

**THE POLITICAL ECOLOGICAL ECONOMICS OF COAL MINING AND WATER
RESOURCES: A PARTICIPATORY ECONOMIC VALUATION APPROACH IN
CAROLINA, MPUMALANGA**

A thesis submitted in fulfilment of the requirements of the degree

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“Although ecosystem valuation is certainly difficult and fraught with uncertainties, one choice we do not have is whether or not to do it... as long as we are forced to make choices, we are going through the process of valuation.”

Constanza, D' Arge, De Groot, Farber, Grasso, Hannon, Limburg, Naeem, O'Neill, Paruelo,
Raskin, Sutton and Van Den Belt (1997)

ABSTRACT

Globally, resource economic valuation has traditionally focused on monetary and market-based methods. However, there has been a recent move towards more transdisciplinary methods that encourage civil participation in resource economic valuation studies with the aim of generating more site-specific and appropriate values which can potentially improve natural resource management decisions. With a focus on Carolina, this thesis investigated whether citizen based participatory approaches can result in more appropriate resource economic values that reflect the social environmental values in Carolina. A qualitative research approach was adopted for this research which incorporated questionnaires and semi-structured interviews. The research also adopted an inductive thematic analysis. The findings of the research showed that local scale stakeholders have different perceived values of natural resources. The research further showed that national scale resource governance institutions deal with issues of natural resource economic conflicts related to environmental policy and decision making. The study will contribute to deepening an understanding of the contribution that a natural resource economics assessment, or analysis can have on equitable, sustainable and efficient water resource management in the face of water-use contestation.

DECLARATION

DECLARATION

This thesis has not been submitted to a university other than Rhodes University, Grahamstown, South Africa. The work presented is that of the author and all references have been accurately recorded.

Signed

A handwritten signature in black ink, appearing to read 'Ngimande', written over a horizontal line.

Date May 2020

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LIST OF ABBREVIATIONS

CMA	Catchment Management Agency
CSES	Complex Social-Ecological System
DWS	Department of Water and Sanitation
IUMCA	Inkomati-Usuthu Catchment Management Agency
UKCMF	Upper Komati Catchment Management Forum
WRC	Water Research Commission

CHAPTER 1 INTRODUCTION

1.1. RATIONALE AND SIGNIFICANCE OF THE RESEARCH

This research is based on a larger project that was funded by the South African Water Research Commission (WRC) through a fine which was paid to the Ermelo High Court for severe damages to a wetland because of unlawful mining activities. The R1 million fine was paid by Golfview Mining (Pty) Ltd and allocated to WRC for research that investigated the impact of coal mining on wetlands in the area around the town of Carolina. The WRC research project aimed to achieve the following objectives:

- **Aim 1:** Conduct an analysis of available resource and catchment-based tools aimed at sustainable development of water resources and management.
- **Aim 2:** Investigate and evaluate the decision-making processes followed in issuing mining authorisation.
- **Aim 3:** Determine the relationship between licensing processes and ecological infrastructure from a landscape and connectivity perspective.
- **Aim 4:** Propose an integrative decision-making process and institutional arrangement required to support licensing for sustainable use of natural capital.
- **Aim 5:** Develop guidelines necessary to understand the socio-economic value of selected wetlands, demonstrating their importance to society.
- **Aim 6:** Develop and test a multi-sectoral integrative monitoring framework linked to a decision support system that will cater for bio-physical, economic and societal needs.
- **Aim 7:** Develop appropriate capacity for officials involved in licensing, business, and affected communities

These objectives were met and reported as “Developing a multi-sectoral integrative licensing and monitoring framework to align and integrate biodiversity and environmental water quality in the coal mining development life-cycle” (Munnik, Humby, van der Waals, Houdet, Thomson, Keighley, Cobbing and Palmer., 2018). This thesis focuses on Aim 5 which was reported in Chapter 5 of the Munnik *et al* (2018) report. Chapter 5 is referred to as Houdet (2018) and as an individual publication - Houdet (2017). In the review of Munnik *et al* (2018), concern was

expressed as to the limitations faced in Chapter 5. This research seeks to explore the limitations faced by Houdet (2017, 2018) and it further seeks to advance the field of natural resource economics by considering the value of the public participation which was reported in Munnik *et al.* (2018).

Carolina is the study area of the Munnik *et al.*, (2018) and Houdet (2017, 2018) publications and the Carolina study serves as a clear depiction of how difficult it is to value natural resources. Carolina has a complex natural resource base and various land uses such as natural highveld grasslands, wetlands, afforested and urban land. The natural resources and land-uses are set in a strong agricultural and coal mining context which has created tension between the different land-users in the Carolina area. Resource economic valuation studies have the potential to mitigate these tensions by providing economic values that can be used as a tool for area-specific natural resource management discussions. As this research progressed, it became evident that resource economic valuation has a number of limitations to overcome before the valuation process can fulfill its purpose.

This research was thus motivated by two primary shortcomings the researcher identified with conventional resource economic valuation studies of Houdet (2017, 2018). The shortcomings that were identified relating to natural resource economic valuation are that i) economic values are often aggregated and this can hide a wide range of the values stakeholders assign to ecosystem services; and ii) there is often a failure to consider the political and power dynamics in a study area. In the context of this research, *conventional natural resource economics* refers to the allocation, supply, and demand of the earth's natural resources (Perman, Ma and McGilvary, 2003).

The main goal of natural resource economic valuation is to advance human knowledge about the role of natural resources in the economy in order to develop more sustainable methods of managing natural resources to ensure their availability for future generations (Perman, Ma and McGilvary, 2003). Economic values are assigned to the natural resources to make it possible to measure the values of the trade-offs that occur when natural resources are used or affected by human activities. Barbier, Acreman, Knowler (1997) define economic valuation as “the process of assigning monetary values to goods and services provided by environmental and natural resources, whether or not market prices are available”. Economic value is generally measured in terms of what people

are willing to pay for a commodity less the cost to supply it (Barbier, Acreman and Knowler, 1997).

The problem of economic valuation is that most definitions of economic valuation aim to express values in monetary terms so that they can be aggregated into a common value for decision making. However, it becomes difficult to express natural resources in economic values because the process of valuation includes factors such as people's subjective and varying values. The problem of economic valuation is therefore not solely with the aggregation of values but is instead it is with ensuring that values capture the necessary elements that can lead to less reports of under or overvaluation of ecosystem services. This research has shown that resource economic valuation is a method prone to power and political influences which can mute the environmental values of citizens who are less powerful in terms of their influence.

Therefore, this research hopes to begin discussions on finding ways to make resource economic valuation a tool that reflects the values of all stakeholder groups within a study area, especially those with less influence. The research has aimed to make economic values make more sense by exploring the complex social issues surrounding natural resource economic valuation. The Carolina case study gave the researcher a realization that well structured resource economic valuation studies can potentially give more of a voice to the voiceless within communities, especially those subjected to mining impunities. The hope is that the value of a citizen based, bottom-up approach to resource economic valuation will become a more commonly used and discussed tool for democratically managing natural resources.

1.2. RESEARCH GOAL AND OBJECTIVES

This thesis aims to critically investigate conventional and more modern resource economic valuation approaches (with a focus on Houdet, 2017, 2018) in order to explore whether a citizen-based participatory approach to resource economic valuation can help us better understand how the values that different stakeholders assign to ecosystem-services influence natural resource management.

In order to explore the research goal, four objectives are explored:

- i. To more clearly determine the reasons for natural resource contestations in Carolina and the Upper Komati Catchment Management Forum. (Chapter 4)
- ii. To discover the values that different stakeholders in the Upper Komati Catchment Management Forum assign to natural resources in the Carolina area. (Chapter 4)
- iii. To analyze the complex political and power dynamics at play between the diverse stakeholders in the Upper Komati Catchment Management Forum. (Chapter 4)
- iv. To more broadly consider the nature of natural resource economic valuation research. (Chapter 5)

A qualitative case study methodology was adopted in order to explore objectives one, two and three. The *case study* is based on the Water Research Commission K5/2230 (Munnik *et al.*, 2018) report which took place in Carolina, Mpumalanga. Objective four was explored via qualitative semi-structure discussions that took place with the Water Research Commission (WRC), Department of Water and Sanitation (DWS) and the WRC K5/ 2230 project leaders. The study will contribute to recommendations to the Department of Water and Sanitation and the Water Research Commission, who wanted specific water management insights from the WRC K5/2230 study – including the value of wetlands as ecological infrastructure in Carolina, Mpumalanga.

1.3.BACKGROUND

Coal is a trusted economic driver and is essential for electricity generation, but coal mining has resulted in acute and chronic water pollution (Hallowes and Munnik, 2016: 4). Water pollution caused by coal mining is an even greater problem because South Africa is a water scarce region (Department of Water Affairs RSA, 2013). Water pollution caused by coal mining impacts other human activities such as agriculture which is an essential requirement for human livelihoods (Ochieng, Seango and Nkwonta, 2010). As seen in the Carolina in 2012, water pollution can further impact entire communities limiting the amount of potable water. As a result, contestations arise between stakeholder's dependent on land and water resources in an area (Munnik *et al.*, 2018: 10). The fact that coal mines pollute water resources across South Africa and can continue without

consequences points to a problem with effective implementation of environmental legislation in South Africa. This is discussed in more detail in section 2.7.

Economics has been used to value natural resources and their trade-offs in such contestation nexuses. The economic values can act as a tool in guiding decision making and have the potential to bring to realization of the true costs of inadequate environmental policy implementations. Monetary values have been the most accessible for society to compare and rank preferences (Schroter, van der Zanden, van Oudenhoven, Remme, Serna-Chavez, de Groot and Opdam, 2018). Natural resource economic valuation has long taken the route of monetized value to help people grasp the concept of ecosystem services (Constanza, D' Arge, De Groot, Farber, Grasso, Hannon, Limburg, Naeem, O'Neill, Paruelo, Raskin, Sutton and Van Den Belt, 1997). The concept of ecosystem services clarifies the benefit that people receive from ecosystems (Millenium Ecosystem Assessment, 2005). However, many natural resources such as water are a political issue, subject to power imbalances (Turton, Hattingh, Classen, Roux & Ashton, 2007). While people are generally aware of a range of values other than money, these are often not straightforwardly understood, and vary considerably amongst different stakeholders.

The Munnik *et al.* (2018) Carolina report understood the Carolina natural resource contestation and aimed to contribute to the tightening an understanding of the legal constraints on coals mining, and of ensuring better environmental practices. Houdet (2017, 2018) took the route of natural resource valuation in the aim to provide better decision-making tools for Carolina stakeholders. The economic method selected by Houdet did not produce economic values that were monetary in nature but instead the values were based on units such as land hectares. This thesis is not concerned with the value measurement (monetary vs non-monetary) but instead it is focused on the economic valuation *process* and the identified shortfalls faced by natural resource economic valuation (Section 1.1.i & ii).

One interesting factor that was previously mentioned was that the Munnik *et al.* (2018) study incorporated a citizen-based participatory approach. The institution for participatory water governance in the area – the Upper Komati Catchment Management Forum (UKCMF) was the primary stakeholder group involved in the research. The UKCMF was able to point out that there is a serious problem with environmental legislation and governance pertaining to coal mining in Carolina (Munnik *et al.*, 2018: Appendix E). Hence, the 2012 AMD event was an indication of

inadequacy in local natural resource governance. During and after the finalization of the Munnik *et al.* (2018) report, it was verbally communicated, though not formally recorded, that the UKCMF, DWS, and the WRC were disappointed with the outputs of the Houdet (2017, 2018) resource economic valuation study. Resource economics and the valuation of natural resources is a contested field, with many methodological approaches (Constanza *et al.*, 1997; Prior, 1998). Houdet (2017) followed a traditional resource economic valuation approach which is embedded into a more rigid neoclassical economics framing. This research seeks to probe the Houdet (2017, 2018) study whilst engaging with the Munnik *et al.* (2018) study to gain insight into the value of citizen-based participatory approaches in the process of natural resource economic valuation.

