloudy around the third month after Christmas (that is the month of March), farmers know it is planting time. This must be accompanied by the development of fresh leaves as well as some specific flowers budding by some trees in the forests (where “gods” are believed to be dwelling). Bee farmers were reported to be those who easily identified the right planting time based on observing the growth of flower in the forest and bushes. Once these symptoms were observed, the traditional authorities then performed traditional rituals believed to increase soil fertility and fruitfulness thereby announcing the beginning of the planting season.

The dry season potato farming was explained to be usually dependent on the rains. Farmers explained that the dry season potato planting begins at different times in different zones, because the rains vary from place to place. Once farmers noticed that the intensity of rainfall was reducing, dry season potato farming started. Generally, farmers explained this usually takes place about 6 months after the rainy season potatoes was planted (meaning in September). Planting potato for dry season farming along the bounds of streams and in marshy areas was observed to be done later in October and November depending on the amount of water in the soil. In the table below, the researcher makes a summary of the potato farming calendar as uncovered by the study.

TABLE 4.3: POTATO FARMING CALENDAR IN BUI DIVISION

Activity	January	February	March	April	May	June	July	August	September	October	November	December
Clearing of Farms	Xx						Zz	Zz	Zz			Xx
Tilling and preparing ridges	Xx	Xx						Zz	Zz	Zz		Xx
Planting		Xx	Xx						Zz	Zz		
Weeding and Mulching				Xx	Xx						Zz	Zz
Harvesting	Zz	Zz			Xx	Xx						
Sorting, Grading, Drying and Preservation	Zz	Zz	Zz		Xx	Xx	Xx					

Source: The Researcher, compiled based on observations and discussions with farmers

Note: Xx = activities for the rainy season farming; Zz = activities for the dry season farming

4.3.7.1 Crop maturity indicators

Indigenous technique of determining maturity of the potato tuber for harvesting was through observation and trial testing. Farmers explained that, two months after planting, the potatoes could be matured based on the fertility of the soil and the intensity of rains after planting. Based on observation, the indigenous potato farmers mentioned that when potato leaves are getting yellow, with the flower drying off, it was usually an indication that the potato was ready for harvesting. So once they noticed yellowish potato leaves, they conducted trial harvesting as a means of establishing with certainty maturity. The indigenous potato farmers stated clearly that three weeks post flowering was enough time for the tubers to get mature for harvesting. The picture below depicts a farm where the potato has flowered which is an indication that the tubers will soon be matured for harvesting.

PICTURE 4.3: FLOWERING IN A POTATO FARM IN JIKEJEM (RAINY SEASON FARMING): AN INDICATION THAT THREE WEEKS AFTER THE TUBERS WILL BE MATURED FOR HARVESTING

Photo source: The Researcher

Generally, it was observed that two (2) weeks after the yellowing of potato leaves, the crop was matured and ready for harvesting. Harvest time was determined based on the intensity of post planting rainfall, yellowing of potato leaves 2 months after planting and the drying of the potato flower three weeks after flowering. Trial test harvesting was reported to be efficient in establishing with certainty the maturity of the potato tubers.

4.4 SECTION C: POSTHARVEST LOSS

As mentioned earlier, postharvest loss are any losses occurring after harvest and before consumption. In this section, the researcher presents the nature of postharvest loss and the impact of postharvest loss as uncovered by the study.

4.4.1 Nature of postharvest loss

Study participants were asked to explain the nature of postharvest losses in the potato sector. Overall data generated as concerns postharvest losses in potato farming, indicated that the nature of such losses can be viewed in terms of quality, quantity, profits and in terms of time.

4.4.1.1 Qualitative losses

As highlighted by agricultural officials, qualitative losses were very high in potato farming in Bui Division. Qualitative losses as noted reduce the physical beauty of the tuber and its nutritional worth. Study participants explained that postharvest handling practices of the farmers were responsible for qualitative losses. Further, the farmers argued that the road network in the area, the tools

used in harvesting as well as the time of harvest contributed to qualitative losses *For Instance a staff of the Ministry of Agriculture and Rural Development maintained that the indigenous practice of drying potato on kitchen roofs greatly brought about qualitative losses. Similarly, a potato farmer in Jikejem recounted his transportation results in postharvest qualitative losses:" I usually transport my potato by carrying them in bags. At times I fill the bags and then pay a bike to carry it home. On several occasions because the roads are bad the bike falls and at the end of the day, the quality of the potato is not there again".*

It is worth mentioning that to the farmers, qualitative losses were not a major concern.

4.4.1.2 Quantitative losses

Quantitative losses were highly visible in potato farming in Bui Division. Study participants explained that their greatest challenge was tackling quantitative losses. Farmers explained that quantitative losses were highly linked to harvesting time, transportation and preservation difficulties. *For instance, a middle aged female potato farmer in Vekovi recounted history to show how harvest time was crucial: " there was a year that I was sick and unable to harvest my potato at maturity. Finally, I harvested it later, transported it home and within a month all the potato was rotten. That year I had nothing to feed on or to sell".*

4.4.1.3 Financial losses

With the high level of postharvest losses, farmers maintain that they are unable to make any financial gains from their potato farming activity. Similar to the story of from Vekovi, a male potato farmer explained how he invested in the dry season farming and ended up with nothing: *"I once spent a lot of resources in cultivating*

potato in the dry season, at the end of the day, my harvest was bad and I could not even recover my investment". This finding is similar to findings of Chege and Carson (2017), who highlight that economic losses associated to postharvest losses if valued in financial terms may be as high as US$940 billion per year.

4.4.1.4 Loss of time

As maintained by the farmers, when there are high postharvest losses, it is very frustrating. One male farmer *said: "At times I feel I should have been doing other things rather than cultivating potato... but I have no option than to go back and cultivate potato even when it looks like I am wasting my time".* This assertion indicates that potato farming is a widely cherished activity in the study area. As revealed by farmers, potato was grown in the study area not just for consumption but also for commercial purposes, thus regarded as a cash crop to the farmers.

4.4.2 Impact of postharvest loss

As highlighted by study participants, potato farming in Bui Division is meant for both home consumption and commercial purposes as potato was viewed as a food crop and at the same time a cash crop for the indigenes. However, postharvest losses continue to affect potato farming bringing about several impacts. To understand the impact of postharvest losses arising from the use of indigenous knowledge techniques, a series of interviews and focus group discussions were conducted with farmers, officials of the Ministry of Agriculture and Rural Development, NGO staff, Officials of institutions that promote farming as well as with traditional authorities. From the responses, it was uncovered that postharvest losses affect the community and the agricultural industry as discussed below.

4.4.2.1 Economic impacts

The economic impacts affected both individual households and the agricultural industry as a whole. These economic impacts as mentioned by the farmers during focus group discussions were reduced household income, low profit and reduced council revenue, as discussed below.

As mentioned by farmers during focus group discussions, household incomes were immediately affected with high postharvest losses. For example a male farmer in Simonkoh said: "*when our harvest gets bad we will have nothing to sell and will therefore have no money because in this area, potato is both our food crop and also our cash crop".* Similarly, in Jikejem, another male farmer engaged in dry season potato farming for commercial purposes highlighted "*it's usually not cost effective when I have high postharvest losses because I am unable to make any profits and at times I am not able to pay back the money I loaned from the "njangi" house for farming".* Also, it was noted that a 20 liters bucket well filled with potatoes was sold at 2,000 frs CFA during the harvesting period and 3,500frs CFA during the off season in the surveyed villages. The risk of high postharvest losses was mentioned to always force farmers to sell their products immediately after harvest. Following the concept of demand and supply, farmers earned less when they sold during the harvesting period.

Discussions with officials of the Ministry of Agriculture and Rural Development indicated that trade and industry activities related to potato farming were seriously affected by postharvest losses. This was observed through the limited level of commercial postharvest value added activities. For example, a staff of the Divisional Delegation of Agriculture noted that the development of value addition industries like those for the processing of potato to potato flour are not available in Bui Division. Correspondingly, an official of one of the local NGOs promoting farming in Bui said: "*when I was growing up, there was a company that came to set up a potato transformation unit in 0ku. This has never been done and I*

think it is because postharvest losses are so high". This implies that the absence of value addition industries is highly responsible for much of the postharvest losses.

The low trade associated to postharvest losses has brought about multiple effects. One of the traditional authorities mentioned that the lack of value addition industries has reduced revenue that could have been generated by the Council and used for community development.

Related to trade and industry was the impact of postharvest losses on job creation. Many stakeholders in the potato chain explained that they usually become idle once the harvesting period was over. For example it was observed that during the harvesting season, many small businesses cropped up typically frying potatoes and selling along the major road junctions. This business was noticed during the harvesting period and usually disappeared one month after harvesting. This was associated to difficulty having potatoes to fry and increased prices.

4.4.2.2 Social impacts

This pertains to social aspects of life that are affected as a result of postharvest losses in potato farming as practiced by the indigenous people of Bui Division. These included food shortages, health care challenges and access to education amongst others as can be seen below.

4.4.2.3 Food shortages and health care challenges

Preservation challenges were highlighted to result in high post-harvest losses in terms of food loss and food wastage. Farmers explained that high postharvest losses brought about food shortages in the community especially

during the Months of March and April. However, as mentioned by participants during focus group discussions, the degree of food shortages experienced were not so high in the community. Food shortages were directly linked to poor health. *For example an elderly woman in Tadu,* said: "*if you and your children don't have enough food to eat, you will not be healthy".* This implies that postharvest losses aggravate hunger and pose a threat to food security (FAO, 2011).

Associated to health was lack of access to modern health care as a result of low income brought about by postharvest losses. One of the traditional authorities interviewed strongly held that the attention given by villagers to traditional medicine was because they lacked money. For example the traditional authority said: "*I do not even think about western medicine because it is expensive. My income is not much so I prefer to follow traditional medicine which I can afford".*

4.4.2.4 Lack of access to quality and advanced education

Study participants highlighted the inability to access quality and advanced formal education as one of the difficulties they face as a result of postharvest losses in potato farming. This was confirmed by NGO officials in the study area who mentioned that when postharvest losses are high, farmers will not have the means to pay school fees for their children as well as cater for their school needs. It is worth mentioning that children from most of the sampled farmers were said to be attending government schools. To buttress this, a female farmer in Nseh said: "*I would have preferred my children to go to mission schools but I cannot afford to send them there because at times when I harvest my potatoes, they get bad in large quantities and the revenue I make from selling what I can sell is very small".*

4.4.2.5 Low living standards

Also low standards of living was mentioned by study participants as one of the impacts of postharvest losses they experience in potato farming. Participants explained that due to the fact that they made minimal gains from potato farming as a result of postharvest losses, they are unable to construct decent housing for themselves. For example, *in Ijim, one elderly man said: "I cannot take the little income I make from my potato farming to construct a modern house. I prefer to use it to send my children to have basic education".*

4.4.2.6 Environmental impacts

Field interviews, observations and discussions showed the impact of postharvest losses on the environment. According to officials of the Ministry of Agriculture and Rural Development, high postharvest losses has made farmers to increasingly search for new fertile farm lands so as to have relatively good yields. This was observed to be resulting in environmental impacts. Field observations and interviews confirmed that potato farming was encroaching towards virgin lands along the slopes of Mount Oku, areas previously preserved for posterity (see picture below).