1.4. STUDY AREA

Carolina is a small farming town in the Mpumalanga ‘grass and wetlands’ region, with an estimated population of 23 000 (McCarthy and Humphries, 2013). The assured water supply from springs was the reason for its original settlement in 1883, as a service point for farmers (Munnik *et al.*, 2018: 11). The town receives its water via the Boesmanspruit River, which drains quaternary catchment X11B. Moreover, the Mpumalanga Highveld is renowned for some of South Africa's best agricultural land, hence Carolina's strong agricultural history (Sharife & Bond, 2011). Over the past decade there has been rapid coal mining expansion. Consequently, there are now six identified operational mines, one unauthorised mine and one closed mine in the Carolina catchment (Munnik *et al.*, 2018: 11). As a result of coal mining in the area, Carolina's water became contaminated with acid mining drainage (AMD) (McCarthy and Humphries, 2013). The 2012 AMD event led to 8 months of unclean contaminated water which meant that local dwellers had to be supplied with water via water tanks (McCarthy, 2011). Nationally, coal has served as an important site of wealth accumulation and has been the basis for a particular path of industrialisation in South Africa (Sharife & Bond, 2011). This is still the case in the present day and the DWS continues to receive new coal mining applications in the Carolina area and needs more appropriate resource economic tools for decision-making.

1.5. COMPLEX SOCIAL-ECOLOGICAL SYSTEMS

The nexus of the Carolina natural resource contestation is centred mainly on the influence of agriculture, coal mining and domestic water users on ecosystems and wetlands in the area (Keighley, 2017). Given the interconnectedness of social, economic and ecological systems, addressing the contestation challenge in an area like Carolina requires an integrated approach for natural resource valuation that accounts for the multiple interlinkages and dependencies between these systems (Biggs, Rhode, Archibald, Kunene, Mutanga, Nkuna, Ocholla and Phadima, 2015). The interactions and dependencies between humans and nature in Carolina exemplify *Complex Social-Ecological Systems* (CSESs) (Folke, 2006). A social-ecological system is a complex adaptive system, hence CSES. A CSES consists of the interactions of many actors with ecosystems, whose interactions within the given social and biophysical environment determine the development of the system over time (i.e. a catchment can be viewed as a CSES) (Stockholm Resilience Centre, 2019). CSES thinking aims to shift practitioner and research observation from understanding ‘characteristics of parts’ to understanding ‘systemic properties’ (i.e. the impact of one activity on the environment vice versa within a catchment) (Preisner, Biggs, De Vos and Folke, 2018). CSES thinking also has the capability to shift economic valuation from solely measuring natural resources like Houdet (2017, 2018), to actually ‘assessing complexity’ (Preisner *et al.*, 2018).

In the Carolina CSES context, the strong power asymmetries between stakeholders, means that there is a need to better understand the “social” element within Carolina’s CSES. Incorporating more of the social aspect into resource economic valuation studies means that people can add more local knowledge creating greater clarity about a study area. Secondly, engaged social research can help local stakeholders’ understanding of the differing value perceptions among themselves possibly reducing resource conflicts. *Political ecological economics* (Louise, 2003) is a recent academic arena that is playing a role in deconstructing the traditional split between environmental and ecological economics in the move towards more integrative and participatory economic environmental valuation methods. This research study is framed in the domain of *political-ecological economics* (Louise, 2003). Political-ecological economics stems from the combination of ecological economics and political ecology with the aim of gaining deeper insights into complex

environmental processes (Louise, 2003). Combining the two fields further assists with inquiries into political processes and the institutions involved in environmental affairs.

The Carolina coal mining, agricultural and household water use and water quality contestation nexus is acute at the local scale, and exemplifies a global issue. In this Anthropocene era, coal mining threatens planetary boundaries (Rockstrom, Steffen, Noone, Persson, Chapin, Lambin, Lenton, Scheffer, Folke, Schellnhuber, Hans Bjorn, de Wit, Hughes, van der Leeuw, Snyder, Constanza, Karlberg, Falkenmark, Svedin, Snyder, Corell, Fabry, Hansen, Liverman, Richardson, Richardson, Crutzen, Foley and Jonathan, 2009). The economic approaches contrasted in this study are the conventional resource economic valuation methods, and the newer disaggregated resource economic valuation approaches (Blignaut, 2004; Nkambule and Blignaut, 2012). Disaggregation depends on many factors such as the reason for the valuation exercise, the need for parsimony and simplicity, and the type of data available (Lindquist, 1999). Disaggregation can further be divided according to stakeholder groups. The disaggregation analysis can provide useful information required for deliberative decision-making and to provide vital insights on how economic value is generated (Lele and Veena, 2013). The disaggregation method (via discourse-based valuation) is explored later in this thesis.

1.5.1. Valuing Ecosystems

Houdet (2017, 2018) estimated the way different land uses and practices changed natural capital stocks and flows, at the time of the study and into the future (50 years). Wetlands were the key ecological infrastructure/ ecosystems of interest. Houdet (2017) also aimed to explain the implications for policy and decision-making processes surrounding the coal mining contestations in Carolina. However, there were limitations to the access of relevant mine operation-specific data which led to the economic study not fulfilling the wetland valuation aim. The resource economic valuation approach used by Houdet (2017) did not take into consideration how acknowledging Carolina as a CSES requires moving away from classical natural resource economic valuation approaches. Conventional resource economic valuation studies often try to aggregate externalities on a large scale in the presence of complex, interacting social and political issues.

A study similar to the Carolina natural resource study by Nkambule and Blignaut (2012) pointed out that the lack of economic valuation studies linked to coal mining externalities, means that

researchers often adjust monetary estimates of externalities from previous studies leading to results that are often extensively quantified (i.e. estimated using various values from a range of similar previous study data) creating a gap between a community's reality of the environment and the economic values. Many economic valuation studies are highly aggregated which is fine for highlighting the scale of an issue, but they do not bring local values and priorities to help with difficult trade-offs, and do not assist local decision-makers identify or prioritise issues (Nkambule and Blignaut, 2012)

Resource economists like Constanza *et al.* (1997), Biggs *et al.* (2015) and Blignaut (2017) have contributed to the dialogue of strengthening the relationship between environmental economic valuation and the concept of CSESs. The concepts of these researchers incorporate the idea that values are embedded in a CSES where social, economic and biophysical elements interact and there are feedbacks and uncertainty. O'Farrell, De Lange, Le Maitre, Reyers, Blignaut, Milton, Atkinson, Egoh, Maherry, Colvin and Cowling, (2011) highlight that natural resource economic valuations do not clearly reflect known dependence and importance of ecosystem services. Enhancing how resource economic valuation studies are carried out in today's complex 21st century has potential to create stronger links between economics and ecological studies by connecting environmental economic valuation to ecological theories such as Ostrom's linking of economics to CSES theory (Ostrom, 2009; de Wit, 2016). Ostrom (2009) highlights that all human used resources are 'embedded' in a CSES which comprises subsystems that interact to produce feedbacks and outcomes. Equally, Blignaut (2019) provides a disaggregated method where a cluster of values can be collected from different entities within local CSES subsystems. According to Blignaut (2019), most efficient interventions in environmental issues are socio-institutional which tend to be political in nature.

Newer natural resource economic valuation ways of thinking provide clearer emphasis on the complexities and dynamics involved in natural resource valuation. The newer approaches differ from the conventional in the sense that they incorporate transdisciplinary thinking to address the relationship between human economics and natural ecosystem. Max-Neef (2005) states that the new *problematicues* that are part of the 21st century (such as environmental crises) cannot be dealt with from a sphere of individual disciplines. Transdisciplinary approaches can engage more efficiently with these *problematicues* as they include i) the integration of different disciplines

(Max-Neef, 2005) and they also ii) aim to involve society more fairly in addressing complex problems (Lang, Wiek, Bergmann, Stauffacher, Martens, Moll, Swilling and Thomas, 2012; van Breda and Swilling, 2018).

The newer and more transdisciplinary natural resource economic valuation approaches have shown that disaggregated valuation which considers local scale decision making, can be a powerful tool to address impediments to local problems. Disaggregation functions at a finer scale, which means more meaningful ecological infrastructure values can be created (Brooks, Smith, Holland, Poppy & Eigenbrod, 2014). The disaggregation approach also aims for greater stakeholder inclusion by examining socio-institutional dynamics that are present at a local scale. Therefore, disaggregated values can provide more realistic values that can then be applied to regional balance sheets and local planning at a more understandable, local scale (Brooks *et al.*, 2014). The more recent methods of economic valuation also seek to find an institutional mechanism that could allow for stakeholders and local authorities to treat an ecosystem service, like water security, as an asset.

1.6. OUTLINE OF CHAPTERS

- Chapter two gives a summary and review of the literature that is relevant to this research study. The literature includes conventional and modern resource economic valuation discussions, including shortfalls in methods that have been and are been adopted in studies. New participatory-based economic valuation methods which include citizen based participatory approaches are discussed.
- Chapter three is a description of the methods that were followed during this research to obtain data to support the objectives of the research. The research participants are described and the reasons for their inclusion in this research is described. The sources and procedures of the qualitative data collection are described. Lastly, the thematic data analysis process followed for this research is described.
- Chapter four addresses objectives 1, 2 and 3 and is a case study analysis of the Carolina coal mining contestation nexus, which is described in the context of the WRC K5/2230 resource economic valuation study which was carried out by Houdet (2017, 2018). The

shortcomings of the resource economic valuation are described, with reference to complex social-ecological systems. Findings and discussions are then presented and discussed which stemmed from questionnaires which were conducted with the Upper Komati Catchment Management Forum (UKCMF) in Carolina. The overall chapter provides a picture of the complexity of conducting a resource economic valuation study in a complex political participatory governance setting.

- Chapter five addresses objective 4 and presents an insight into how national entities such as the Water Research Commission (WRC) and Department of Water and Sanitation (DWS) carry out resource economic valuation studies. These insights are presented as findings and discussions which emerged from semi-structured interviews which were conducted as part of this research.
- Chapter six is a synthesis chapter that discusses the findings of this research in relation to the goal and objectives of this research. The main findings and future suggestions by research participants and the researcher are presented in this Chapter.

CHAPTER 2 LITERATURE REVIEW

2.1. INTRODUCTION

When it comes to the topic of resource economics, many economists will readily agree that resource economic valuation can help people make better choices regarding the environment. Where this agreement often ends is on the question of what the most appropriate economic valuation approach is. Debates about how resource economic valuation should be carried out are perplexing because of a variety of concerns. Firstly, while some are convinced that human and ecological quantification is a useful tool that can be used to support decision-making, others spurn resource economic valuation for ‘placing a price tag on nature’ (Constanza *et al.*, 1997). Moreover, there is now a wide array of approaches for documenting ecological values, and these approaches come with their own framings, assumptions and limitations (Tadaki, Sinner and Chan, 2017).

Research shows that there are more modern approaches to resource economic valuation economics that incorporate a transdisciplinary framing (Thiel, Adamseged & Baake, 2015). The first move toward transdisciplinary valuation methods involved integrating economic models with ecological models. More recently, a *discourse-based valuation* approach has been introduced which encourages civil participation during resource economic valuation studies (Lang, Wiek, Bergmann, Stauffacher, Martens, Moll, Swilling and Thomas, 2012; Max-Neef, 2015; van Breda and Swilling, 2018). Studies have pointed out that resource economic valuations can become more appropriate by including and engaging local stakeholders when undertaking a resource economics valuation study (Seymour, Curtis, Pannell, Roberts and Allan, 2011; Jacobs, 1997). Encouraging civil participation during resource economic studies can enhance the quality of economic values and provide a better indication of a study area’s ‘true’ environmental value.

The chapter proceeds as follows:

Section 2.2. provides a timeline of conventional natural resource economics which followed a neo-classical economic approach. The timeline shows how the development of newer natural resource economics came about. **Section 2.3.** explains the importance of natural resource economic valuation in the process of managing natural capital. **Section 2.4** presents common shortcomings of conventional resource economic valuation studies. **Section 2.5.** presents the concept of

transdisciplinarity, with a focus on models that have been used in the attempt to integrate economics and ecology. **Section 2.6.** presents a case study by Seymour *et al.* (2011) that discusses the difficulty of undertaking natural resource economic valuation studies that are inclusive of the various stakeholder values within a study area. Thereafter, **Section 2.7.** introduces discourse-based valuation as an approach that can potentially provide a more socially just assessment of natural resources. Here a discussion on the practical application of discourse-based valuation is also presented. **Section 2.8.** discusses participatory natural resource governance forums and how discourse-based natural resource economic valuation can improve economic valuation and stabilize natural resource tensions within forums. **Section 2.9** returns to the Carolina case study with a general discussion about resource economic valuation studies in a coal mining and natural resource contestation context. Finally, the chapter is concluded in **Section 2.10.**

2.2. TIMELINE OF CONVENTIONAL RESOURCE ECONOMICS

The main techniques that are used to value natural resources can be divided into two main groups i) revealed preferences (for measuring *use values* of natural resources) and ii) stated preferences (for measuring *both use-values and non-use values*). *Revealed preferences* depend on the actual market behaviour by users of natural resources and rely on observable behaviour and analysis (i.e. hedonic pricing technique, travel cost methods and market prices) (Choi, Ritchie, Papandrea and Bennett, 2010). *Stated preferences* stem from individual responses to questionnaires and surveys and often relate to hypothetical situations (i.e. contingent valuation and choice modelling) (Choi *et al.*, 2010). These various presently available valuation techniques stem from a history of constant questioning about the validity of natural resource economic valuation by researchers, practitioners and the general public that began around the 1960s.