PICTURE 4.4: ENVIRONMENTAL IMPACT - FARMING ACTIVITIES ENCROACHING TOWARDS MOUNT OKU AS FARMERS SEARCH FOR FERTILE LAND IN KEVU AREA

Photo Source: The Researcher

The environmental impacts of postharvest losses as observed were in line with the assertion by Patricia Woertz, during the World Economic Forum in 2010, in which she said *"Preserving what is already grown is critical to reaching those who need crops most and to making the most of the land, water, energy, and other inputs already used to grow crops."* By implication therefore, the environmental cost of producing food and it ends up being wasted as postharvest losses keep occurring significantly.

The table below gives a summary of the impact of postharvest losses in potato farming in Bui Division as uncovered by this study.

TABLE 4.4: SOME DIRECT IMPACTS OF POSTHARVEST LOSSES

Economic Impacts	Social Impacts	Environmental Impacts
Low incomes as farmers sell their harvest (produce) at low prices so as to avoid risk of it getting bad Low value adding activities thus minimal job creation opportunities	Poor living conditions Lack of means to access appropriate health care and education when need arises Quantitative and qualitative reduction in available potato tubers for consumption hence food security is not guaranteed	Encroachment into virgin lands in search of more fertile areas

Source: Author's own construction

4.5 SECTION D: POTATO POST-HARVEST LOSS PREVENTION METHODS

As noted by Boserup (1965), the risk of hunger and feeding challenges motivates improvement in farming methods and inventions in order to produce more food. This is true of the indigenous farming techniques as utilised by the people of Bui Division in potato farming, processing and preservation. Constant interaction with the environment, the high perishable nature of the potato tuber resulting in postharvest losses has forced the indigenous small holder farmers to develop coping measures.

In the following paragraphs, the researcher presents the findings in relation to postharvest losses prevention methods.

4.5.1 Pre-harvest practices carried out to prevent postharvest losses

As noted earlier, pre-harvest activities have a significant effect on the degree of qualitative and quantitative losses that are recorded postharvest.

Indigenous pre-harvest practices aimed at minimizing postharvest losses in potato farming are as discussed below:

4.5.1.1 Pre-planting

Preparations made prior to planting were reported to have significant effect on postharvest losses. Farmers explained that before planting, ridges are made in such a way that water does not accumulate and stand on the farms. This allows the farm to be dry enough such that the potato will not grow and mature in water. According to one male potato farmer in Tadu, potato that grows in standing water gets rotten shortly after harvest.

Furthermore, seed selection was another crucial pre-planting activity that helps minimise postharvest losses. As highlighted by the farmers, when seeds from hot areas are cultivated in cold areas and vice versa, postharvest losses will be high. Farmers explained that having experienced this, they always take serious precautions to ascertain the source of seeds before the planting time comes. This implies that geographical factors influence how crops grow and also postharvest losses. *For instance a male potato farmer recounted his past experience: "there was a year that I got potato seeds from my friend in Ichim and planted in my farm in Tadu. The yield was poor and to make it worse one week after I harvested I noticed that my potato was getting rotten. I had not known this before so when I complained, an elderly woman explained to me that the seeds I used were not adapted to Tadu".*

Another pre-planting issue raised and which is associated with postharvest losses was in the spiritual realm. As explained by the Chief of Jikejem village, "*prior to planting, sacrifices are offered by the traditional authorities to beg the "gods" of the land and also to prevent witches from making tubers to get rotten postharvest".*

4.5.1.2 Planting

The major issue highlighted by study participants as concerns planting and postharvest losses was timely planting. Farmers maintained that crops planted late usually registered high postharvest losses as they are harvested during the heavy rains of July. *For instance one elderly woman in Manchok said "I usually plant my potato in February when I have cultivated my farm. Once the rain comes, it germinates and starts growing and it will mature by May ending and early June so I can harvest it before the heavy rains in July".*

Generally, farmers maintained that they usually avoided harvesting potato when it is raining so that the harvested tuber would not come in contact with water. This confirms with the view point expressed by SPORE (2011), that in African countries, tropical weather and poorly developed infrastructure contribute to postharvest losses.

4.5.1.3 Farm management

Continuous and proper farm management practices were highlighted as a key factor in preventing postharvest losses. Farm management practices highlighted were weeding and crop growth monitoring which ensures that potato affected by diseases are immediately removed from the farm. To the farmers, the conditions under which potato grows and matures contributes to the rate at which it decays postharvest. *For instance a male potato farmer said: "if you do not weed your farm at the right time, the farm will be wet and the potato will also be wet. When you harvest potato from a farm that weeding was not done at the right time, it decays at a faster rate. This is what I have experienced myself. So I usually make sure that grass does not grow to cover my potato in the farm. I weed the farm once I notice that grass is growing up to a certain level. Furthermore he said: Also, I monitor the farm such that when I see potato that has been attacked by a*

disease I remove it immediately and destroy it so that it does not contaminate the others. With such a practice, I am sure my potato will not decay when I harvest it".

Another farm management activity mentioned was in the spiritual realm. According to the traditional authorities in the study area, *non farming days referred to as "country sundays" "Ngongkse, Nsamnen"* (non farming days for Oku Sub Division) *and "Ngoilum and Kilovii"* (non farming days for Kumbo, Mbiame, Jakiri and Nkum Sub Divisions) *were reserved for the "gods" who ensured that the crops grow well such that when harvested will not get rotten so that it can be stored for long to serve as food for the children of the land. The respect of "country sundays" was thus highlighted as a practice that ensured good yields and minimal postharvest losses.*

4.5.1.4 Harvesting

As mentioned by agricultural officials, harvesting techniques had an effect on postharvest losses. For example, it was asserted that when the small hand hoe is used in harvesting, postharvest losses are likely to be high as the hoe is more likely to injure the tuber. These injured tubers later decay reducing both qualitative and quantitative value of the tuber.

Cautious of this, indigenous people highlighted that they use the small hand knife specially fabricated locally and designed for the harvesting of potato. "This knife is small and hence less likely to injure a large quantity of potato" said a male farmer in Nseh.

In Ichim, it was observed that the farmers have fabricated their harvesting knife carved out of wood. This wooden knife according to the farmers was the best and less likely to injure the tuber during harvesting. Similarly, locally fabricated small baskets tied at the waist were used during harvesting to collect the tubers as

they are removed from the soil. These baskets as observed cause less friction and thus minimise qualitative losses. This observation was confirmed by farmers and agricultural officials.

Furthermore, agricultural officials mentioned that on time harvesting of potato was crucial in preventing postharvest losses. According to them, when potato is overdue in the soil after maturity, once it is harvested it decays within a short period of time. According to discussions, indigenous farmers were aware of this fact and had their system of monitoring crop maturity. *For instance one male potato farmer said: "I usually monitor my farm as my potato grows. After about eight weeks post germination, when I see potato flowers and leaves drying up, I do trial harvesting by harvesting the ones that are getting dry. Then I try to peel it with a stick. If it peels easily, then I know the tuber is not ready and so I can give sometime again. With this technique, I am able to harvest my tuber once it is matured".*

This practice as explained by the study participant helps in monitoring crop maturity and makes it possible for the crop to be harvested at the right time. This ties with the view point of Kitinoja and Kader, (2002), that when crops are harvested at due time, postharvest losses will be less as the crop postharvest life will be long.

4.5.2 Postharvest practices carried out to prevent postharvest losses

In the following paragraphs, the researcher presents postharvest loss prevention practices as utilised in potato farming by indigenous small holder farmers in Bui Division, North West Region of Cameroon. These practices are either in the form of processing or preservation of the potato tubers.

4.5.2.1. Processing and preservation

The need of food for household consumption as well as the need to make higher profits by selling during off season made indigenous people to develop a variety of ways of processing and preserving their potatoes. During field interviews and focus group discussions, it was noted that indigenous farmers made use of more than one of the indigenous techniques of potato processing and preservation so as to prevent losses occurring postharvest.

Participant observations and field interviews revealed that there were basically two levels of processing and preservation - on farm and off farm. These were done either for short term and long run consumption or for commercial purposes aimed at benefitting from higher prices during off season.

According to the farmers, the preservation practices depended on the climatic conditions of the place and the time of harvest. To maintain quality, preservation practices revolved around the continued observation and the selection of bad tubers averagely bi-monthly. Hence, this minimises post-harvest losses as such making the local agricultural system somehow profitable for the resource smallholder farmers. For example, it can be argued that this is an adaptation technique practiced by farmers in the study area.

The short growing life cycle of potato was discovered to be a great blessing to the indigenous farmers. Field observations noted that the period commencing April is often characterized by famine. So immediately the potatoes start maturing, it is widely consumed. Indigenous people process the potatoes in several ways. Usually when the harvesting season begins, processing is more of peeling the tubers and boiling. The boiled potatoes are either consumed with vegetables or with groundnut soup. Also, farmers process potatoes for short term consumption

by peeling, boiling and then pounding to eat with vegetables. Very short term and fast processing for consumption is by roasting the tuber particularly by burying it in hot charcoal and wood ash. Relatively wealthy families usually fry or boil their potatoes, adding palm oil, fish, tomatoes and onions. Later on, as beans begin to mature in May and June, processing for consumption was reported to be done by boiling beans and then later on adding potatoes and pounding together. This was observed to be the most widely cherished and practiced indigenous potato processing technique for short term consumption in the study area. This widely cherished dish called *'tok-kuni'* as it is called in local parlance is usually sold by petty food vendors.

The need for future consumption was also mentioned by farmers during focus group discussions. For example in Kevu, a female farmer said: "*when I am cooking my potatoes, I think of the fact that I will need to eat potatoes for a long time before harvesting potatoes again. So I make sure that I preserve some well"*.

Farmers highlighted that they process potatoes by drying it under the sun. This was mentioned to be the primary processing stage. Once it is dry, it is peeled and chopped into tiny sizes and then ground to produce potato flour. Generally, it was reported that indigenous techniques for processing potato for future consumption were very limited and were not widely practiced largely due to lack of adapted facilities needed for processing, lack of interest and also due to ignorance.

4.3.2.2 On and / or off farm processing and preservation

On and off-farm processing / preservation were a common practice. During field interviews and focus group discussions, farmers explained that different reasons accounted for which preservation technique was utilised. For example in Jikejem, a middle age male farmer said: "*I usually preserve my potatoes in the farm during the rainy season because the road is very bad which makes it difficult*

for me to use my motorbike". He went further to explain that *because his farms are far off from his home he usually prefers to keep his seeds in the farm after harvest*. By keeping these seeds and produce in the farm, they are prevented from being touched by the rain thus they remain dry thereby reducing the quantity of postharvest losses. The picture below shows an on-farm preservation facility.

PICTURE 4.5: AN ON-FARM PRESERVATION FACILITY IN TADU

Photo source: Author

Off- farm preservation on its part was likened to the need to have potatoes at home for consumption as well as for commercial purposes at short notice. This was aimed at benefiting from price increases when demand increases.