The 1960s marked the emergence of *environmentalism* (this is not to say that there were not earlier traces of environmentalism). The work of Hotelling (1949) and Wantrup (1947) had already sparked a few discussions that led to economic valuation methods such as the *travel costs method* and *contingent valuation* during the 1940s. However, the increasing public interest related to understanding environmental problems in the 1960s led economists to begin rethinking the role

the environment played in maintaining human well-being and production. During the 1960s, Kenneth Boulding (1966) produced a comparison between the “cowboy economy” model which viewed the environment as a *limitless resource* and the “spaceship economy” approach which acknowledged the essential limits of the environment. At same time Krutilla (1967) was arguing that humans received increased utilities through the vicarious enjoyment of natural areas indicating that government should have a reason to conserve land and natural resources. Moreover, as more valuation methods and techniques emerged, different types of values included as part of both *use values* and *non-use values* were simultaneously emerging. Examples of economic values that were introduced in this era such is the *existence value* which includes the *option value* and the *quasi-option value* (Weisbrod, 1964).

Classical environmental economists tended to pay only attention to ecosystems that provided direct tangible benefits to humans (Gowdy, 1997). This is how economic valuation of the environment came to be anthropocentric (human centred approach to valuation). So, ecosystem values were measured according to their ‘value in use’. It took a while before economists paid attention to the values of ecosystem services that were not been directly utilized by humans. But, it became evident that ecosystem services without a direct value/ benefit often played a crucial role in nature (Gowdy, 1997). For example, facilitating the provision of ecosystem services that humans perceived to have direct benefits. These are now known as exchange values. Following this recognition of tangible and intangible benefits by economists arose a valuation problem. Not all ecosystem services could be exchanged or valued in the existing goods and services markets. As a result, more economic valuation methods were introduced and there was an expansion of already existing methods. For example, new environmental economic valuation approaches included the *contingent valuation* (Davis, 1963), *travel cost* (Clawson, 1959) and *hedonic pricing methods* (Ridker and Henning, 1967).

While resource economic valuation was becoming a more spoken about topic among economists, ecologists were also proposing their own valuation methods (see for example, Krutilla, 1967). Some concerns raised by the ecological practitioners and researchers pointed out that economic valuation assumptions were often inappropriate, especially considering that they stemmed mainly from neoclassical economic theory. Two examples of the neoclassical assumptions within neoclassical theory that were present in economic valuation methods was the *utilitarian*

assumption and the *substitution assumption*. Firstly, the neoclassical economic utilitarian assumption assumed that all people have a ‘utility function’ that they try to maximise through consumption. This is not the case for many natural resources as some natural resources solely exist in nature and are not consumed by humans. Would that mean that a natural resource is less valuable if nobody is consuming it? Secondly, neoclassical economic valuation assumptions were viewed as impractical because as the substitution assumption implied that one good can automatically be compensated by the supply of another good. When irreversible damage occurs to a natural resource such as a wetland, how can one then substitute a wetland as the wetland has vital roles that it performs in nature that another natural resource cannot perform. Therefore, the main debates presented by ecological practitioners and researchers highlighted that the danger of adopting economic methods was that the methods for valuation could not easily be divorced from underlying assumptions and theories.

Economists and ecologists debated and highlighted their differences regarding the concepts of ‘value’. However, economists remained founded in the principle that value was determined by people’s willingness to pay (utility function assumption) (Clawson, 1959). Rapid expansion of resource economics in the 1970s led to emerging concerns about the methods that were being adopted by economists. In the first half of the 1980s, differences still existed between ecologists and economists regarding prices and values. However, 1987 saw the beginning of a coalition between economics and ecology. Farber and Constanza (1987) co-authored a paper which incorporated the crossing of economics and ecology discipline boundaries. In addition, the spark of industrial growth in the 19th century had triggered a series of changes in the way people were valuing the environment. Economic valuation shifted from purely physical valuation to monetary valuation to aggregated measures of capital (Braat and de Groot, 2012). What ties all the approaches that resource economic valuation adopted throughout history is that is that they all aimed to measure ecosystem good and services (Ehrlich and Ehrlich, 1981). The paper by Farber and Constanza (1987) began the process of watching resource economic valuation studies draw from other disciplines. The transdisciplinary approach of crossing discipline boundaries has led to economics drawing from ecology.

Jacobs (1997), Coote and Lenaghan (1997) proposed the *discourse-based valuation* method to conduct ecosystem valuation with the inclusion of citizens. The *discourse-based valuation* method

is founded on the principle that resource economic values should not result from the aggregation of separate individual preferences (i.e. conventional resource economics valuation methods), but through open debate (Jacobs, 1997; Coote and Lenaghan, 1997). The discourse-based valuation method is discussed in finer detail in section 2.7. The next section describes why natural resources need to be valued and why there was such a push towards understanding the value of natural resources since the emergence of environmentalism.

2.3. WHY VALUE NATURAL RESOURCES?

In a review paper, Constanza *et al.* (2014) highlighted that all other forms of capital that exist are dependant on natural capital, **Figure 2.1.** shows that *built capital* and *human capital* are embedded in society (social capital). Society is further embedded into the rest of nature (natural capital). Natural capital is a concept that has become widely accepted by all disciplines focused on the environment. Natural capital includes the “elements of nature that directly and indirectly produce value or benefits to people, including ecosystems, species, freshwater, land, minerals, the air and oceans” (United Nations, 2014). Wetlands are an example of key natural capital and ecological infrastructure. Ecological infrastructure refers to “naturally functioning ecosystems that deliver valuable services to people, such as water” (South African National Biodiversity Institute, 2013). Natural capital also forms part of a complex social and ecological system (the environment) and it plays a key role in the benefits it provides within the system.

Resource economics came into existence because humans realized that they could no longer overlook the effects they have on the environment when using resources and producing pollution (Tadaki *et al.*, 2017). Natural capital forms the foundation that sustains human well-being and it is essential to human survival. However, the relationship between natural capital, other forms of capital and human well-being has proved to be too complex for many *conventional resource economic valuation methods*, with ecosystems either being over-or under-valued. Ecosystem services do not flow directly from natural capital to human well being (Figure 2.1.). One of the challenges of natural resource economic valuation (shown by the red X) is to assess the relative contribution made by natural capital stock in order to assist humans in making decisions that will lead to sustainable well-being Constanza *et al.* (2014). Potschin and Haines-Young (2011), and

Pascual and Muradim (2010) are some of the researchers who have recently highlighted that a complex social and ecological system means that resource economic valuation needs to adapt a broader transdisciplinary approach due to the overlapping factors at play in the complex human-environment system.

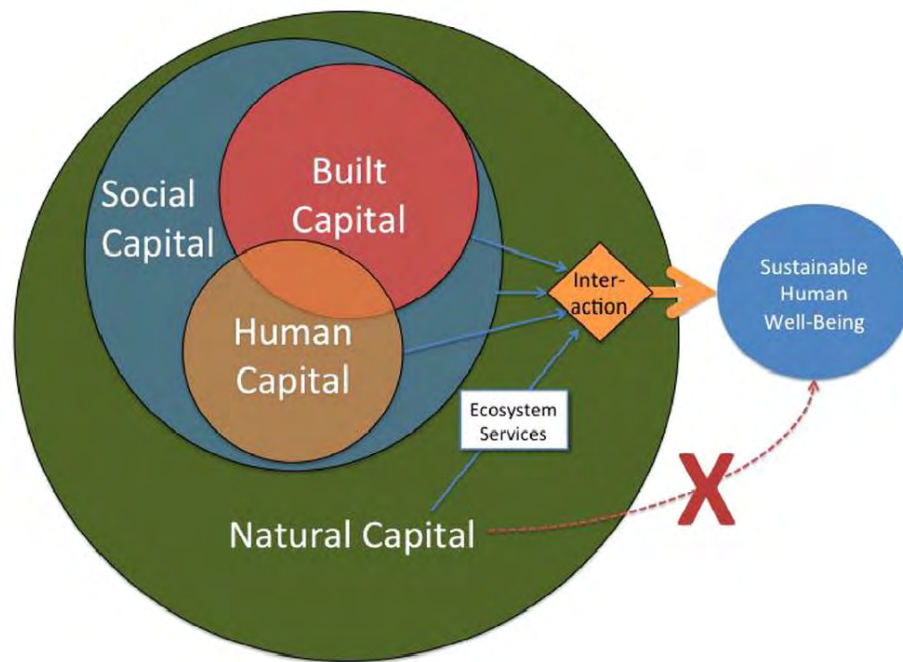


Figure 2. 1. The interaction between natural capital and other forms of capital and their relationship in influencing the sustainability of human welfare (Reproduced from Constanza, de Groot, Sutton der Ploeg, Anderson, Kubiszewski, Farber and Turner, 2014).

2.4. SHORTCOMINGS OF COVENTIONAL RESOURCE ECONOMIC VALUATION STUDIES

Resource economic valuation faces a number of application and theoretical challenges. In a critical discussion paper, Constanza *et al.* (2017) emphasised that one of the most common challenges in environmental economics is the *aggregation of economic values*. The aggregation of economic values is often seen in general supply and demand theory where individual values are summed up to create a societal value (e.g. a Demand Function for apples). However, environmental properties cannot be estimated in a straightforward manner due to the different uses of natural resources and

the fact that there are natural resources that simply exist in nature without market or human uses. Since the natural resource values cannot be estimated as easily as market goods and services, natural resource economists will then use values from previous studies that have similar traits. The method of aggregating via transfer techniques has brought about problems about the validity of economic values because aggregated measures often provide a summary measure to describe a market or economy. This can undermine area specific details when undertaking a resource economic valuation study.

The approach of aggregating values glosses over many complexities and area specific information (Constanza *et al.*, 2014). Furthermore, transferring values from one study to another may lead to the inheritance of values which were previously over- or underestimated. A classic example of how resource economic valuation can be misleading is “the value of the world’s ecosystem’s” paper by Constanza *et al.* (1997) which was published in *Nature*. The paper had relied on the economic ‘benefit transfer’ method by applying economic values from valuation studies that were done at ‘specific’ (smaller scale) locations, to *vast areas of ecosystems*. The resultant value produced by the study had overvalued many ecosystem’ uses and it undervalued the value of the world’s ecosystems.

Dixon (2008) points out that there is a trend towards ‘mystifying’ environmental economics analyses by making them overly opaque and mathematical which can become a problem in the presence of missing data values or when values are aggregated. Other common shortcomings in resource economic valuation include the problem of *imperfect information*, and there are problems with *accurately* quantifying and measuring ecosystem services. Moreover, study areas in resource economic valuation studies and the surrounding natural resource contexts are often not fully understood (e.g. how local stakeholders perceive or use natural resources). Dixon (2008) further points out that natural resource economic valuation faces the challenge of translating a physical ecological system into economic values and there is a further struggle to translate those economic values into practical and understandable policy advice.

2.5. USING TRANSDISCIPLINARITY TO INTEGRATE THE RELATIONSHIPS BETWEEN PEOPLE, RESOURCES AND ECONOMIC VALUES

The novel idea of the *ecosystem services* concept is that is meant to re-examine the links between ecosystems and human well-being in a pragmatic way. The stakeholders and local community groups that deal with problems regarding ecosystem services often have various types and levels of expertise, along with different agendas and values (Poschin-Young *et al*, 2018). Conventional resource economics has struggled to incorporate these differences because of the narrow singular type approaches and methods that exist in economic modelling. For example, the most commonly used method of natural resource valuation entails the traditional *cost-benefit* method which is estimated and measured by economic practitioners using the valuation techniques mentioned in section 2.2. Korten (1980) long ago identified the danger of applying blueprint approaches to social-ecological problems and urged that policy makers adopt a learning process of understanding ecological values in relation to their study area, rather than solely imposing final solutions on stakeholders. Transdisciplinary research has been introduced into economics to counter the traditional practice of practitioners of using *panacea* economic valuation methods that do not attempt to understand the deeper characteristics of a study area in relation to the available natural resources.