On and/or off farm processing and preservation to minimise postharvest losses were characterized by several techniques as follows:

4.3.2.3 Drying as a technique to prevent postharvest losses

Minimization of postharvest losses in potato farming was basically through drying. The drying was done in different ways depending on the climatic conditions. To maintain quality, drying practices revolved around the continued observations and the selection of bad tubers averagely weekly. The continuous selection and disposal of the bad tubers prevented them from infecting other tubers. Hence, this minimises post-harvest losses as such making the local agricultural system somehow profitable for the resource smallholder farmers. The different drying methods as mentioned by the farmers are discussed below.

Drying in house ceilings

Small holder indigenous farmers in Bui Division store potatoes at home by keeping in house ceilings. The ceilings are specially prepared with bamboos that are covered with mud. Bamboos as raw materials are often readily available to the villagers while the construction of the roofs is usually done by elders who master the technique. Once the mud gets dry, the ceilings usually remain very dry. The potato in these ceilings is usually free from moisture and thus can last for up to 6months. Most often, these ceiling are kitchen ceilings and continuous heat resulting from cooking keeps the potatoes dry. This preservation technique was observed to be widely used in cold areas like the areas around the forest in Simonkoh, Tadu and Vekovi. During field interviews, in an attempt to justify the use of house ceilings, a female farmer in Tadu said: "*I am a single mother*. *I stay in this one room in our compound with my children which is the only space we have. So I must dry my potatoes in the ceiling despite the fact that the heat from the fire side makes it to get too dry and not very attractive to buyers if I want to sell".*

Drying of potatoes using saw dust and dry grass

Another indigenous drying technique involves the use of saw dust and dry grass. With this preservation technique, farmers who do not have house roofs adapted for potato preservation usually use an empty dry room. In the room, heaps of saw dust are poured on the floor, then potatoes are piled on the saw dust, and saw dust is again used to cover the potatoes. In some cases, farmers again cover it with dry grass. The rooms are usually kept closed and access is prohibited for non-family members. This was observed to be the widely used preservation technique utilised for preserving potatoes farmers for commercial purposes.

At the farm level, a typical on-farm preservation technique observed was covering with dry grass. During the rainy season potato harvest which is meant for consumption is preserved on-farm in farm houses that are usually constructed with local materials. The potatoes are placed in one corner in the thatched farm house and carefully covered with leaves to prevent contact with water. In this way, the potatoes remains relatively dry and are not subjected to a high degree of rot.

Drying of potatoes in shelves (semi cupboard-like stands)

Also, to prevent postharvest losses, some indigenous farmers preserved their potatoes using shelves (semi cupboard-like stands). The stands are usually constructed using wood and/or bamboos. These stands are kept in dark rooms and potatoes piled on them. This keeps the potatoes free from contact with the ground and thus it remains dry. Such rooms are usually built in such a way that the sun rays do not penetrate. Farmers' belief that without contact with the sun rays, the potatoes can last longer. Agricultural officials in the study area reported that this method significantly reduced postharvest losses.

Sun drying

Another indigenous technique used by farmers to prevent postharvest losses is by drying the harvested potatoes in the sun. Field interviews with farmers revealed that sun drying as an indigenous potato processing technique was usually plagued with the challenge of having continuous sun shine for say a day or two during the harvesting period. Farmers explained that the sun drying technique is usually very tedious as it demands that every day, farmers carry the potatoes and place under the sun and once the sun is going down they carry it back. As observed, the difficulty of drying in the sun was aggravated by the heavy rains characteristic of the rainy season harvesting period.

4.3.2.4 The use of potato pits to prevent postharvest losses

Potato pits was another indigenous preservation technique utilised by the small holder farmers to prevent postharvest losses. In situations where there are no farm houses, it was observed that a pit is dug and potatoes poured inside and then covered with soil. This is done is such a way that it is impossible for water to stand there. The area is then marked with a sign best known to the farmer. With this technique, a pit is dug and lined with dry grass. Then potatoes are placed in layers in the pit with wood ash sprinkled on each layer as a measure to fight pathogens. After all the potatoes have been filled in the pit, it is then covered with dry grass and soil. The area where the pit is sunk is usually well catered for to prevent the pit from direct contact with water.

This technique is usually for a very short time during the rainy season because the wet nature of the soil causes rot. During the dry season harvesting period, on-farm preservation by digging a pit is very much utilised as the soil is dry, thus the challenges of rot resulting from contact with water or as a results of goats eating the potato are minimal.

As highlighted by farmers during focus group discussions, the preservation technique by digging a pit was reported to be more effective and efficient and resulted in very minimal on-farm postharvest losses for dry season preservation than the rainy season preservation.

The pictures below show a farmer preserving potatoes in the farm using this technique. Pictures 4.6 and 4.7 show the preservation technique whereby through burying in the ground, postharvest losses are avoided as a result of goats eating the tubers.

PICTURE 4.6: DRY SEASON ON-FARM PRESERVATION TECHNIQUE AT SIMONKOH

Photo source: The Researcher

PICTURE 4.7: PRESERVED POTATOES USING THE DRY SEASON ON-FARM PRESERVATION TECHNIQUE AT SIMONKOH

Photo source: The Researcher

4.3.2.5 Preventing postharvest losses by flooring

As highlighted by farmers during focus group discussions, prevention of postharvest losses through preserving potato seeds was slightly different from preservation of tubers for food. As recounted by an elderly female farmer in Kevu, "*Seeds are usually preserved at home by pilling directly on the bare floor. Neither saw dust nor dry grass is used*. *Instead, I pour some small wood ash on it to heal any wound on the tubers that might have occurred during harvesting".* The rooms where seeds are preserved are also usually access prohibited. Farmers mentioned that the rooms are usually opened such that sun rays can reach the seeds when it was about two weeks to planting. Indigenous farmers hold the belief that by letting sun rays touch the seeds makes germination faster.

4.3.2.6 Domestication of cats as a means to prevent postharvest losses

During field visits, it was observed that the farmers rear cats. Farmers justified the rearing of cats as being a way to reduce damages caused by house rats that eat potatoes. Cats were thus considered as a domestic animal necessary for minimizing post-harvest losses resulting from potato consumption by rats. For example a female farmer in Nseh said: "*I prefer a cat to a dog. I do not need to feed the cat but the cat will help me catch rats that destroy my potatoes".*

4.3.2.7 The use of fresh leaves/calabash to preserve processed potatoes for home consumption

Processed potatoes was also preserved using some indigenous techniques with varied lasting durations. Potatoes pounded with beans, or just pounded potatoes was tied in banana leaves and carefully preserved in baskets made from bamboo. This preservation technique is limited in that the processed potato can last a maximum of 3 days after which it loses quality. Potato flour is usually kept in a calabash. The flour stored in a calabash was reported to last for more than six months without losing its quality. In the table below, the researcher presents a summary of the main potato preservation techniques as uncovered by the study.

TABLE 4.5: MAIN POTATO PRESERVATION TECHNIQUES AS USED BY FARMERS IN BUI DIVISION

Preservation method	Preservation technique	Description	Purpose
On farm		Potatoes are stored on the farm	To avoid high transportation cost due to bad state of roads Way of seed storage in the farm
	Burying in a pit in the ground and stockpiling in one corner of the farm house	-Leaves are used as cover to prevent contact with rain water Water sensitive	For future consumption To prevent goats from eating the potatoes during the dry season
	Wood ash potato pits	Pits are dug and lined with dry grass in which potatoes are placed and sprinkled with wood ash	Dry grass prevents contact with rain water Wood ash is believed to fight against pathogens
	Keeping potatoes in the open after harvesting	Not water sensitive	To be used as future seeds
Off farm		Potatoes are stored at home	Home consumption For sale
	Kitchen ceiling	Potatoes is dried on bamboo-mudded kitchen ceilings	For consumption
	Saw dust and dry grass	Heaps of saw dust and dry grass are interspersed with potatoes in an empty room	For sale
	Use of shelves	Potatoes are piled on wooden or bamboo made shelves found in dark rooms	Potatoes remain dry as contact with the ground is avoided For sale
	Keeping potatoes on bare floors	Wood ash sprinkled to heal wounds -Sun's rays allowed to on it 2 weeks before planting	To be used as future seeds

Source: Fieldwork, 2016.

4.6 SECTION E: INDIGENOUS PRACTICES POSTHARVEST PREVENTION METHODS THAT CAN BE ADVANCED TO MINIMISE POSTHARVEST LOSSES

Generally, in-depth discussions revealed that with the use of indigenous knowledge techniques, farmers have been able to preserve well matured potatoes for some time especially when the harvested tuber has not been touched by water from the farm to the house. During field interviews and focus group discussions, information was collected on farmers' past experiences as they have been utilizing indigenous techniques for processing and preservation. Results showed that qualitative and quantitative losses varied depending on the method and the seasons of the year. In the following paragraphs, the researcher presents the on and off farm indigenous knowledge practices that can be advanced to minimise postharvest losses. The table below shows the degree of losses likely to occur when the various techniques are utilised.

Based on the extent of losses, the researcher in the following paragraphs, presents the on- and off-farm indigenous knowledge practices that can be enhanced to minimise postharvest losses in potato farming in Bui Division North West Region of Cameroon.

4.6.1 Pre-harvest loss prevention

As mentioned earlier, pre-harvest factors can contribute to post-harvest losses. It may thus be necessary that some pre-harvest issues be considered when advancing indigenous knowledge. As discovered during field interviews, adaptation of seeds to specific climatic conditions was critical not just for yields but also to minimise postharvest losses. In this light, agricultural officials maintained that to ensure that farmers have access to quality seeds adapted to the various localities where their farms are, there is need for the promotion of indigenous seed multipliers. Such seed multipliers will be in all the villages. If this is

done, access to adaptable seeds will be ensured and the results will be high yields and minimal postharvest losses.

TABLE 4.6: DEGREE OF QUALITATIVE AND QUANTITATIVE LOSSES LIKELY TO OCCUR USING VARIOUS INDIGENOUS PROCESSING AND PRESERVATION TECHNIQUES

Indigenous method Processing/preservation	**Degree of postharvest losses**		**Comment**
	Qualitative	**Quantitative**	
Sun drying	Low (R) Low (D)	High (R) Low (D)	Best for the processing/preservation of potatoes meant for consumption
Drying using saw dust/grass/wood ash	Low (R) Low (D)	Moderate (R) Low (D)	Use for the processing/preservation of potatoes for consumption and for preservation of seeds
Drying on Kitchen roof	Very High (R & D)	Low (R & D)	Use only in very cold areas for very short term processing/preservation of potatoes for consumption
Drying on shelves	Low (R & D)	Low (R & D)	Best for the processing/preservation of potatoes for consumption and for preservation of seeds
Burying in a pit in the farm	High (R) Low (D)	High (R) Low (D)	Used for preservation where on-farm facilities do not exist
Covering with grass in an on-farm facility	High (R) Low (D)	High (R) Low (D)	Used for the preservation of potatoes for consumption and for preservation of seeds

Source: Field work 2016 – Compiled by the author based on field observations and discussions with farmers. Note: R = the rainy season farming period; D = the dry season farming period

4.6.2 On-farm practices that can be advanced to minimise postharvest losses

Discussions with farmers, officials of the Ministry of Agriculture and Rural Development as well as officials of institutions (NGOs) that support agriculture showed that the magnitude of losses that may be recorded postharvest very much depend on activities at the farm level. *For example, the Chief of Agricultural Statistics mentioned that if after harvest, potato is soaked by rain, the chances that it will start to rot soon and at a higher speed are high.* To stop such occurrences and prevent postharvest losses, there is need for on farm preservation facilities (Farm Houses) to be constructed such that potatoes once harvested can be stored in dry conditions on the farm.