Palmer, Biggs and Cumming (2015) states that transdisciplinarity is the concurrent building of knowledge from various perspectives. There are various methods of undertaking transdisciplinary research (Lang *et al*, 2012; Max-Neef, 2015; van Breda and Swilling, 2018). Lang *et al.*, 2012 present a conceptual model of an ideal typical transdisciplinary research process. **Figure 2.2.** shows a three phase process for undertaking transdisciplinary research. The process begins with the collaboration of a research team to frame the problem. The second phase involves the co-creation of transferable and solution oriented knowledge through the collaborative research. Finally, the co-created knowledge is integrated and applied (for example, Hamer, Lipile, Lipile, Molony, Nzwana, O'keeffe, Shackleton, Weaver and Palmer, 2018; Wolff, Cockburn, De Wet, Bezerra, Weaver, Finca, De Vos, Ralekhetla, Libala, Mkabale, Odume and Palmer, 2019). The benefits of following transdisciplinary research methods is that they can widen the knowledge of practitioners and researchers from different fields. Collaborating between different fields can further help researchers answer questions and find solutions that they may have not been able to do within their

designated academic fields. Therefore, the practices of crossing discipline boundaries are an attempt to improve how ecosystem services are valued. The following section describes ways in which ecological models have been used in the attempt to enhance resource economics in a transdisciplinary manner.

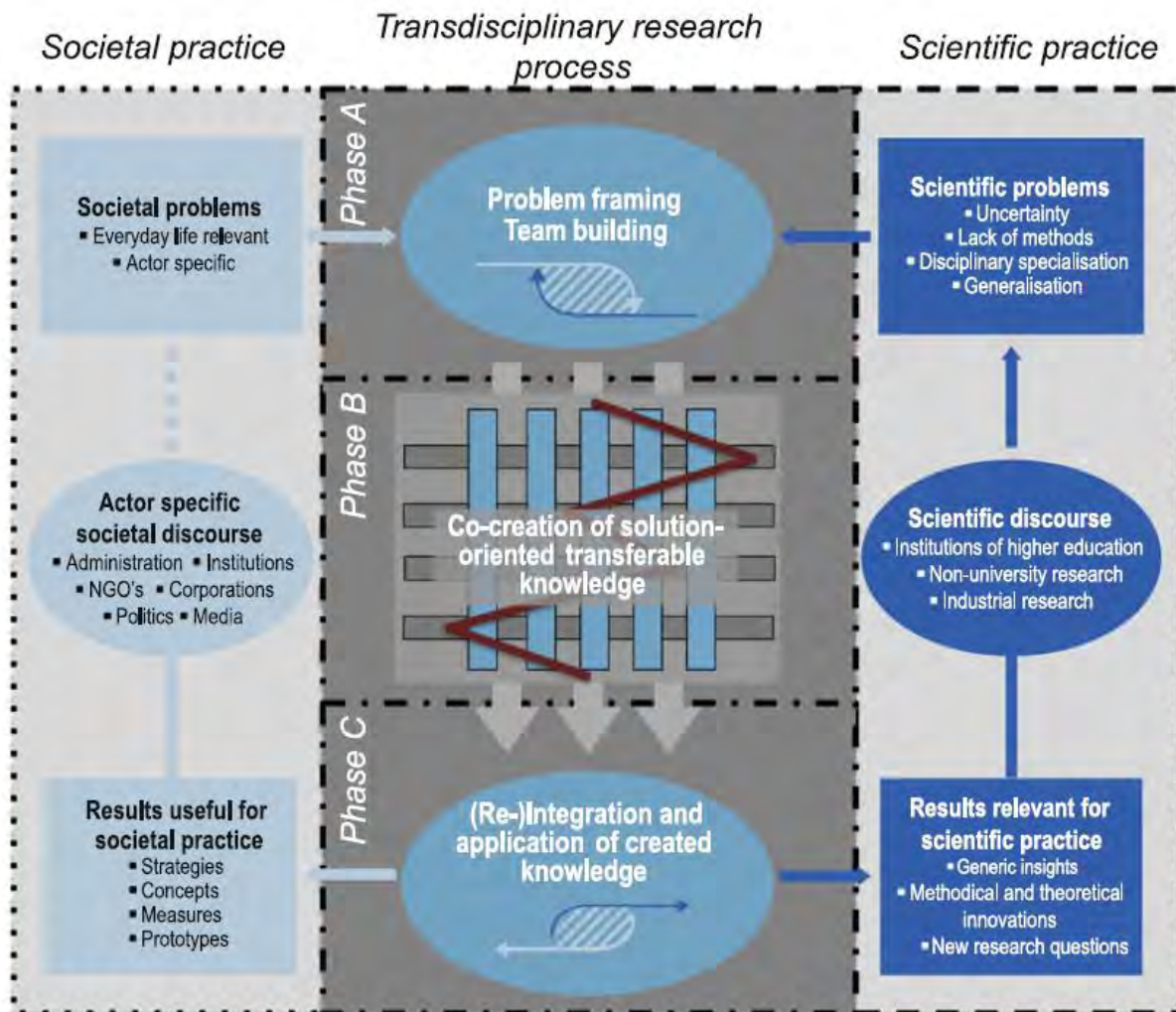


Figure 2. 2. Conceptual model of an ideal-typical transdisciplinary research process (Reproduced from Lang, Wiek, Bergmann, Stauffacher, Martens, Moll, Swilling and Thomas, 2012).

2.5.1. Integrating ecology and economics

Neoclassical economics emphasizes the maximizing of human welfare while using economic incentives to modify destructive behaviour (Tietenburg & Lewis, 2009). This purpose is achieved by using theoretical economic models which provides a simplified characterization of reality. Theoretical models allow for complex global and local subjects to be broken down into more manageable portions that can be better understood by humans. Unfortunately, models can yield conclusions and results which are wrong because of various shortcomings such as those mentioned in section 2.4. Partial models often increase the chances of omissions which may have been vital for understanding certain important dimensions of an economic study. Various authors have become activists to the idea that integrating economics and ecology can help explain the effects of humans and policy on the environment (Boumans *et al.*, 2002; Constanza *et al.*, 2017; Farber, Constanza, Childers, Erikson, Gross, Grove, Hopkinson, Kahn, Pincetl, Troy, Warren, Wilson and Matthew, 2006). Ecological and resource economic valuation approaches share the common objective of attempting to understand the *human-economy-environment* relationship so to shift economies towards sustainability (Tadaki *et al.*, 2017).

Some natural resource valuation practitioners and researchers have now combined ecological models with resource economic studies in the attempt to provide more accurate estimates of ecosystem values and the models describe the relationship ecosystems have with their social setting. The role of integrating these ecological conceptual frameworks with economics was to overcome conventional resource economic valuation shortcomings by providing a common reference point for natural resource practitioners and researchers to be able to structure work and clarifying conceptual framing issues. This helps to then define the scope and the focus of the assessments needed in a resource valuation study (Poschin-Young *et al.*, 2018).

The Modified Cascade Model (van Oudenhoven, Petz, Alkemade, Hein, de Groot, 2012) and Ostrom's (2007) Social Ecological Systems (SES) Framework are two ecological models that have been used by economists to try enhance the conceptual framing aspect of economic modelling. Potschin and Haines-Young (2011) developed the Cascade Model to analyse the relationship between ecosystems, humans and values in a conceptual framework. Similarly, Ostrom's (2007) SES Framework is a multi-tier framework for analysing social-ecological systems. Both Frameworks aimed to fulfill the purpose of framing the relationship between social and environmental aspects of the environment.

2.5.2. Ostrom's Social Ecological Systems Framework

The generally accepted theory regarding social-ecological systems (SESs) is that resource users will self organize to maintain their resources and that government must impose solutions. Ostrom (2009) noted that research in different disciplines has in fact found that some government policies accelerate resource degradation while some users have invested time and energy to achieve sustainability. To understand the relationships of users and natural resources within SES's, Ostrom devised a Framework that describes the individual variables that are often found within a SES according to a nested multi-tier framing. The nested multi-tier framework organizes information about the structure of an SES in terms of the resource system, resource units, users, and governance systems (see **Figure 2.3.**). Breaking down a study area at multiple spatial scales can help mitigate the tensions that exist between among stakeholders in a study area and among practitioners.

The SES Framework grants practitioners from diverse disciplinary backgrounds and different resource sectors within different geographical locations an opportunity to share a common vocabulary for the construction and testing of alternative theories and models (Ostrom, 2009). Ostrom's SES framework focuses on the key elements and relationships required for effective natural resource governance. The model uses stakeholder and institutional governance to create order in natural resource management by reduce conflict, therefore resulting in mutual gains. The model has contributed to natural resource economic studies adopting a clearer understanding of social systems in environmental processes. For example, Ostrom's SES Framework provides a basis that brings the social equity element into environmental valuation studies (Howoritz, 2019).

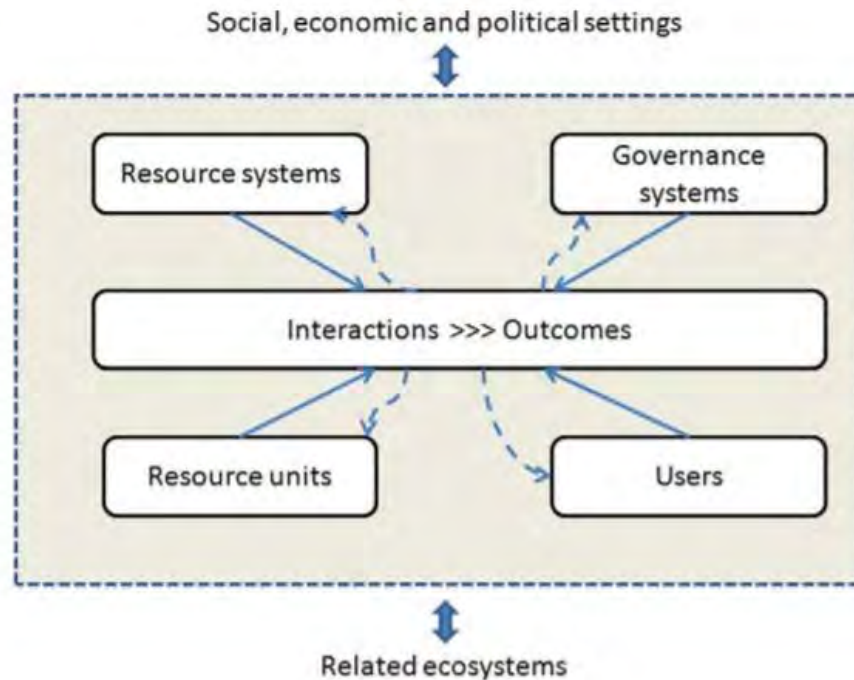


Figure 2. 3. Ostrom’s multi-tier approach for analyzing social-ecological systems (Reproduced from Ostrom, 2009: 12).

2.5.3. The Cascade Model

The Cascade Model (**Figure 2.4.**) is one of the simpler conceptual representations of social ecological systems. The model represents benefits and value concepts within the *ecosystem, service provision, human well-being, societal response* and *driving forces* context in the attempt to highlight emerging questions in natural resource economic valuation. In the Potschin and Haines-Young (2011) Cascade Model, the benefits are separated from values because benefits are viewed as gains in welfare and are generated by ecosystems. This means that different groups of people may value these gains in different ways, in different places at different times.

One of the most important questions that the cascade model specifically focuses on is “how do we *value* the contributions that ecosystem services make to human well-being?” (Potschin and Haines-Young, 2011). Another important question that the model raises is “how can trade-offs, synergies and conflicting interests be valued in different decision making contexts?”. Researchers in a

workshop that took place in Scotland during 2013 reported that the cascade model could help better value the contributions that ecosystem services make to human well-being through the models ability to clarify the relationships and problems between biophysical components leading to ecosystem services and the benefits and values derived from them (**Figure 2.4.**) (Potschin and Haines-Young, 2011).

After the discussions about the possible contributions the Cascade model can make to conceptualizing resource economic valuation, an application exercise of the model took place during the workshop. Twenty-seven ecosystem services valuation case studies were carried out by the researchers who were present at the workshop (Poschin-Young *et al.*, 2018). When the case study results were interpreted, it was discovered that the different elements of the cascade model had been interpreted differently by the various researchers for each of the case studies. Concerned researchers then highlighted that no single model can be applicable to all situations and that conceptual representations were *context dependent* (Poschin-Young *et al.*, 2018). Constanza *et al.* (2017) recently argued that ecological models like the Cascade Model are an oversimplification of a complex reality. They further stated that the Cascade Model appears to follow a conventional economic valuation approach because of how the definition of *value* is limited to only the environmental elements that have direct benefits that people will be willing to pay for (Constanza *et al.*, 2017).