However, considering that most farmers may not have the needed resources to construct improved farm houses, agricultural officials uphold that through government support, farmers can construct preservation facilities on locations close to their farms. For instance, an Agricultural Officer said: "*We know that potato is very perishable and once rain falls on it after it has been harvested, the rate of decay is usually very fast*. *We can only tackle this at the farm level through improving our farm houses. It is possible for farmers to group themselves to form a Common Initiative Group and the government can support them to construct a preservation facility around farms. This will help the farmers to store their potato during harvesting and it will thus reduce postharvest losses".*

4.6.3 Off-farm practices that can be advanced to minimise postharvest losses

As mentioned during participant observations, field interviews with farmers and agricultural officials, significant postharvest losses are recorded at the off farm level as the tuber journeys from the farm to either the market directly or to home preservation facilities. The different techniques employed by the indigenous farmers have yielded varied results as concerns prevention of postharvest losses.

For example an ACEFA staff said: "when farmers are transporting potato from the farms using motorbikes, there are high qualitative and at times quantitative losses as accidents are often recorded". To this official, the practice where farmers group themselves and go round harvesting and transporting by carrying on their heads was better and should be promoted. This can be promoted through forming farmers into small Common Initiative Groups. Such an initiative will significantly reduce postharvest losses as harvesting and transportation will be done with ease.

Although prevailing climatic conditions in the various villages were noted to influence the choice of preservation and processing techniques used, there were some techniques that could be used in any circumstance. *For instance, the Divisional Chief of Agricultural Statistics for Bui maintained that using shelves to dry potato was the best technique that should be promoted. According to him, this technique is easy and can be easily promoted through training farmers on how to construct their shelves. He maintained that the shelves can be constructed using bamboos or sticks that are available in the locality.* Such improvements, he argued, will significantly reduce both qualitative and quantitative losses and will bring about a positive impact on farmers through food security and even financial gains.

According to farmers, the use of saw dust, dry grass and wood ash to dry were least costly and effective indigenous techniques utilised in preventing qualitative and quantitative postharvest losses when compared with the other methods. Regarding these methods, agricultural officials maintained that though they help minimise postharvest losses, they can only be promoted for the preservation of potato for home consumption.

4.7 SECTION F: CHAPTER SUMMARY

In this chapter, the researcher has presented the results and analysed the findings of the research. It is important to note that the discussions are focused on establishing a framework for the advancement of indigenous knowledge practices to minimise postharvest losses in potato farming in Bui Division, North West Region of Cameroon.

The researcher used the thematic network analysis method to bring out the different categories under review. In the following paragraphs, the researcher presents the summary of the major findings in the different sections.

In section A, the researcher presented the analysis of the demographic characteristics of the farmers. It is important to highlight that the demographic results showed that the majority of the farmers have been engaged in potato farming for at least 22 years, with farm sizes averaging about half a hectare. Farm ownership was noted to be such that people who belonged to the ruling class (family) owned more and larger farm sizes when compared to others. Most of the farmers who were study participants had not received formal education.

In section B, the researcher presented the study findings in relation to the nature of potato farming in Bui Division. The results showed mono and mixed cropping of potatoes for either commercial purposes or home consumption. Mixed cropping is practised during the rainy season while mono farming of potatoes is done during the dry season. Labour for farm activities comes mostly from the household with some cases of group farming and hired labour.

In section B, the researcher also presented results related to the potato farming process. The farming calendar runs all year round with different activities carried out in different months. It is important to mention that potato farming

process includes farm preparation, seed selection, sowing, continuous farm management (weeding and mulching) and harvesting.

In section B, it was also shown that the ability to carefully select good potatoes seeds was not common. Elderly farmers due to experience were more capable of identifying good seeds than the young farmers. Due to seed preservation difficulties, community seed exchange is widely practiced by farmers. Both mono and mixed cultivation practices make use of rudimentary tools for farm preparation, mulching and harvesting of potatoes in the study area.

In section C, the researcher presented the results of the impact of postharvest losses. The results showed that postharvest losses had negative impacts on the individual farmers, the community and the economy at large. The results analysed showed the social, economic and environmental impacts of postharvest losses on potato farming as revealed by the study participants in Bui Division. Economic losses brought about by postharvest losses had multiplier effects causing social and environmental impacts. Social impacts mentioned by farmers included risk of food shortages, lack of means to cater for their educational needs, health care and to construct decent houses. The environmental impacts were easily visible along the slopes of Mount Oku as farmers were extending their farms towards the forest.

It is also worth mentioning that according to officials of the Divisional Delegation of Agriculture and Rural Development for Bui, value chain activities that could have developed due to potato farming in Bui have not been done due to postharvest losses.

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Section D focused on indigenous postharvest loss prevention methods utilised by indigenous farmers engaged in potato farming in Bui Division. Analysis showed a series of loss prevention methods utilised both on and off farm. The

indigenous postharvest loss prevention methods are basically in the form of processing and preservation. These methods as cited by study participants include drying (drying in house ceilings, drying using saw dust and dry grass, drying in shelves (semi cupboard-like stands) and sun drying), the use of potato pits, flooring, domestication of cats and the use of fresh leaves/calabash to preserve processed potato for home consumption.

Of utmost importance to mention is the fact that analysis indicated that the choice of which postharvest loss prevention method used by farmers was dependent very much on climatic conditions and the seasons. On-farm drying in pits was noted to be highly used in the dry season. Drying in kitchen roofs which was common in very cold places was reported to have very minimal quantitative postharvest losses but was associated with very high qualitative postharvest losses. The widely used technique with minimal both qualitative and quantitative losses is the use of saw dust/dry grass and wood ash.

In section E, the researcher has analysed the indigenous postharvest loss prevention methods that can be advanced to minimise postharvest losses in potato farming. The methods highlighted were based on the qualitative and quantitative losses registered as indicated by farmers. To cater for on farm losses, discussions indicated that enhancing on farm preservation facilities will greatly reduce losses. As concerns off farm losses, advancing preservation and processing techniques which use sawdust/grass/wood ash drying and drying in shelves were highlighted to be the best indigenous techniques effective in preventing qualitative and quantitative postharvest losses.

CHAPTER FIVE

DISCUSSIONS, RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

This final chapter discusses the findings of the research. The chapter culminates in recommendations that can be implemented using indigenous knowledge to prevent postharvest losses in potato farming in Cameroon. It is important to highlight that with the constrained resource setting, small-holder farmers in Bui Division are unable to afford Western processing and preservation facilities to minimize postharvest losses. This study argued that the implementation of indigenous knowledge and practices could assist small-holder (rural) farmers to increase their crop yields and economic situation. By assisting these farmers to upscale their indigenous practices to incorporate commercial activities, government, entrepreneurs, traditional authorities and NGOs can contribute to increased socio-economic benefits for farmers and communities. Such interventions will also make a contribution to the economic development of the country through wealth and job creation.

This study identified the research gap that farmers' indigenous knowledge techniques utilized to prevent postharvest losses have not been adequately studied in Cameroon. The result was that indigenous potato farming has taken its rightful place in addressing poverty, unemployment and low socio-economic conditions in Cameroon.

By following an interpretivistic research approach, this study has produced important findings on indigenous knowledge and practices used in potato farming in Cameroon. The study provides important recommendations that would benefit these farmers, their communities and their country.

This chapter is structured as follows. Firstly, the researcher provides general information from participants on the contextual background of the problem of postharvest losses in potato farming in Cameroon. Secondly, the findings in connection with the nature of postharvest losses in potato farming in Cameroon are discussed. Thirdly, the findings around potato postharvest losses prevention methods used by indigenous farmers in Bui are discussed. Finally, the main findings are summarized and their concomitant recommendations are highlighted. This final section underscores the contribution that the findings of this study could make to the socio-economic development of the farmers, their communities and the country at large.

5.2 THE CONTEXTUAL BACKGROUND OF THE PROBLEM OF POTATO POSTHARVEST LOSSES IN CAMEROON

The cultivation systems and common practices in potato farming are briefly discussed. The nature and impact of postharvest potato losses are also briefly highlighted.

5.2.1 Cultivation systems

According to the findings, all the study participants identified mono farming and mixed farming as their cultivation systems. Mono farming is practised widely during the dry season farming, while mixed farming is common in the rainy season farming period. Assuming that the study participants are all indigenes of Bui Division, they are engaged in both rainy season and dry season farming both for commercial purposes and for consumption. As indicated in Chapter 4 paragraph 4.3.7, activities related to potato farming are continuous all year round depending on the nature of the soil and other hydrological factors.

It is worth mentioning that the findings regarding cultivation systems are similar to those reported by other researchers around the world (see Chapter 2 paragraphs 2.3.1.1 and 2.3.1.2). Mixed farming of potatoes is done mostly with crops like beans, maize, and cocoyams (see Chapter 4 paragraph 4.3.2.1).

5.2.2 Common practices

An important finding in this study is that because potato farming is both for consumption and for commercial purposes (with potatoes even considered as a cash crop in the area), there were a series of common practices with the aim of making maximum gains from the activity. The common practices uncovered by the study include the group farming practices, crop rotation and community seed exchanges with impressive indigenous techniques of seed selection (see Chapter 4 paragraphs 4.3.4 and 4.3.3.2)

It is significant that other research works carried out in different parts of the work have highlighted similar findings as those mentioned here. For example, refer to Chapter 2 paragraph 2.4.2; Takoutsing et al. (2012) for seed exchanges; Demo et al. (1998) for optimal seed sizes; Altieri (1994) for mixed farming.

5.2.3 Nature of postharvest losses

Smallholder farmers in Bui Division were keen to explain the nature of **on-farm** postharvest losses. As observed in the study area, during harvesting the small hand knife used for harvesting often injures the potato tuber, causing contamination with subsequent mould growth during the postharvest stages which causes it to rot. Such qualitative losses later increase, leading to both qualitative and quantitative losses beginning at on-farm level (see Chapter 5 paragraph 5.2). Still at the farm level, findings indicate that lack of adequate on-farm preservation facilities, the climatic conditions at the time of harvest as well as handling at the

farm level were basically the determinants of postharvest losses at the farm level. On-farm losses were dependent on the farming season, with much higher postharvest losses recorded during the rainy season than the dry season.

Scholarly works such as those by World Bank (2010), Kitinoja and Kader (2002), Kader (2005) and Kitinoja et al. (2011), have reported similar results to those uncovered by this study.