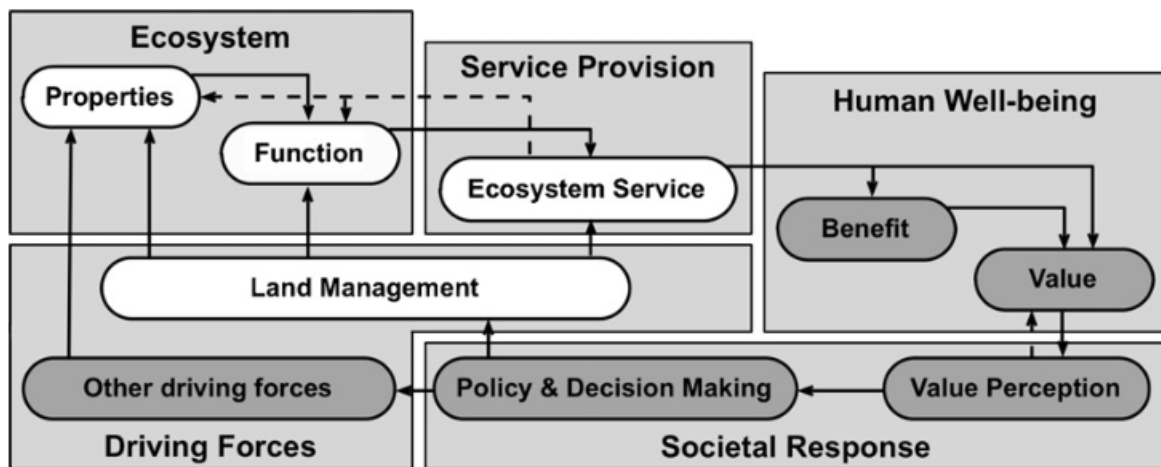


Figure 2. 4. The modified version of the cascade model reproduced from van Oudenhoven *et al.* (2012). The model has been modified to enhance the concept of *value*.

Looking into the future, models and frameworks used for ecosystem valuation need to go beyond uncritical ‘problem-solving’ that does not capture the geographical perspective of ‘true’ ecosystem functions and services in an area. Uncritical ‘problem-solving’ refers to the fact that the solutions that are sometimes presented for study areas by expert practitioners are not tailored to the people who live in the place. Current research has highlighted the need for *place-based* approaches to ecosystem assessments and valuations (Harrington and Allan, 2008; Potschin and Haines-Young, 2011). Norton and Hannon (1997) emphasise that “sense of place” should become an important concept in the evaluation of environmental policies and environmental valuation. Place-based approaches and orientations feature all the people’s experience of the environment rather than relying on models that come with their own various limitations. Although it may not be practical to collect economic valuation data from every single individual in an area, understanding the different types of communities in the area and their environmental value perceptions is one way to ‘make values make more sense’.

Place based research often incorporate *participatory research* methods which are one of the best ways to assure that results are reflective of reality. Working with stakeholders means that stakeholders can provide the key elements that are needed in resource economic studies in order to capture the complex natural capital base that society functions within. Finally, participatory

research methods can assist natural resource economic valuation to move from an isolated conceptualization process to one that includes site-specific local knowledge and inputs about an areas existing natural resource base. It is important to note that this research does not imply that participatory research can completely replace the modelling that has been described in this section, but instead they can be used hand in hand in the goal towards efficient natural resource economic valuations. The following section describes why it is important to understand how communities value natural resources instead of depending solely on theoretical models and expert opinions.

2.6. “SAME RESOURCE, DIFFERENT VALUES” (*SENSU* SEYMOUR *ET AL.*, 2011)

It has become evident in the past few decades that even when an area-specific conceptual transdisciplinary framing is engaged, researchers still struggle with the fact that the perceptions of natural resource values by different stakeholders in a study area tend to differ. A well described example of the differing value perceptions among community stakeholders is provided by Seymour *et al.* (2011). The paper entitled *Same river, different values and why it matters*, explored the concept of differing value perceptions by examining the values that people assigned to a river in south-eastern Australia (Loddon River). The results of the study pointed out the fact that there is a need for environmental managers and researchers to ensure consultation is not limited to the most actively engaged sectors of the community, as their responses may not be representative of other groups. The results further showed that the responses by community residents (urban and rural) about natural resources contrasted those of the natural resource management professionals. The value of certain natural resources, such as water supply, differed between the various stakeholders.

In investigating the competing and shared values assigned to the natural resources by stakeholders, Seymour *et al.* (2011) acknowledged that an approach was needed that would recognize the diversity of the communities surrounding the river. The study used Harrington and Allan’s (2008) *foundations of community theory* to classify the different stakeholder groups situated along the Loddon. The *foundations of community theory* realizes that various communities (stakeholder groups) often represent heterogeneous beliefs, values, interests and norms signifying differences. These differences are the ones that lead to varying value perceptions. Natural resource

contestations and conflicts also often stem from the differences that exist between the stakeholders in communities. Seymour *et al.* (2011) classified community groups as following:

- Communities of Locality – communities which are place based and located within political, social or physical boundaries;
- Communities of Practice – communities structured around common practice or activity (e.g. farmers, miners and governance forums);
- Communities of Interest – communities bound together by shared interest or concerns (e.g. environmental conservationists).

The classifications of communities highlight how different different stakeholder groups interact with natural resources. Stakeholder groups will interact with natural resources based on their beliefs, values and interests. The dangers of subsuming nature into resource economic values as a *homogeneous* set of values is that the study area will always have various stakeholder groups who have heterogeneous value perceptions. A large portion of the social aspect (i.e. local stakeholder natural resource knowledge) is overlooked during resource economic studies and that is how economic values end up over- or under- valuing natural resources and ecosystem services (Seymour *et al.*, 2011). Recognising these different communities can possibly provide more coherent approaches to community participation in natural resource management and valuation (Harrington and Allan, 2008). Recent resource economics valuation studies have begun to embrace the community participation and engagement in order to produce more accurate area specific values.

2.7. DISCOURSE-BASED VALUATION FOR ESTABLISHING FAIR OUTCOMES THROUGH DEMOCRATIC DELIBERATION

There is an increasing trend of resource economic valuation methods moving towards more disaggregated approaches with the intention of avoiding the problems associated with aggregating values (Wilson and Howarth, 2002). The *discourse-based valuation* approach stemmed from the recognised need to calculate more accurate site and study specific economic values. The discourse

approach is founded on the assumption that the valuation of public goods needs to result not from an aggregation of separately measured individual preferences but from free and open public debate (Wilson and Howarth, 2002). A 'bottom-up' approach that includes citizens can help researchers identify important site-specific natural resource elements and provide knowledge to researchers, that is significant from a problem solving perspective (Thiel *et al.*, 2015). The discourse-based valuation method further provides the opportunity for researchers to understand community stakeholder values while stakeholders learn about how values are created and interpreted (Wilson and Howarth, 2002).

Ecological models such as the Cascade Model and Ostrom's SES Framework describe the interaction between humans (their entities) and ecosystems. On the other hand, the discourse approach is able to describe how to potentially make valuation processes about learning among the different humans in the SES, while simultaneously collecting site specific data. This approach holds the potential to lessen the chances of resource economic valuation errors while making local stakeholders more aware about managing natural resources. The allocation of ecosystem services affects many people and induces questions regarding social equity (Ostrom, 2007). Discourse-based valuation is a method that can help ensure the achievement of social-equity goals regarding natural resources.

By implementing a free and open public debate, the belief is that the small group of citizens can provide informed judgements about public goods not simply in terms of personal utility but in terms of the widely held social values. An example of public debate in discourse based valuation is how a small groups of citizen stakeholders can be brought together to discuss the economic value of a public good, such as water (Jacobs, 1997). Stakeholders within a discourse-based valuation study do not negotiate (trying to create winners and losers) but they engage in a deliberative process that creates consensus based judgements (Wilson and Howarth, 2002). The values derived with the input of citizens can then be used to guide environmental policy and decision making, that will most likely be supported by citizens. It is further believed that outcomes will improve the political legitimacy and social equity of economic valuation through deliberation. The issue of social equity has always remained overlooked in conventional resource valuation analyses. Norton and Hannon (1997) pointed out that economists have instead dealt with questions

of social equity in terms of the fixed individual preferences of sovereign individuals, which is similar to the message Seymour *et al* (2011) aimed to relay in the Australian study

A more socially just assessment of ecosystems can be developed through encouraging people to act together as a group. When people begin to understand the value of the natural resources within their area through public debate, this can capacitate communities to challenge mining impunities such as those that occur in areas like Carolina. The awareness by community members may then result in polluters such as certain mining companies then having to engage in the discussion of environmental decision making. The discourse-based approach of valuation further contains a learning process that not only enhances economic valuation results, but also already existing ecological models and framings. In relation to Ostroms SES Framework (2007) (Figure 2.2), the *user* component in the SES Framework can be enhanced by the *discourse-based approach*. The discourse process assists social unit structures (citizens) to learn about and articulate preferences for alternative ecosystem services. In terms of the Cascade model (Potschin and Haines-Young, 2011), the *societal response* component can further be enhanced by discourse-based approaches because stakeholders will be able to better understand value perceptions.

The goal of the discourse process is to produce free and fair valuation systems where social power, deception and ideology do not influence decisions regarding economic value (Wilson and Howarth, 2002). The basic requirements of the discourse system include that there be equal access to discussions, freedom to all stakeholders to raise and object changes, and freedom of stakeholders to express their own actions. According to Wilson and Howarth (2002), the purpose of the discourse-based methods is to therefore reach an agreement on what should be valued on behalf of society as a whole. However, this is not a simple process to undertake. Discourse based valuation would require some coercion mechanism which would enforce the participation of the more powerful and influential (economic) actors within a CSES. Even discourse does not mitigate effect of political immunity. The absence of effective legislation can be hindered without the co-operation of powerful actors. The issue of legislation in a South African coal mining context is discussed further in section 2.8.

2.7.1. Practical Application of Discourse-based Valuation

There are different ecological and economic authors that have proposed steps for conducting discourse-based valuation analyses. Discourse-analysis valuation is often discussed in the field of political ecology but it can also be applied in resource economic valuation. Fedra, Kubat and Maja (2007) proposed a two-step process for undertaking participatory economic valuation. Step one involves the identification of relevant stakeholders. A series of workshops are then run in step two, to familiarize the stakeholders with the valuation study and their value perceptions are obtained simultaneously (Fedra *et al.*, 2007). Their feedback is also then obtained on the model structures developed by researchers who propose them throughout the series of workshops. Step two can be repeated a number of times till the most efficient model is identified. On the other hand, Wilson and Howarth (2002) presented a set of procedural rules which makes the outcome of participatory valuation more fair. The rules that were set in place are (1) that all stakeholders should be allowed to partake in discourse, (2) each stakeholder has the right to place issues on the agenda, (3) that each stakeholder should be allowed to propose their own assessment of an ecosystem service, (4) that each should be allowed to express their attitudes, needs and preferences, (5) that no speaker should be stopped because of external pressure or compulsion, (6) the goal of discourse analysis is to reach a consensus of values among stakeholders. A discourse based valuation that is properly conducted provides a forum with equality through the open deliberation (Wilson and Howarth, 2002).

In a study by Kaplowitz and Hoehn (2001), comparisons between focus groups and individual interview techniques were carried out in Mexico's Yucatan Peninsula to analyse how effective participatory resource economic valuation research is via *focus groups*. Individual interview techniques refer to the traditional techniques of valuation methods such as the revealed and stated preference techniques mentioned in section 2.2. The values collected via individual interview techniques stem from individual responses, whereas participatory group valuation takes place in a group setting. It was evident that *focus groups* and *individual techniques* are not substitutes of each other. Kaplowitz and Hoehn (2001) revealed that small discussion groups were found to yield more ecosystem service specific information while individual techniques held privately made people more comfortable, with some even providing controversial information. Discourse-based

valuation is therefore not an approach that aims to replace individual conventional resource economic studies because each of the approaches produces its own type of information.

There are however challenges with implementing discourse-based valuation in small groups which can be overcome if well observed during the discourse process. Stakeholders tend to have different information because of backgrounds, training and life experiences. Moreover stakeholders will frequently have different information about a given ecosystem alternative under consideration (Wilson and Howarth, 2001). The stakeholder group will have a higher probability of making more informed choices if the ‘unshared’ information (information preciously held by individuals and not known to the group as a whole) is *effectively pooled* among stakeholders. There will be more informed decisions among stakeholders who are part of a participatory process compared to individual stakeholders value perceptions techniques. However, social psychology shows that small stakeholder groups may not be very efficient at pooling unshared information which can then lead to sub-optimal results (Wilson and Howarth, 2001). The next sections return to the Carolina and South African coal mining context, and explores why a discourse based valuation may be suited in South African natural resource economic valuation.