Once crops have been harvested from the farm, they are either preserved at the farms or they are transported to off-farm preservation facilities at the market. Study results show that **off-farm postharvest losses** occur during transportation to off-farm preservation facilities, in preservation, and during the processing stage. As observed, the road network linking farms to homes is very bad, and during the rainy season, often inaccessible. Transportation is largely done using the motorbike or on the head, with high exposure to rain, resulting in both qualitative and quantitative losses (see Chapter 5 paragraph 5.2). Documented works have highlighted similar issues to the ones uncovered by this study (see Chapter 2 paragraph 2.5.2.1 and 2.5.2.2).

While some studies (see FAO, 2013; World Bank 2010) have highlighted poor packaging at the postharvest stage as contributing to losses, this study's results did not see packaging contributing significantly to postharvest losses in potato farming.

5.2.4 Impact of postharvest losses

The impact of postharvest losses manifest in the social, economic and environmental spheres.

Social

An important finding in this study is that in spite of postharvest losses bringing about food shortages, the degree of food shortage as reported was not so high. It is important to note that since the degree of losses varied based on the different postharvest loss prevention techniques used, there was variation in the impact. However, this study has uncovered some common social impacts of postharvest losses in the community such as lack of access to quality and advanced formal education by the children of smallholder farmers in the community, as well as low living standards (see Chapter 4 paragraph 4.4.2.2).

Economic

Study participants frequently spoke of the negative economic impacts of postharvest losses on farmers and the community at large. As demonstrated by this study, the economic impacts of postharvest losses in potato farming include low household income and poor development of trade and industry in the area (see Chapter 4 paragraph 4.4.2.1).

It is important to mention here that these findings are similar to those reported by other scholars like Ahmed (2013) and Patrick (2013). It is also noteworthy that farmers made no mention of spending in buying other crops as a means to ensure food availability. This could be explained by the fact that smallholder farmers cultivate a series of food crops alongside potatoes such as beans, maize and cocoyams.

Environmental

A fundamental impact of postharvest losses uncovered by this study was environmental in nature. Observations were that farming activities are encroaching on and taking over virgin lands that were initially preserved for posterity. As explained by officials of the Delegation of Agriculture and Rural Development as well as officials of NGOs, postharvest losses have forced farmers to move into the slopes of Mount Oku in search of more fertile land so as to have high yields (see Chapter 4 paragraph 4.4.2.6). The result of this has been continuous soil degradation and an increasing volume of gases in the air, as well as deforestation.

Interestingly, although the environmental impacts were glaringly obvious (see photo gallery appendices to this thesis), they were not particularly mentioned by the farmers. Other studies have highlighted the environmental impact of postharvest losses (see Chapter 2 paragraph 2.5.3).

5.3 THE NATURE OF POTATO POSTHARVEST LOSSES IN BUI DIVISION

The indigenous postharvest interconnected chain of activities in potato farming are carried out under different climatic conditions due to the fact that there exist two farming seasons for potatoes in Bui Division. Specifically, in Bui Division, with potato production using indigenous knowledge, the postharvest functions include: grading/sorting, assembling, drying, storage, packaging, transportation, processing (for immediate consumption and for future consumption) and marketing. The specific conditions under which these postharvest functions are carried out explain the nature of postharvest losses.

Generally, as highlighted earlier, (in chapter two), an effective postharvest system should ensure that harvested crops reach the consumers in good conditions and in sufficient quantities. Once potatoes are harvested, they are

subjected to deterioration but the rate of deterioration (postharvest losses) is determined by some factors and practices that expose the potato tubers to temperature changes, water, air and damages resulting from transportation and / or storage.

Although postharvest losses occur along the postharvest chain, production conditions (which are pre-harvest and harvest in nature) were noted to contribute significantly to the volume of postharvest losses recorded in potato farming. For example, "*it was observed that during harvesting the small hand knife used for harvesting often injured the potato tuber, causing contamination with subsequent mould growth during the postharvest stages which caused it to rot".* In such a situation, the postharvest losses are both qualitative (as gradual spoilage reduces the tuber quality) and quantitative (when the tuber completely reaches a state that it cannot be consumed again) in nature. Therefore the observations in Bui division hold same with the view of Hodges *et al.*, (2011), who identified seasons as well as the conditions under which crops are grown, harvested and/or stored as key areas for explaining the nature of crop postharvest losses. Therefore, it can be established that changes in climatic conditions as a result of climate change, may therefore increase or decrease postharvest losses in potato farming. It can be asserted therefore that strengthening indigenous farmers' capacity with modern tools for farming and improving on their storage facilities will minimize postharvest losses in potato farming.

Also, hand harvesting which is the indigenous method used by smallholder indigenous potato farmers in Bui was reported to be more effective than the method of using the small hand held hoe, but constraints to adequate labour can lead to delays and at times failures to harvest the crop. For example during field interviews, a farmer in Tadu recounted his past experience:

> *"There was a year that I cultivated 5 potato farms. My children were still very young and I was newly wedded. At the time potatoes was*

matured for harvesting I was 7 months pregnant and could not work for long. I contacted some people to help me but everybody was busy. Finally I didn't have many people to help me. That year, most of my potatoes that was harvested got bad because they were harvested very late. I will never forget this experience".

These delays result in significant postharvest losses considering that indigenous farmers depend on the physiological maturity of the crop. Farmers stated clearly that once the potato tuber was overdue in the ground, it started to rot and such overdue tubers usually got rotten at a faster rate after harvest thus indicating that high postharvest losses would be recorded should the farmers delay in harvesting. This is similar to the view reported by the World Bank (2010) on the situation of postharvest losses in grains in Sub Saharan Africa.

Further, immediately harvesting is done, most smallholder farmers lack adequate on-farm storage facilities. The lack of on-farm storage facilities coupled with the poor state of roads was reported to contribute to postharvest losses. As observed in Vekovi during the sorting process, the lack of on-farm storage facilities made farmers to dispose some potato tubers in the farms especially those whose sizes were not big enough. This was reported to be largely due to difficulties with transportation since the farming area is quite a distance away. For example, a female farmer in Vekovi said: "*I cannot kill myself. I have no option than to dispose the potatoes that the sizes are small. My farm is located right up the hills; I do not have a farm house. There is nobody to buy. My children are still very young and cannot come to this far off farm so I can only select the bigger ones and the quantity I can carry home"*.

Delays in getting the transport facility often exposed the tubers to rain in the rainy season since the area experiences high rainfall during the rainy season harvesting period. Transportation on the head and on motorbikes, a very common

practice, also leaves the tubers wounded as they easily rub against each other. Also, during transportation, since the roads are very inaccessible, the tubers sustain some breakages due to too much friction as such reducing quality and quantity as well as the shelf life when stored. The poor transportation mode wherein smallholder farmers use bicycles, motorcycles and pickups, has been reported to be high in Africa causing high postharvest losses as the crops are not properly protected (World Bank, 1996; World Development Report, 2009).

As noted, qualitative and quantitative postharvest losses were reported to be high during the processing and preservation stages. High reliance on sunshine for drying potatoes resulted in high quantitative postharvest losses. The alternative drying of potatoes on kitchen roofs resulted in high qualitative losses as the potatoes wrinkled. Also, drying on shelves in closed rooms was also noted to be characterized with postharvest losses as it exposed the tubers to rats coupled with the poor state of the shelves. These findings related to processing and preservation are similar to those of De Lima, (1982) who observed that high dependence on drying crops based on sunshine and the movement of atmospheric air through the crops, resulted in high postharvest losses in Swaziland.

5.4 POTATO POSTHARVEST LOSS PREVENTION METHODS UTILIZED BY INDIGENOUS FARMERS

A range of indigenous practices have been adopted by smallholder farmers to minimize postharvest losses in potato farming in Bui Division, North West Region of Cameroon. This range of indigenous practices can be grouped into three categories namely: postharvest management along the chain, storage facilities and pest/fungi management and storage structures, and communal arrangements for potato marketing. A deep review, examination and understanding of these indigenous knowledge based practices to best ensure the adoption and enhancement of least costly but effective practices can significantly minimize

postharvest losses in potato farming thereby resulting in significant impacts on individual farmers and the agricultural economy of the region as a whole.

Smallholder farmers have been utilizing their indigenous knowledge practices in postharvest management along potato chain to reduce losses. These practices were noted to be recording varied rates of success and to differ between the farming seasons. These practices it was observed are tailored to achieve the best possible results spanning from proper harvesting, drying, preservation and transportation.

Seed selection and prompt harvesting at maturity were noted to be a critical beginning step in preventing loses occurring subsequently in the postharvest stages. In some villages, especially marshy farm lands, potato seeds produced from research institutes often called “variety” by the local people were noted to be at a disadvantage because immediately they were overdue in the soil, they got rotten at a faster rate once harvested. Further, potatoes grown in marshy areas during the rainy season were also noted to be vulnerable to rot in storage and, consequently, are sold soon after harvest. To combat this, test harvesting and observation of the crop characteristics were the identified efficient methods utilized by the indigenous farmers to determine crop maturity dates for harvesting. This therefore indicates that indigenous practices of the smallholder farmers in Bui Division tie with the views of the World Bank (2010) highlighting the fact that postharvest losses can be minimized by first ensuring that crops are harvested at the right time.

PICTURE 5.1: GROUP HARVESTING IN A MEMBERS’FARM IN VEKOVI

Source: The Researcher

Further, communal (group) farming where farmers worked from one member's farm to another, was also mentioned as a means of ensuring labour supply. This ensures that potatoes are not over due in the farms hence minimizing postharvest losses. Group farming practice coupled with the marketing of the crops immediately after harvesting in the farms was noted to be an indigenous practice utilized to transfer the risk of postharvest losses occurring from farmers to other actors in the chain. These findings are similar to those reported by FAO (2008) indicating how the use of revolving community schemes among farmers helped minimize postharvest losses in grains in nine African countries for the period 1997–2007. On this basis therefore, it can be argued that encouraging and strengthening the indigenous communal (group) farming practice can significantly reduce postharvest losses in potato farming in Bui Division. Picture 5.1 shows

group farming harvesting activity in the farm of a member as captured during the study period.

Considering that in Bui Division, rainy season potatoes are harvested mostly in May and June close to the start of the heavy rains in July, damp and cloudy weather has always made it difficult for the crop to be adequately dried for storage. Indigenous smallholder farmers have continuously employed the practice of drying by spraying wood ash and saw dust as the best techniques that can minimize quantitative postharvest losses without impacting negatively on the qualitative aspect of the crop. This practice is enhanced by the fact that wood ash is easily available in reasonable quantities as the local people use wood as a source of energy for cooking. The use of wood ash does not add any financial costs to the farmer. This finding is similar to those of Haile (2006), World Bank (2010), Boxall (2002), who observed that in Ethiopia as well as in other Sub Saharan African Countries, the indigenous practice of using plant materials as natural insecticides or as repellents was successful in minimizing postharvest losses.

Further as noted by Haile (2006), World Bank (2010), Boxall (2002), the efficacy of natural insecticides is highly variable even within plant species. The same holds for the efficiency of using wood ash and/or saw dust to prevent postharvest losses in potato farming. Preservation in cold areas was highlighted to be far more challenging. The indigenous technique utilized in cold areas was through drying in wooden shelves placed in dry dark rooms and also in specially prepared kitchen ceilings using bamboos and mud. However, qualitative losses were reported to be high when using kitchen ceilings caused by the heat from the fire. Farmers stated that, the wood ash and the saw dust are very effective in minimizing postharvest losses in warm areas but not so efficient in cold areas. This was caused by the fact that the wood ash or saw dust easily absorbed the moisture from the wet air and soil thus rendering the tubers wet.

Further, high mastery and application of basic safety principles was noted to be common among indigenous farmers. These included protection and monitoring of potato storage rooms and shelves, constant changing of the sawdust when it gets wet and regular addition of wood ash. For example a male farmer who practices mono farming for commercial purposes said: "*I constantly check on my potatoes in the preservation room. This is my only source of income. I open and do sorting to remove the potatoes that have started to get rot from contaminating the others on weekly basis. I also make sure that my storage room is very dry by adding saw dust when need be".* Frequent monitoring made it possible for losses to be minimized as the rotting potatoes were immediately removed as such preventing it from contaminating the other tubers. Such a practice made it possible for farmers to store potatoes for several months and to benefit from price increases resulting from changes in season. Such indigenous postharvest reduction practice though successful was observed to be very demanding as it required regular sorting through-out the storage period, coupled with the fact that the loss of bio-resources has made construction of traditional drying platforms and storage facilities very difficult. These findings are in line with those reported by the World Bank (2010), on Postharvest Grain losses in Sub-Saharan Africa.

The indigenous knowledge limitation for transformation and processing of potatoes especially for long term consumption was observed to result in both qualitative and quantitative losses. Field evidence showed basically that potatoes were highly processed just for immediate consumption. Thus since the harvest time yields cannot be completely consumed immediately, lack of transformation resulted in postharvest losses since the tuber is perishable coupled with preservation challenges. This therefore confirms UNIDO (2006) argument that transformation and preservation of local products for mass consumption, which are mostly agricultural products, are less developed and as such significant postharvest losses are recorded in the agricultural sector in Cameroon. .

5.5 DISCUSSING THE FINDINGS ON INDIGENOUS KNOWLEDGE TECHNIQUES TO MINIMIZE POTATO POSTHARVEST LOSSES

This study clearly shows that smallholder farmers possess abundant knowledge with respect to agricultural practices with some indigenous knowledge practices noted to be contributing significantly to productivity and in minimizing postharvest losses in potato farming. These practices were highly mentioned by the farmers during field interviews with the general wish for better measures to prevent postharvest losses. For example an elderly man in Ijim said: *"we have several different ways of preserving our harvest but none of these methods has helped us to record very minimal postharvest losses. We really need assistance to improve on our preservation facilities and methods".* Thus, it is important that these indigenous knowledge techniques should be enhanced to minimize postharvest losses so as to ensure the world cry of food security as well as improve on socioeconomic livelihood conditions of smallholder farmers.

The indigenous knowledge techniques are applied along the three stages of potato farming namely production, processing and preservation. The discussion highlights the areas where these techniques need to be enhanced in order to minimize postharvest losses.

5.5.1 Enhancements in the production stage

With the growing talk of climate change, indigenous knowledge farming practices have been highlighted to be environmentally friendly UNCTAD, (2009). However, the constrained resource setting has limited farmers from making maximum potential of their knowledge base. For example, during field interviews, farmers mentioned access to quality and adapted seeds as a serious hindrance to their production efforts. This implies the need for quality and adapted seeds, which can be achieved through establishing and supporting community seed growers

associations. Considering that good quality seeds are very important factors that influence yields, improving on access to quality seeds by smallholder indigenous farmers will likely translate to high yields. The benefits of high yields will be both in terms of increasing food for family consumption hence fighting hunger and also increasing quantity available for sale hence a source of income for the family. This similar opinion has been advanced by Adam (2014). Such income will then be utilized in improving on the general family welfare as such benefiting the smallholder farmers. Further, farmers explained that farms are getting old and there is need for soil fertility to be improved upon as well as the use of adapted seeds. By avoiding the “Ankara” and cultivating legumes that act as soil-enhancing crops alongside potato as well as making use of farm yarn manure, fowl droppings will significantly improve soil fertility. With fertile soils, yields will be high, hence helping farmers as they struggle to meet their livelihood needs. Since fallow periods (a major indigenous technique of regenerating soil nutrients and soil fertility) are reducing due to population pressure on land (FA0, 2010), training farmers on better techniques of preparing organic manure and better organic farming techniques will increase organic matter content in the soil and make the soils more resistant to drought as such supporting agricultural production (IFOAM, 2002; FAO, 2008 & IFOAM, 2007). A great source of organic manure can be from sewage. This can be done through the use of composting toilets as the area practices only on-site sanitation. This framework thus suggests that farmers’ indigenous knowledge should be enhanced by making seeds that are adapted to the climate physiognomy ecology of Bui Division available as well as by training farming on environmental friendly farming systems.

Furthermore, since indigenous potato farming demands a lot in terms of labour, there is need to strengthen the farmers’ practices of group farming. Grouping farmers and strengthening them into Cooperatives/Common Initiative Groups and providing minimal support through training and farm tools will significantly impact potato farming in Bui Division. Mechanized farming can also be

introduced especially in the low lying areas. This will be a great substitute for human labour and will boost production. Through the practice of group farming, postharvest losses resulting from delays in harvesting (after maturity of the crop) will be reduced as the crop will be harvested on time. By harvesting the crop on time, the shelf life of the crop will be longer, making it possible for farmers to preserve for longer periods and benefit from high prices during off season as well as to have a guaranteed source of food for the household. Also, group farming will increase the amount of cultivated land with the likelihood of translating into high yields.

With improvements through seeds and support for communal farming, high quality potatoes will be harvested and thus a need to link farmers to markets in the major towns of the country and even of the West African sub region as Cameroon serves as a major bread basket in this sub-region. Such a market link will significantly reduce postharvest losses as farmers will transfer the risk of preservation to buyers. By linking farmers to the market, the demand for potato will surely exceed supply and prices will increase thus benefiting commercial smallholder farmers in Bui Division. It can therefore be noted that such enhancement of indigenous techniques at the production stage will positively improve on the socioeconomic livelihood conditions of small holder farmers practicing potato farming in Bui Division.

5.5.2 Enhancements in the processing stage

As observed from the field, the indigenous knowledge processing capacity is basically efficient in the short term than long term. Most processing was transformation for immediate and short term consumption. This calls for an urgent need to enhance indigenous processing techniques so as to minimize postharvest losses. Field studies identified drying and improvement of facilities for potato flour

production as the main processing activities that need to be enhanced. By improving on drying, small holder farmers can make much gain as postharvest losses will be reduced. Better conditions for drying can be realized through support to farmers to construct storage rooms with good shelves. With reduction in postharvest losses and linkage to markets, farmers will experience higher incomes and their welfare conditions will improve.

Also, transformation and processing of potato to flour was almost inexistent in the study area. This was linked to the lack of grinding facilities and the insufficiency of electrical energy needed to install and run the grinding facilities. The use of renewable energy resources which are abundant in the area will improve upon energy and encourage petit business persons to install potato grinding facilities in these areas. Thus strengthening the indigenous practice of potato flour production with low cost grinding machines will significantly reduce postharvest losses as smallholder farmers will convert their potato from the form which is difficult to preserve into potato flour which can be easily preserved for a long period. Further, with transformation facilities, the potato value chain will be enhanced and the role of the farmers in the chain will be more profitable.

5.5.3 Enhancements in the preservation stage

Household food needs depend on a sustainable supply of food at all seasons, thus a need for an adequate food system, with efficient preservation so as to minimize postharvest losses. Field results showed that preservation of perishable crops like potatoes is very challenging. Though Indigenous knowledge techniques are useful, the level of postharvest losses were noted to be very high thus confirming the view of FAO–World Bank, (2010); Prusky, (2011) on the magnitude of postharvest losses experienced in food production across the world. To meet with the growing food demand, there is need to strengthen indigenous knowledge techniques as utilized in preservation.

Field observations and interviews show the need for enhancement of both on-farm and off-farm preservation facilities. By enhancing on-farm preservation facilities and making such facilities more water proof, warm and dry enough, the consequences of damp weather which increases rot in potatoes will be reduced. This will thus reduce the quantity of postharvest losses occurring as a result of lack of appropriate on-farm preservation facilities. Similarly, enhancement of off-farm preservation facilities will also have a significant impact as farmers will be able to preserve the crop when it has been transported out of the farms in such a way that both qualitative and quantitative losses are minimized. Field observations and interviews identified preservation on shelves and using bags as the most appropriate indigenous knowledge techniques that can be enhanced to minimize postharvest losses. With shelves, the potatoes are suspended and do not have direct contact with the cold floor thus providing favourable conditions for continuous drying especially in situations where there was no adequate drying before storage. Improvement in storage facilities and capacity have been highlighted by the World Bank (2010), as a suitable way to minimize postharvest losses in grains in Sub Saharan Africa.

5.6 CONTRIBUTION OF THE STUDY: OBSTACLES TO SOCIO-ECONOMIC DEVELOPMENT IN THE FARMING COMMUNITIES OF CAMEROON

This study has produced important findings that have implications for the socio-economic development of the rural population of Cameroon via the commercialisation of potato farming and employment creation. The study highlighted the following obstacles to this development:

- The availability of land for potato farming. Only the royal families possess large farms, while the majority of the rural farmers possess small-holdings, which are too small to produce potatoes on a large scale.

- Postharvest losses caused by pre-harvest and in-harvest production activities, for example the use of small hand knives during harvesting often injured the potato tuber, causing contamination with subsequent mould growth during the postharvest stages which caused it to rot.

- Challenges with regard to improving soil fertility and therefore the need for fertilizers.

- Seed selection being a specialized skill. This is not recognised as such and therefore the necessary training and remuneration in that regard are not provided.

- Constraints to adequate labour leading to delays and failures to harvest potato crops.

- Lack adequate on-farm storage facilities especially on small-holder farms.

- Poor road infrastructure that inhibits the safe transporting of crops.

- Damage to potatoes caused by current means of transportation such as on-head and motorbikes.

- Lack of drying facilities and too much reliance on sunshine for drying purposes.

- Problems caused by alternative drying methods, such as drying of potatoes on kitchen roofs and on shelves in closed rooms. Challenges in these regards included exposing the tubers to rats and poorly constructed shelves.

- Preservation of potatoes in cold geographical areas presents the challenge of keeping the crops dry and healthy.

- Producing potatoes primarily for immediate consumption and not for commercialisation.

- The absence of machines and tools to foster commercialisation of potato farming.

- Challenges with regard to linking farmers to markets.

- Lack of knowledge to manage potato storage rooms and shelves.

5.7 CONTRIBUTION OF THE STUDY: RECOMMENDED SOLUTIONS

The overriding challenge for the rural potato farmers is the lack of capital to commercialise potato farming. Most of these farmers are small-hold farmers producing potatoes for immediate consumption. The present study argues that large outlays of capital are not necessarily required to commercialise potato farming rural areas and that sufficient indigenous knowledge exists that could be harnessed in a commercial way to provide both the immediate consumption needs and commercial advancement of these rural communities. The present study argues that by increasing the farm sizes of rural farmers and organising these farms according to business principles such as division of labour and management tasks (planning, organising, leading and control), these farmers could be good commercial farmers. The focus however should be on applying these business principles and management functions in the contact of indigenous knowledge in the following ways:

- Local and national government must systematically make available more land to indigenous farmers. This could be done by developing and implementing bio-conservation programmes and laws that facilitate the securing and preserving of virgin lands for the future farmers.