2.8. MAKING RESOURCE ECONOMICS VALUATION MORE APPROPRIATE THROUGH PARTICIPATORY GOVERNANCE FORUMS

There are a growing number of natural resource participatory governance forums across South Africa. South Africa has recently experienced a growth in the present number of catchment management agencies including the Inkomati-Usuthu Catchment Management Agency (IUCMA), which overlooks the Upper Komati Catchment Management Agency. These forums consist of people who share a wide range of information that is related to natural resources. Conducting natural resource valuation studies with these forums can potentially unlock richer site and study area specific information for researchers. The governance framework used in these forums have created a space with a useful balance of formal and informal structures, with government and non-governmental engagement, and soft and hard regulation. The resource governance forums have thus created a structured environment where information shared between stakeholders can be distributed and collected. Research is often occupied with time, budget and information access

constraints. The researcher conducted research within the Upper Komati Catchment Management Agency (UKCMF) to further explore if future resource economic valuation studies could in fact be made appropriate through participatory studies.

Catchment Management Agencies and Forums are spaces that can contribute to increased knowledge sharing as the agencies and forums bring together people from diverse backgrounds. However, the diversity within the agencies and forums can also contribute to the complexity of the establishment process of these spaces (Hill and Meissner, 2018). Once the participatory governance spaces have been established, diversity among participants can continue to contribute to making decision-making processes more complex (this issue is explored in Chapter 4 and 5). On the other hand, participatory governance spaces can act as a catalyst in changing the behavior of stakeholders within communities through the deliberation that takes place which can result in increased awareness about how human activities impact water resources.

2.9. RESOURCE ECONOMIC VALUATION STUDIES IN A COAL MINING AND NATURAL RESOURCE CONTESTATION CONTEXT

Returning to the Carolina coal mining context, valuing coal mining activities in relation to their impact on natural resources is an issue consisting of complex political and environmental factors. Ecosystems provide a wide range of natural ecosystem services. Humans manage these ecosystems for tangible benefits such as *water*, *energy* and *food* (Power, 2010). South Africa is a water scarce country and is a large net exporter of coal. South Africa remains heavily dependant on coal for electricity generation and coal mining is heavily dependant on fresh water resources, which is heated to generate electricity. Moreover, South Africa's annual population growth requires an increase in food production, which is dependant on water for irrigation. The different sectors responsible for food, energy and water are continuously competing for water resources.

The effects that coal mining inflicts on functioning ecosystems are usually never rehabilitated. A lack of legislation was to blame in the past for the 'bad practices' that were carried out by the coal mining sector. Although legislation such as NEMA (1998) was introduced, the challenge became and still is implementation and enforcement (Mapulane, 2017). According to Solom (2016), poor regulation by the Department of Mineral Resources (DMR) and the Department of Water and

Sanction (DWS) are a contributing factor to Mpumalanga's deteriorating water quality. In response to the poor implementation of legislation, an Inter-Departmental Project Implementation Committee comprising of the DWS, DMR and Department of Environmental Affairs was formed aiming to improve the implementation and regulation of mining related environmental legislation.

The Inter-departmental Project Implementation Committee suggested that guidelines should be created for calculating the financial costs of coal mining and the involved rehabilitation costs (Mapulane, 2017). They further suggested that training be provided to consultants and mines on the implementation of the guidelines. Researchers are beginning to try to fully grasp the environmental damage of coal mining and although institutions like the DMR, DWS and DEA have attempted to broaden discussions around the coal mining environmental damage, values are often the missing link (Mapulane, 2017). Resource economic valuation studies have been carried out in areas such as Mpumalanga with the aim to provide economic values that can express the extent of coal mining externalities (Nkambule and Blignaut, 2012). The resource economic values are further meant to provide ecosystem values that can guide coal-mining related discussions. Missing data and lack of study area knowledge have however limited many coal mining related case studies.

In recent years, research has pointed out concerns about the impacts that coal mining has on water resources (McCarthy, 2011). The concerns stem from the increasing water contamination and high water usage in coal mining areas in South Africa and globally. Acid mining drainage (AMD) which is caused by mines, is becoming more prevalent throughout South Africa which decreases water quality, making water unfit for use. Most of the AMD cases that have been reported in Mpumalanga are situated where there is extensive agricultural activity. Agriculture can contaminate rivers when chemicals from fertilizers get flushed into nearby rivers. The impacts of agriculture are however less severe and temporary in comparison to coal mining impacts which are often permanent and more severe (Power, 2010).



Figure 2. 5. Many coal mining sites are situated along rivers in Mpumalanga. Coal mining waste can end up in the rivers which are also used by farmers, communities and other stakeholders. The polluted water resources often result in contestations between the different stakeholders. (Image from Solomons, 2016)

The available data and information required to undertake coal mining related studies is scarce and this is a problem when there is a need to conduct resource economic studies. Munnik (2010: 156) emphasised that mining has long been a closed book for researchers. Research information has long been circulated in small circles, under the close scrutiny of mines and with their co-operation. This is often to protect the interests of the industry. Secondly, economic valuation that involves coal mining is often difficult to conduct because South Africa's coal mining business model has various stages of production (Mathu and Chinomona, 2013). The different levels of the coal mining life-cycle impose different types of impacts on natural resources and ecosystem services. The stages of coal mining production are heavily intertwined and this makes expert valuation difficult because various data is required to create a conceptual picture of the coal mining damage to natural resources like water.

A study by Nkambule and Blignaut (2012) was able to frame a valuation study that quantified the external costs of the mining and coal transportation stages at the Kusile coal-fired power station in

eMalahleni, Mpumalanga. A summary of annual damage estimates were produced which estimated that the externality costs caused by coal mining is between 50% and 100% of South Africa's average electricity price per kWh. Electricity costed R0.41/kWh at the time the study was conducted in 2010. Therefore, Nkambule and Blignaut (2010) were able to disclose that the external costs of coal mining at the Kusile Power Station were between 20.24c/kWh and 39.3c/kWh in 2010. The approach used by Nkambule and Blignaut did however face the typical limitations faced by natural resource valuation studies. Unavailability of data meant that values had to be estimated from previous studies of a similar nature. For example value data such as the amount of coal mined for Kusile, the coal produced in various years, water pollution damage cost, opportunity cost of water and land use values were all obtained via the benefit transfer method which takes values from previous studies (Nkambule and Blignaut, 2010). The Nkambule and Blignaut (2010) study discussions also mentioned that some environmental externalities were not investigated due to constraints such as time.

The limitations of data availability and accuracy are not limited only to Mpumalanga or South Africa. Researchers in Colombia raised concerns about the limitations encountered when conducting resource economic valuation studies. The Colombian Government has recently prioritized the development of its large-scale mining industry. However, the Colombian government and researchers and government became aware that the country's capacity to assess and manage the water impacts of coal mining are limited (McIntyre, Angarita, Fernandez, Camacho, Pearse, Haguet, Baena, Oscar and Ossa-Moreno, 2018). Similar to South Africa, the impacts which were caused by poorly managed mining combined with general public opposition to large scale coal mining have resulted in a strong public opposition and political resistance to coal mining. McIntyre *et al.* (2018) believe that the political contestations around coal mining in Colombia stem from the fact there is a lack of the publicly available data needed to promote understanding of coal mining impacts.

McIntyre *et al.* (2018) suggested that to create a shared understanding of water and coal mining related values, and how they can be managed requires a strategic program of education, monitoring and research. Similar to the *discourse-based valuation* approach, McIntyre *et al.* (2018) recommended a framework that incorporates a learning and engaged research process which can overcome the problem of limited data availability and miscalculated value estimates. The

framework that was recommended is an Australian based framework known as the *Strategic Assessment of Regional Water Impacts of Mining* (SARWIM) (McIntyre *et al.*, 2018). It has seven stages which include group discussions. The guiding framework has the potential to overcome general concerns about Colombia's ability to monitor ecological change. In addition, the framework strongly emphasises group discussions and civil participation as part of resource valuation studies. Natural resource management has historically been prone to a lack of interest by powerful stakeholders such as the DMR and mining companies. These stakeholders have long been excused from participating in discourse-based type of deliberation by the politics of power. Chapter 4 and 5 unpack the issue of politics of power and other issues that need to be resolved in order for more participatory discourse.

2.10. CHAPTER CONCLUSION

This chapter has discussed the role that natural resource economic valuation plays in assisting humans to understand how natural capital can be better managed. Natural resource economic valuation has real potential to help people understand what trade-offs and decisions people need to make in order to ensure sustainability of natural resources for future generations. However, more traditional natural resource economic valuation methods consist of a number of flaws which have been discussed throughout this chapter. Therefore, the next best option towards more efficient natural resource valuation potentially lies within participatory governance. As discussed in this chapter, participatory governance also carries its own challenges such as being subjected to political and power issues from certain stakeholders making the participatory deliberation more difficult. The issue of differing values between different stakeholders may also contribute to difficulties in implementing a participatory discourse-based valuation study. The following chapter describes the research methods that this research followed in order to further explore the issues that arose in this chapter, focusing on Carolina.

CHAPTER 3 QUALITATIVE METHODOLOGY AND DESIGN

3.1. INTRODUCTION

This chapter provides detail on the qualitative research design for this thesis, the participants who were included in the research and how they were selected in section 3.3. The data collection methods and the procedure used by the researcher are defined in section 3.4. Section 3.5 describes the qualitative data analysis process this research followed. Section 3.6 addresses the Rhodes University ethics policy in relation to this research.

3.2. RESEARCH DESIGN

An essential part of research is to develop an effective research design as it provides a structure for the collection, measurement and analysis of data (Saunders, Lewis and Thornhill, 2009). An exploratory case research method was used to conduct this thesis research. The exploratory case research method can be defined “as an empirical enquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and multiple sources of evidence are also used” (Yin, 2009). An exploratory research approach allows for the exploration and understanding of complex issues through primary and secondary data. It is a robust research method which can be used when a holistic, in-depth investigation is required (Zainal, 2007).

Multiple sources of data were collected during this research. All of the data collected was focused on resource economic valuation, focusing on Carolina as the central case study. The WRC K5/2230 natural resource economic valuation study by Houdet (2017, 2018) was the main reference point for this research (Munnik *et al.*, 2018). To support the claims made in this research about the Houdet (2017) study, other sources of data were sought to deepen the conversation about natural resource economic valuation using a political-ecology and complex social ecological systems perspective. The additional sources of data were collected from people who were either involved in the Munnik *et al.* (2018) report and/or those who understand natural resource economic valuation processes and/ or those who are from Carolina.

3.3. RESEARCH PARTICIPANTS

The population dependent on water resources and who were affected by the Carolina AMD event include approximately 23000 people (McCarthy and Humphries, 2013). However, undertaking a study using the Carolina population to draw a random sample, would have been impracticable due to the budget and time constraints. Facing the constraints, the researcher selected the Upper Komati Catchment Management Agency (UKCMF) as the study population. The UKCMF is a representative natural resource management forum in Carolina with a wide range of stakeholder members that were able inform important facets and perspectives related to this research. The UKCMF also worked alongside the WRC K5/2230 project team during the Munnik *et al.* (2018) project. The focus of the UKCMF in this research further aligns with the researchers interest to understand how forums can become part of a discourse-based valuation method.

Additional perceptions, which formed as part of the data, were collected from key members of the Water Research Commission (WRC), the Department of Water and Sanitation (DWS) and project leaders of the WRC three-year report (Munnik *et al.* 2018). The project leaders who directed and led the development of the three-year WRC project were interviewed due to their holistic knowledge of the WRC K5/2230 report purpose and issues surrounding natural resources in Carolina.

In total, 33 Participants were selected for this study. The participants consisted of 27 members from the UKCMF, 2 senior members of the WRC, 2 senior members of the DWS and the 2 project leaders of the three-year WRC report. Below are descriptions of four entities selected by the researcher, and their relevance to this research is described:

3.3.1. Upper Komati Catchment Management Forum

South Africa consists of several catchment management agencies (CMAs) which are statutory bodies established in terms of the National Water Act (1998) (de la Harpe, Ferriera and Potter, 2016). The primary goal of a CMA is to include local communities in water resource management. CMA's manage water resources within their assigned water management area. A CMA often has

several catchment management forums (CMFs) that function within different parts of the area appointed to the CMA (de la Harpe *et al.*, 2016).