- Employ the expertise of elderly people to perform the seed selection, as this was highlighted as a critical step in preventing postharvest losses. More employees should also be trained as seed multipliers.

- In addition, the quality of seeds can be improved through establishing and supporting community seed growers associations.

- Train employees in the practice of drying potatoes by spraying wood ash and saw dust.

- Implement communal (group) farming in an organized and employment creating manner whereby farmers work from one member's farm to another to ensure sufficient labour supply to prevent delays and failure to harvest crops.

- Group farming could be further strengthened through the establishment of cooperatives, common initiative groups or communal farming, which could support through the provision training and farm tools.

- Government and these cooperatives or common initiative groups should establish grinding facilities to produce potato flour which can be preserved for long periods. Renewable energy resources, which are abundant in the rural areas, can be used to drive these grinders.

- Train employees and create businesses around the use of indigenous practices of using plant materials as natural insecticides and insect repellents.

- Create businesses that focus on increasing soil fertility through the cultivation of legumes that act as soil-enhancing green manure alongside potato and through the production of farm yarn manure and collection of fowl droppings. A great source of organic manure can be from sewage produced in composting toilets.

- In cold geographical areas, train employees on how to use the indigenous technique of keeping crops dry in specially constructed dark rooms on wooden shelves and in ceilings covered with bamboos and mud. In managing these dark rooms, these employees must be trained to master the application of indigenous basic safety principles, such as the constant monitoring of the shelves and the regular changing of the sawdust when it gets wet. The regular addition of wood ash to ensure the drying of potatoes.

- Government, cooperatives or private firms should establish on-farm and off-farm preservation facilities which should provide quality waterproof, warm and dry preservation services, wooden shelves and bags.

- Local governments should assist these farmers to gain access to markets in the major towns of the country and the West African sub-region.

By implementing all the above-mentioned activities on a larger scale on farms or service businesses could change these rural farms in businesses based on indigenous knowledge. These commercialization activities should create employment and economic growth without large outlays of capital.

5.8 RECOMMENDATION FOR FUTURE RESEARCH

This study recommended important interventions that should be implemented to reduce postharvest losses in the potato farming industry of Cameroon. By conducting action research on the progress of the implementation of these recommendations, it will provide valuable lessons on how indigenous knowledge systems should be implemented to benefit communities and economies of countries.

5.9 CONCLUSION

The present study has identified potato farming in Cameroon as a potential contributor to the socio-economic development of farmers, their communities and their country. The potato farming industry largely consists of smallholder farmers, predominantly women, producing primarily for immediate consumption. Historically, these farmers have been sustaining their farms through indigenous knowledge and practices that are not being exploited to the fullest beneficial opportunities for these farmers. It has often been suggested that highly mechanised Western approaches should be implemented to commercialise these farms in order to access these benefits. These approaches of mechanisation require large capital outlays which these smallholder farmers cannot afford, hence the approach taken by the present study to capitalise on the indigenous knowledge and practices of these farmers.

The present study identified postharvest losses in potato production as a threat to food security of smallholder farmers and their communities. The postharvest losses could be minimised, poverty and low socio-economic conditions could be reduced. The present study argued that working with the existing indigenous knowledge and practices of these farmers, a level of commercialisation with results in job creation and economic benefits could be achieved.

This study has succeeded in identifying the causes of postharvest potato losses on the smallholding farms, the obstacles in reducing these losses and the techniques to reduce these losses. The study provides important recommendations to improve on smallholder potato farming in Cameroon. By implementing the findings of this study, the Cameroon government, prospective potato farmers, entrepreneurs, traditional authorities and NGOs could make a significant contribution to the improvement of socio-economic conditions and the reduction of poverty levels in these farming communities.

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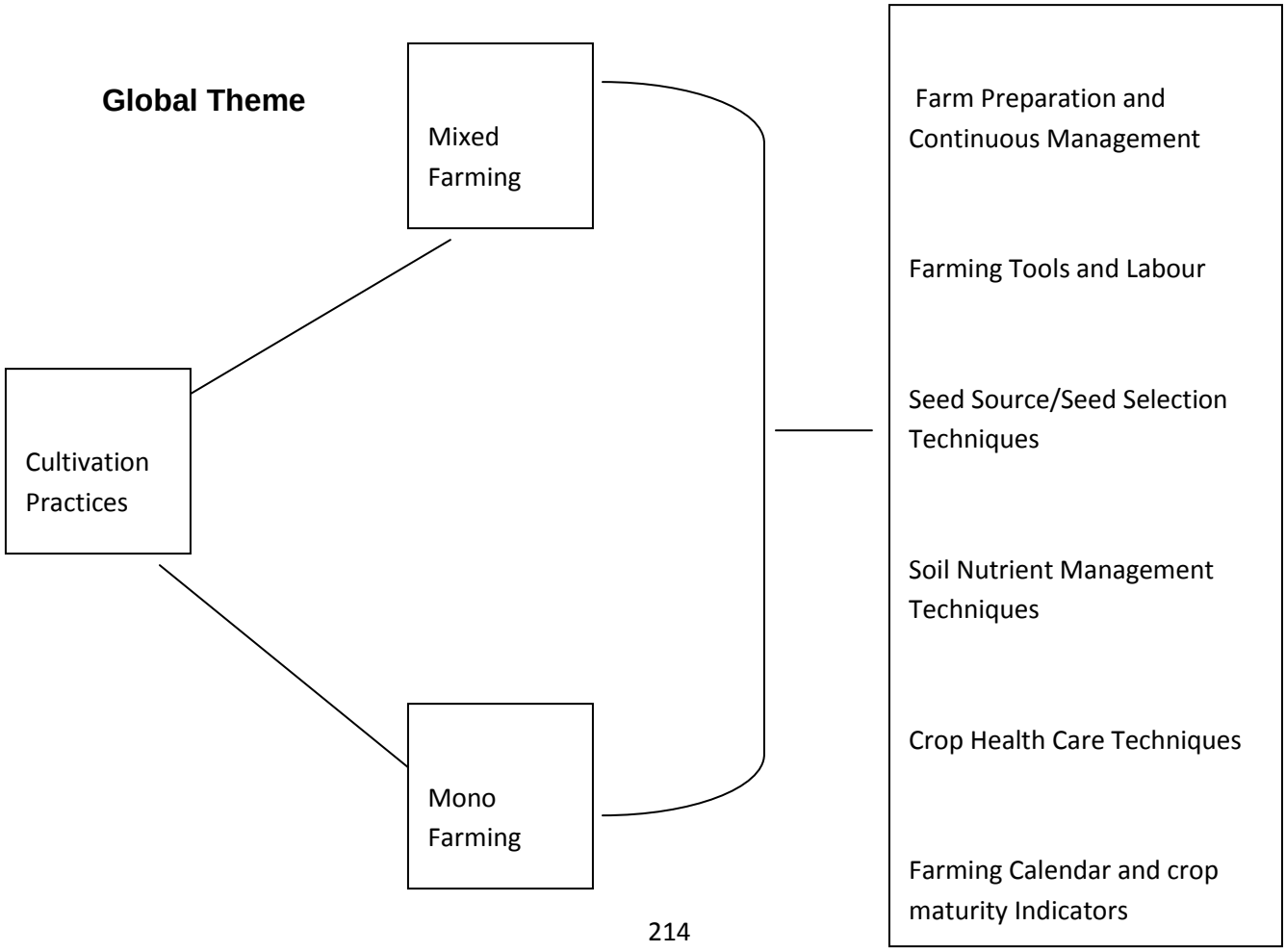
APPENDICES

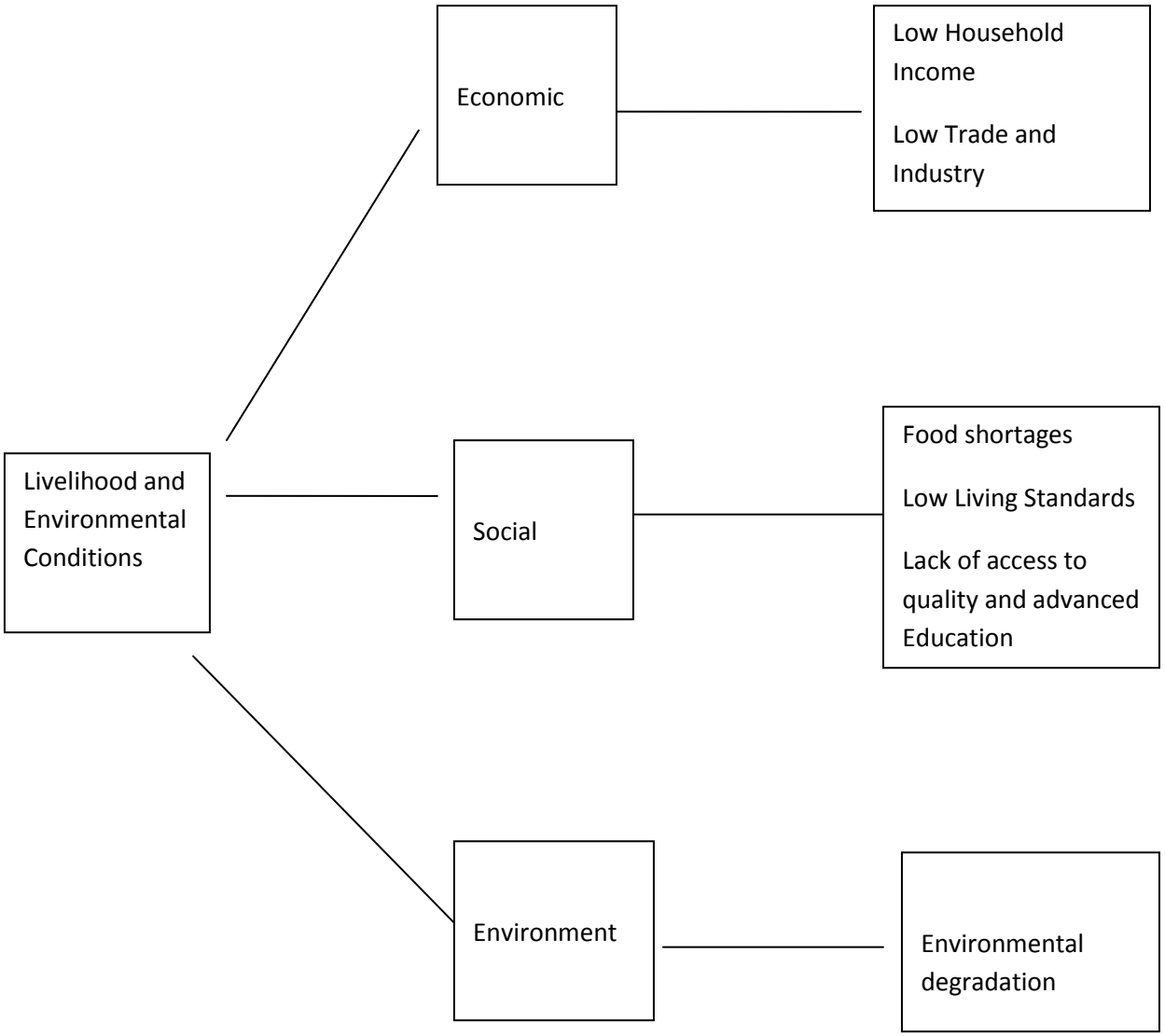
Appendix A: Thematic Network Diagrams – QUALITATIVE ANALYSIS