The first 8 out of 19 CMA's have been established in South Africa (Karar, Mazibuko, Gyedu-Ababio and Weston, 2010). The Inkomati-Usuthu Catchment Management Agency (IUCMA) was developed in the Mpumalanga region, to improve decentralized water resource management decision-making for stakeholders. Moreover, the IUCMA is a pioneering catchment management agency in the Mpumalanga area, that empowers stakeholders to engage *in consensual and adaptive resource decision-making* at local levels (Inkomati-Usuthu Catchment Management Agency, 2019). The UKCMF is a catchment management forum under the IUCMA that was created to manage water and other natural resources in the Carolina area.

At the time of the three-year WRC project (Munnik *et al.*, 2018: 156), the UKCMF was included in the project through workshops and meetings that were held that focused on improving resource decision making in the Carolina area. Especially, in mining related decision-making processes. Members of the UKCMF gave insights into the political, economic and social impacts of coal mining and how these could possibly be improved. Members of the UKCMF also assisted the WRC project (Munnik *et al.*, 2018: 156) by providing a diverse range of information because of the diverse group of people from different backgrounds. The Forum participants provided local knowledge to the project team throughout the Munnik *et al.* (2018) project in order to provide insight into the catchment issues.

For the purpose of this study, the UKCMF was identified as an ideal entity that could help the researcher obtain information regarding natural resource management and governance issues in Carolina. Since the whole Carolina community could not be interviewed, the UKCMF was ideal as the forum consists of representatives from multiple stakeholder groups that reside in Carolina.

3.3.2. Department of Water and Sanitation

The Department of Water and Sanitation (DWS) is relevant to this research as the researcher was able to find out what impact or influence natural resource economic valuation has in the governance projects been undertaken by the DWS on a national scale and how natural resource economic valuation can better 'fit' into environmental policy processes. The interviews with the

DWS also helped to identify what social and political factors contribute to environmental policy gaps.

The DWS is a national government department whose role is to manage South Africa's water resources by acting as the custodian of South Africa's water resources. The DWS therefore acts as a connecting entity between water resources and the people of this country. The legislative mandate of the DWS is to ensure that South Africa's water resources are protected, managed, developed, used, controlled and conserved in a sustainable manner that benefits all South African citizens and the environment (Department of Water and Sanitation, 2019). The DWS is further mandated to develop a knowledge base that focuses on water resources. A key role of the DWS is also to implement effective policies, procedures and integrated planning strategies for water resources and services.

3.3.3. Water Research Commission

The WRC is relevant to this research as it provided the aims and funding for the WRC K5/2230 Report (Munnik *et al.*, 2018: 3). The WRC is a reporting entity to the DWS, and it has an influential role in guiding and influencing local water resource management. In addition, the WRC provides vital information to the DWS which informs policy making. The WRC funds research into all water-related matters and the WRC K5/2230 project was funded in a natural water resource protection theme (Munnik *et al.*, 2017). Due to the extensive knowledge the WRC has in environmental studies, information was sought from them on the role of natural resources economic valuation in water and resource governance and policy.

3.3.4. WRC K5/2230 Report

The WRC K5/2230 project was developed to address the growing concerns that the impact of coal mining on biodiversity, particularly on wetlands, and environmental water quality are not sufficiently considered by the current coal mining life cycle provisions which ultimately results in negative impacts (Munnik *et al.*, 2018: 4). The project aimed to support improved decision making related to coal mining in the Mpumalanga Highveld, focusing on Carolina as the study area.

The WRC project leaders led a project team consisting of researchers from different academic fields who came together with the explicit aim of using trans- and multidisciplinary approaches to address the coal mining versus natural resources contestation. The project team also worked closely with the UKCMF which enabled a broad level of knowledge sharing. The project used a transdisciplinary framing (transcending disciplinary boundaries) (Gallati and Wiesmann, 2011) to investigate the seven project aims that had been provided by the WRC for the study (Munnik *et al.*, 2018: 4). The Carolina AMD event had been well studied prior to the WRC project, which provided the project team with a foundation to undertake the study using a complex social-ecological systems approach (Munnik *et al.*, 2018: 4). Although a straightforward solution may have not been found, the WRC report is an innovative step towards showcasing how much further trans- and multi - disciplinary work can go with providing comprehensive information about a problem. Interviews with the project leaders assisted the researcher to identify and understand the process of the three-year project and what limitations it may have faced.

3.4. SOURCES AND PROCEDURES OF DATA COLLECTION

This research uses a combination of primary and secondary data to address the research question. The first phase of data collection involved secondary data collection, while the second phase of data collection involved primary data collection.

3.4.1. Secondary Data Collection

This research made use of secondary data for the present research because secondary data establishes how the new knowledge described in this research paper differs from what is already known (Cooper and Schindler, 2006). The main secondary source which was used for this research was the *Houdet (2017, 2018) natural resource economic valuation study* which forms part of the WRC K5/2230 project (Munnik *et al.*, 2018: 153). In the context of this research, the Houdet (2017, 2018) was used to analyse issues facing a local scale resource economics valuation study to help the researcher highlight the shortcomings natural resource economic valuation faces on a local community scale (see chapter 3).

3.4.2. Primary Data Collection

Primary data is data that is collected first-hand by the researcher through instruments such as surveys, observations and interviews (Crabtree and Miller, 1999). For the purpose of this research, primary data collection was done via questionnaires and semi-structured interviews. The use of questionnaires and semi-structured interviews proved to be the best approaches for collecting data that would support the objectives of this research (Crabtree and Miller, 1999). The collection of primary data was divided into two phases.

Research participants filled in questionnaires for phase one of data collection and the researcher then conducted the semi-structured interviews during phase two of data collection. The questionnaire interviews were conducted with the UKCMF members. Thereafter, semi-structured interviews were held with members from the WRC, DWS and WRC K5/2230 project team. Below is a description of (1) how the data collection methods were developed, (2) how the interview process worked and (3) how the researcher ensured the data collected was valid and reliable.

3.4.3. Questionnaires

The 27 UKCMF respondents filled out a questionnaire as part of data collection (Appendix C). Questionnaires are research instruments that contain a series of questions and other prompts for the purpose of gathering information from respondents (Abawi, 2017). A questionnaire collection method was selected as one of the primary data collection methods for two reasons. Firstly, a questionnaire was used to interview members of the UKCMF as time and budget constraints did not allow for individual interviews with each of the 27 forum members. Secondly, questionnaires were an appropriate method for data collection in this study as it enabled the researcher to generate a range of views and the extent to which participants agree or disagree on something. There were 27 interviewees, representing 9 different stakeholder groups, during the questionnaire collection. **Table 3.1** shows the number of participants who were present according to their stakeholder groups:

Table 3. 1. A profile of the UKCMF questionnaire respondents

Stakeholder Type	Number of interviewees
1. IUCMA & UKCMF representatives	7
2. Local Environmentalists	5
3. Community and Tourism representatives	4
4. Coal mining representatives	3
5. Local Farmers	2
6. Albert Luthuli Municipality representatives	2
7. Government Dept. Representatives (DWS & DAFF)	2
8. Researchers (ARC)	1
9. Regulators	1
Total Interviewees	27

3.4.3.1. Upper Komati Catchment Management Forum (UKCMF) data collection process

There were 12 question included in the questionnaire which intended to cover three key areas identified during the secondary data collection. The key areas covered in the questionnaire were intended to address objectives one to three of this research.

- i. The first set of questions covered issues of natural resource and land-use contestations in Carolina. Current and future catchment condition question were also included. These questions addressed objective one and two.
- ii. The second set of questions aimed to understand the political and power dynamics that exist in the UKCMF and Carolina which affect natural resource decision making in Carolina. The questions aimed to address question three.
- iii. The third set of questions were directed at objective two. The questions specifically aimed to gather data that could give insight into how natural resource economics studies can

become better suited for participatory natural resources governance spaces like the UKCMF.

To enhance the validity and reliability of the questionnaires, the members of the UKCMF were briefed about this research project through a presentation by the researcher prior to the distribution of questionnaires. The questionnaires were designed in a manner that allowed the participants to answer the questions in approximately 15 minutes.

The questionnaire had been pre-tested in September 2018 using a group of 10 Rhodes University students who had some knowledge of natural resource governance. The interview pilot was conducted over a 30-minute session. The test participants were first briefed about the purpose of the research and the purpose of the activity for 10 minutes. Thereafter, the questionnaires were conducted over a 15-minute period and the last 5-minutes were used by the researcher to get feedback from the students on the questionnaire process. To mimic the forum conditions, the researcher included students from different academic disciplines and academic levels to represent the UKCMF stakeholders who are from different stakeholder groups and knowledge backgrounds.

3.4.4. Semi-structured interviews

Semi-structured interviews took place with members of the WRC, DWS and DWS K5/2230 project team. Semi-structured interviews were selected because they allowed for more in-depth interview sessions using open-ended questions. This meant that the interviewees were able to provide additional information based on their area of expertise, which went beyond the researcher's knowledge and allowed for new issues to emerge for exploration. The study had a total of six interviewees for the semi-structured interviews who are described in the **Table 3.2**.

Table 3. 2. A profile of the semi-structured interview respondents

Respondent	<i>Organisation</i>	<i>Position</i>	<i>Interview time</i>	<i>Interview Type</i>
1.	Water Commission	Research Water Research Manager	50 minutes	Face-to-face
2.	Water Commission	Research Water Research Manager	1 hour	Face-to-face
3.	Department of Water and Sanitation	Production Scientist	1 hour & 10 minutes	Face-to-face
4.	Department of Water and Sanitation	Water Resource Scientist	1 hour	Face-to-face
5.	WRC K5/2230	Political-Ecologist	1 hour	Face-to-face
6.	WRC K5/2230	Ecologist	1 hour	Face-to-face

Once the participant expressed their willingness to participate, the interview date and location was confirmed via email.

To ensure more valid and reliable results, the researcher emailed an additional brief document outlining the purpose of the study. Interviewees were given a copy of the interview questions during the interview so they could also read and understand the questions in more detail. The researcher took notes during the interviews and the researcher took audio recordings of each interview with the permission of the interviewee, as required by ethical standards. The following sections cover the semi-structured interview processes for each of the three entities. Every interview, with each entity, was steered using pre-set question with the intention to address Aim four.

3.4.4.1. WRC Semi-structured Interview Data Collection Process

The first set of semi-structured interviews took place with two senior members of the Water Research Commission (WRC) (Appendix D). There were four key areas covered in the WRC semi-structured interviews:

- i. The first few questions were aimed at understanding the role of resource economic valuation in the WRC.
- ii. The second group of questions were focused on gaining insight into the economic, social and political factors and limitations influence the success of environmental valuation.
- iii. The third group of questions were focused on understanding how the WRC selects environmental valuation experts and what criteria the WRC uses to supervise the level to which experts understand and undertake environmental valuation studies.
- iv. The final group of questions entailed a brief discussion on the WRCs expectations for the K5/2230 report and what sort of limitations they believe the project encountered.

3.4.4.2. DWS Semi-structured Interview Data Collection Process

The second set of semi-structured interviews took place with two senior members of the Department of Water and Sanitation (DWS) (Appendix E). There were five key areas covered in the WRC semi-structured interviews:

- i. The first two groups of questions in the DWS interviews were the same as the WRCs first two set of questions (section 3.4.2.2.1. i and ii). This was done to get a sense of the role of environmental valuation within the two organisations. It was also to understand what economic, social and political factors and limitations each organisation believed influenced the success of environmental valuation outcomes.
- ii. The third group of questions aimed at understanding how political and power dynamics pay a role in poor policy implementation.
- iii. The fourth group of questions were based on how the DWS selects its environmental valuation experts and how their work fits into the DWS.

- iv. The fifth group of questions focused on understanding how the DWS ensures that the environmental valuation experts make sure there is democratic inclusion of different stakeholders.
- v. The sixth group of questions probed how the organisation ensures that all relevant stakeholder environmental values are incorporated into studies undertaken by the entity where natural resources are involved.

3.4.4.3. WRC K5/2230 Project Semi-structured Interview Data Collection Process

The third set of semi-structured interviews were held with the two project leaders of the WRC K5/2230 three-year project. There were six key areas covered in the semi-structured interviews with the project leaders (see Appendix F):

- i. In section one of the interview questions, the interviewer was asked to describe their role in the development of the K5/2230 WRC Report.
- ii. Section two covered the goals and aims of the WRC report and the extent to which the project leaders believed that each aim of the project was achieved.
- iii. Section three of the interview probed the possible constraints that may have made it difficult to fulfil the project aims.
- iv. Section four focused on economic valuation questions and the different type of factors that interviewees believe affected the resource economic valuation.
- v. Section five of the interview was aimed at gaining insight into the political factors that played a role in the under- or over-representation of certain stakeholders during environmental valuation processes.
- vi. Section six of interviews inquired into how environmental valuation could be improved if the WRC report were to be repeated.