A. Nature of potato farming

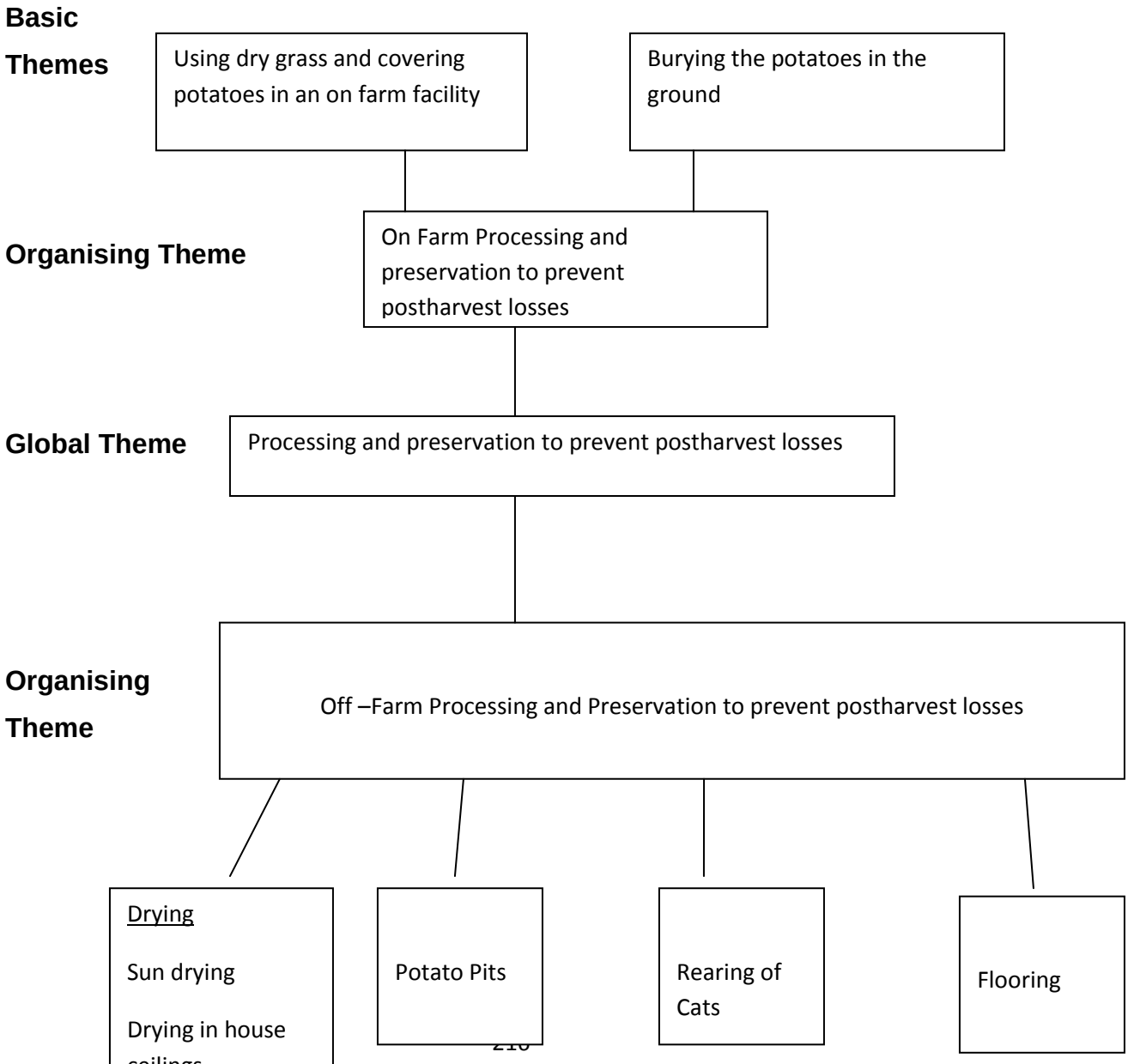


B. Impact of Postharvest losses

Global Theme **Organising Themes** **Basic Themes**



C. Postharvest loss prevention methods



Basic Themes

Appendix B: Photo Gallery

Group harvesting of potatoes in a members'farm in Vekovi

Photo Source: The Author

Crops growing in ridges in a hilly area (Potato cultivation across a slope at Vekovi)

Photo Source: The Author

An on-farm preservation facility in Tadu

Photo source: Author

Environmental Impact - Farming activities encroaching towards Mount Oku as farmers search for fertile land in Kevu area

Photo Source: The Author

Motorcycles used for transportation of potatoes from Farm to home and / or to Market

Photo Source: The Author

Harvested potatoes packed in bags for transportation to off-farm preservation facilities

Photo Source: The Author

Appendix C: Interview guide

NELSON MANDELA UNIVERSITY SOUTH AFRICA
NELSON MANDELA UNIVERSITY BUSINESS SCHOOL

This interview guide is meant strictly for the collection of data for a Doctoral study title Indigenous Knowledge For Agricultural Development: A Framework For Potato Farming In Bui Division, North West Region Of Cameroon

INTERVIEW GUIDE (FOR FARMERS)

Code: **Sub-Division:**

Demographic Information

A. When were you born? (Age)?
B. In which village are you from (Village):
C. What is your Education level:
D. How long have you been involved in potato farming (Agricultural experience (in years)):
E. How many people live with you in your house (Size of the family):
F. Technological information source: (Interviewee will explain each when applicable)
G. Assistant Agricultural officer
H. Own experience
I. Family experience
J. Neighboring farmers
K. Friends
L. Relatives
M. Progressive farmers
N. Input distribution centre
O. Co-operative society
P. Others

A Nature of potato farming

A. Where do you get your seeds?

B. How do you prepare your farm before planting?

C. How is your farm size?

D. How many species do you produce?

E. What is your average potato production per farm (measures in Tins)?

F. Do you use manure?

Probe - If yes which if no why?

G. For how long have you been carrying out this activity?

H. What tools do you use?

I. Why do you farm potatoes?

Probe: just to eat, to sell some etc.

J. Is there someone helping you? And if yes how?

K. How do you see your yields?

L. In case you sell. Who do you sell to?

M. Do you have enough land?

N. Who are those involve. Only family members or paid labour?

O. Do you practice mono-cropping of potatoes or intercropping?

Probe: why do you practice the mono-cropping or intercropping

(depending on what the farmer is into farmer will list other crops)

P. At what times do you plant potatoes?

Q. What is your average farm size (Size of holding): this should go to the section

R. Who work in your farm(s) (Type of agricultural labour): do you hire workers to work on your farm?

S. Agricultural priorities: Home consumption or for commercial purpose or both?

T. Where do you get your seeds (Seed source)?

U. How long does it take after planting for potatoes to be ready for harvesting?

B Efficacy of techniques of farming, processing and preservation

A. How do you know when to plant your potatoes?

B. How do you determine when your potatoes is ready?

C. Where do you store your harvest?

Probe: On farm, in your homes etc

D. Why do you store as indicated above?

E. How do you store your harvest?

Probe: Do you have a different way to store your seeds from the potato meant for consumption or for the market?

F. How long do you use seed species harvested from one farm? Probe: Why?

G. How often do you change or introduce new seeds to you fields? Probe: Why?

H. Rate the level of success of the carrying out mono-cropping or intercropping of potatoes. Probe: What to you is responsible?

I. How do you process your potatoes?

Hints (Before keeping for use or taking to the market or both) Focus to be on indigenous practices?

For each of the indigenous processing practices/techniques the farmers will be asked the following also:

J. Who taught you these methods?

K. How much of your harvest do you lose when you use each of these methods?

L. If you were to suggest, which method do you think is the best?

M. What do you think is responsible for high losses when the various methods of processing/preservation are used?

N. Please describe to me what is needed to use each of the above techniques

O. Please do you use chemicals (“white man medicine”) to preserve your potatoes?

Probe: If yes why? Where do you get it from?

P. Are there any traditional herbs you use that help preserve your potatoes for long while at same time minimising losses?

Q. Which of the traditional methods of potato processing/preservation do you think that if promoted it will help reduce postharvest losses?

R. What other challenges do you face as a potato farmer?

C. Challenges involved in the utilisation of indigenous knowledge

A. Are there some difficulties you face when using indigenous (traditional ways) practices to farm, process and preserve your potato?

Probe: Let interviewee list them

B. What according to you make these difficulties to exist?

D. Impact of challenges on Agricultural Industry

A. In your opinion how do you think the above listed challenges have affected potato production in this area and Cameroon at large?

Hint: Get interviewees relate effects to each challenge mentioned

E. Measures used to overcome the challenges

What are the ways you are using to overcome the challenges you are facing with potato farming, processing and preservation?

Probe: For each challenge raised by the farmers, they will provide a measure they are using to overcome it.

INTERVIEW GUIDE (AGRICULTURAL AUTHORITIES, COORDINATORS OF SMALL HOLDER SUPPORT PROGRAMS ETC)

A. Please describe to me the indigenous nature of potato farming in this area

B. Please kindly explain the indigenous techniques you see being use to process/preserve potatoes so as to minimise postharvest losses

C. Please how do you see these methods in terms of efficacy

D. Please from your experience with farmers, which of these traditional methods do you think needs to be enhanced to minimise postharvest losses?

E. In which ways do you think this enhancement can be done? (Mention and explain)

F. Please explain (if at all it exist) how western methods of potato processing/preservation have been blended and used with the indigenous techniques of the people in this locality

G. Please what are the challenges faced in utilising indigenous knowledge for potato processing/preservation in this area?

H. How do you think these challenges affect agriculture and the entire country?

FOCUS GROUP DISCUSSION GUIDE

A. Please describe how you cultivate potatoes in your area

B. How do you keep your potatoes when after harvesting from the farms?

C. What quantity of your potatoes gets bad after harvest?

Probe 1) Find out how the quantity losses reduces or increases as the days go by based on the type of preservation method used

Probe 2) Find out how long (time in months) potato can last when stored based on each of the traditional methods

D. What are the main challenges faced by potato farmers when it comes to using indigenous knowledge to preserve potatoes?

Probe: 1) Find out if some herbs previously used are not more available

Probe: 2) Find out if the skills are no more there

Probe: 3) Find out if modernisation has an influence

E. What are the ways you are using to overcome the challenges you are facing with potato farming, processing and preservation?

Prob: For each challenge raised by the farmers, they will provide a measure they are using

F. How do you think these challenges faced by farmers affect agriculture and the entire country?