3.5. THEMATIC DATA ANALYSIS

A thematic qualitative analysis approach was used to analyse the data collected in this research (Moira and Delahunt, 2017). A qualitative thematic analysis was undertaken to generate themes to organize the data in a manner that could enable the researcher to closely link the research findings to the literature in this research paper in order to answer the research question. Thematic Analysis involves the process of identifying patterns or themes within qualitative data and it was selected because it is a flexible data analysis method (Moira and Delahunt, 2017). Microsoft Excel was used as a tool to create organized and richly described data for the questionnaire, while other interview data was organized manually. The analysis was not a linear process of moving from one phase to the next. It was rather a recursive and iterative process where movement was back and forth where needed, throughout the phases (Braun and Clarke, 2006).

A qualitative thematic analysis begins with familiarization of data and then initial codes are generated thereafter. Coding is the process of capturing a singular idea that is associated with a segment of data (Elliott, 2018). There are two primary ways of identifying codes and patterns in thematic analysis (Braun and Clarke, 2006). The inductive (bottom-up) analysis is where the final themes are strongly linked to the data collected, and the approach does not attempt to adjust the data into a pre-existing frame or model. The inductive method is also more open-ended and exploratory in nature. The deductive or theoretical (top-down) analysis is driven by the researcher's analytical or theoretical interests (Braun and Clarke, 2006). The deductive approach is narrower in nature and is usually guided by a theory from the beginning. The data analysis in this research was not driven by theoretical or analysis interests, instead the coding and theme development were directed by the content of the data and the researchers interests on the topic. **The thematic analysis in this research followed an inductive research approach.**

3.5.1. Phases of Thematic Analysis

The thematic analysis in this research followed six phases for both the questionnaire data and the semi-structured interviews (Braun and Clarke (2006). **Table 3.3** describes the six phases that were applied in this paper.

Table 3. 3. Phases of thematic analysis (Reproduced from Braun and Clarke, 2006)

Phase	Description of the process
1. Familiarizing yourself with your data	Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas.
2. Generating initial codes	Coding interesting features of the data in a systematic fashion across the entire data set, collecting data relevant to each code.
3. Searching for themes	Collating codes into potential themes, gathering all relevant data to each potential theme.
4. Reviewing themes	Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic ‘map’ of the analysis.
5. Defining and naming themes	Ongoing an analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme.
6. Producing the report	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.

3.5.2. Questionnaire Inductive Thematic Analysis Process

The six phases of inductive thematic analysis that were used to analyse the questionnaires progressed as follows:

- i. The researcher began by actively reading the data. Before making notes or drafting ideas, the researcher read through each of the 27 questionnaires. As the researcher read through the data, they were able to start identifying possible patterns. After reading the first time, the researcher then re-read the questionnaire data and marked segments of data that could potentially become part of the initial coding.

- ii. The second phase involved the production of initial codes from the questionnaire data. The codes were identified using the research questions. As the researcher read through the data, relationships between some of the codes began to emerge. The initial codes were recorded as they became visible. There were some codes that immediately showed relationships such as the *drivers influencing catchment conditions, economic activities influencing rivers, land-use rankings and differing value perception comments concerning natural resources in the Carolina catchment*.
- iii. Phase three began once all the codes had been recorded. The codes that showed a relationship were grouped together. The grouped codes were then ordered according to themes that could closely link the data and the research objectives. For example, the code examples described in phase two were organized to form the theme *Carolina natural resource and land-use nexus of contestation*. There were four themes identified by the researcher using the questionnaire. These are described in section 4.5.1.
- iv. In the fourth phase, the researcher focused on two levels of reviewing and refining the themes. At level one, the researcher reviewed the individual coded data extracts and checked for their relevance to this research paper. The researcher progressed to level two. Level two is a similar process, but it is in relation to the entire data set. The validity of each individual theme and code was considered in relation to the whole data set. This was done by analysing the diagram from phase three. In this process, the researcher then further deciphered the codes into sub-themes. The final themes and sub-themes were then organized into a tabulated spreadsheet as shown in Appendix G.
- v. In phase five, the researcher aimed to ‘define and refine’ the themes to confirm that they portray the ‘essence’ of what each theme is about. The researcher analysed each theme to ensure that the story each theme tells fits into the broader overall story that is meant to be told by the data. Phase five occurred over increments as the researcher would refine how the themes and codes were structured when they saw a need to.
- vi. Phase six is part of the next chapter where the findings of the UKCMF are presented according to the identified themes. In section 4.5.3, each theme is discussed in relation to the research questions and findings. Extracts such as quotes from the data were also carefully identified for the findings to help the researcher provide more vivid examples in the discussion to support the findings.

3.5.3. Semi-structured Interviews Inductive Thematic Analysis Process

- i. Phase one of the semi-structured qualitative data analysis process was like the questionnaire data analysis process. The researcher familiarized themselves with the data immediately after the data was recorded following each interview. The transcribed data from the interviews is available in Appendix D, E and F.
- ii. The time span between the collection of the first and final interview data was over a six-month period because of constraints such as the interviewee availability. The researcher followed an iterative process of generating codes as the data collection occurred. After the final data was gathered, the researcher began to manually identify codes within the transcribed data.
- iii. In the search for themes, the researcher created a list of the potential codes and then organized them according to themes which would provide a link between the transcribed data and the research objectives. Since the semi-structured interviews were aimed at objective four, the themes were generated in a manner where the keywords linked to objective four.
- iv. The themes were manually reviewed constantly through a process of finding links between the themes and the research literature and objectives.
- v. The researcher reached the phase of defining and naming themes during phase four.
- vi. Chapter five reports the findings that were discovered from the interview data that are related to objective four and the research goal. The data was presented according to the themes and sub-themes that were developed in the data analysis process in section 5.2.

3.5.4. Inductive Thematic Analysis Criteria Checklist

Braun and Clarke (2006) present a thematic analysis checklist of criteria for a good thematic analysis. Since thematic analysis is a flexible method, the researcher was aware that they had to be explicit about what they were doing and how it matches up with what they were intending to do.

Therefore, the researcher often referred to **Table 3.4** to determine whether a good thematic analysis was been generated.

Table 3.4. A 15-point checklist of criteria for good thematic analysis (Reproduced from Braun and Clarke, 2006)

Process	No.	Criteria
Transcription	1	The data have been transcribed to an appropriate level of detail, and the transcripts have been checked against the tapes for ‘accuracy’
	2	Each data item has been given equal attention in the coding process.
Coding	3	Themes have not been generated from a few vivid examples (an anecdotal approach), but instead the coding process has been thorough, inclusive and comprehensive.
	4	All relevant extracts for all each theme have been collated.
	5	Themes have been checked against each other and back to the original data set.
	6	Themes are internally coherent, consistent, and distinctive.
Analysis	7	Data have been analyzed – interpreted, made sense of – rather than just paraphrased or described.
	8	Analysis and data match each other – the extracts illustrate the analytic claims.
	9	Analysis tells a convincing and well-organized story about the data and topic.
	10	A good balance between analytic narrative and illustrative extracts is provided.
Overall	11	Enough time has been allocated to complete all phases of the analysis adequately, without rushing a phase or giving it a once-over-lightly.
Written report	12	The assumptions about, and specific approach to, thematic analysis are clearly explicated.
	13	There is a good fit between what you claim you do, and what you show you have done i.e. described method and reported analysis are consistent.
	14	The language and concepts used in the report are consistent with the epistemological position of the analysis.
	15	The researcher is positioned as active in the research process; themes do not just ‘emerge’.

3.6. ETHICAL CONSIDERATIONS

The researcher has complied with Rhodes University's ethics policy and obtained necessary clearance from the Departmental/ Business School Ethics Representative. An ethics form for Human Subjects **was** submitted using the Ethical Review Application System (ERAS) to RUESC via the Departmental/ Business School Ethics Representative and approval **was** granted. The participants selected for the interviews and questionnaires voluntarily participated and information provided by the research participants was kept confidential. Additionally, research participants completed and signed voluntary consent forms before the distribution of the questionnaires at the UKCMF. The same voluntary consent form procedure was applied to the semi-structured interviews. All research participants were briefed about this researchers purpose prior to the interview.

CHAPTER 4 ANALYSIS OF THE CAROLINA COAL MINING CONTESTATION NEXUS, FOCUSING ON THE RESOURCE ECONOMIC VALUATION STUDY BY HOUDET (2017, 2018)

4.1. INTRODUCTION

This chapter firstly provides an analysis of natural resource economic valuation in the context of Carolina, Mpumalanga. In this chapter, Carolina is acknowledged as a *complex social-ecological system (CSES)*. The three-year resource economics study was presented to the Upper Komati Catchment Management Forum (UKCMF) after its completion. Stakeholders in the UKCMF felt that the economic values did not depict values that could be used for local natural resource decision making, considering the complex nature of the natural capital nexus of contestation in Carolina. The issues surrounding Carolina's natural resource study are described along with the shortfalls of the resource economics study. Finally, findings are presented from a questionnaire study that was done with the UKCMF for the purpose of this research study. The findings are explored in relation to the natural resource study outcomes and two assumptions that this thesis leans on regarding resource economic studies conducted in an acknowledged CSES context. The assumptions are as follows:

- i. An aggregation of economic values can hide a wide range of what is valued by stakeholders;
- ii. There is often a failure by resource economic valuation studies to consider the political and power dynamics in the study area;

More specifically, section 4.2. provides a background on Munnik *et al.* (2018) study in the Carolina context. Section 4.3. considers the Carolina case study in relation to complex social-ecological systems. Section 4.4. discusses the valuation of natural resources in the context of Carolina's natural resource contestation nexus. The chapter then discusses what interesting findings the researcher discovered after engaging with the UKCMF. The discussion with the UKCMF is described in section 4.5. according to four key themes which were identified by the researcher. Finally the chapter is concluded in section 4.6.

4.2. BACKGROUND OF THE MUNNIK *ET AL* (2018) RESOURCE ECONOMICS STUDY IN THE CAROLINA CONTEXT

No mining company in Carolina has come forward to take responsibility for the contamination of the town's water sources, since the 2012 AMD event. Instead, the companies have remained hidden behind the presence of many other mines that operate near each other. The Vaal River, Crocodile River and Olifants River in the Mpumalanga province are examples of other major water sources in the country that have been affected by similar AMD events, caused by coal mining in recent years (McCarthy, 2011). Acid mining drainage caused by mines, can lead to the deterioration of wetlands which are meant to perform complex water filtration processes. When water is not filtered by a wetland, contaminants in the water can flow directly into connecting water resources impacting users downstream, including the agricultural sector (Munnik *et al.*, 2018 139).

After the 2012 AMD event, there were concerns with coal mining decision making processes and the consideration of natural resources. A research team led by Rhodes University was then assigned to undertake a three-year project in Carolina. The research was commissioned by the Water Research Commission (WRC), for the Department of Water and Sanitation (DWS), who wanted specific water management insights from the study – including the value of wetlands as ecological infrastructure. The Munnik *et al.* (2018) project funds emanated from a fine which was paid as part of a plea bargain by Golfview Mining Pty (Ltd), at Ermelo Regional Court in 2009 (Fourie, 2014). Part of the funds paid by Golfview were transferred to the WRC, amounting to ZAR 1 million. The mining company was convicted for illegal mining in a wetland in Ermelo which is also an area in Mpumalanga. Golfview Mining also diverted water sources, transformed three hectares of indigenous vegetation and conducted inadequate pollution control (Fourie, 2014).

The court order specified that the funds paid to the WRC were to be used to achieve the environmental research and protection objectives provided by the court. One of the three court objectives that the Munnik *et al.* (2018) project aimed to achieve, was to ensure the full social and environmental costs of any permanent, residual wetland loss will be internalized in mining project

balance sheets, to ensure no net loss of wetland functions at a landscape scale (Munnik *et al.*, 2018: v). The objective was tackled using a resource economics approach as part of the three-year project (Munnik *et al.*, 2018: ix). The resource economics study by Houdet (2017, 2018) aimed to ‘develop guidelines necessary to understand the socio-economic value of selected wetlands, demonstrating their importance to society’, in order to achieve the court objective (Munnik *et al.*, 2018: vi).

4.3. COMPLEX-SOCIAL ECOLOGICAL SYSTEM (CSES) AND THE CAROLINA RESOURCE ECONOMIC VALUATION STUDY

The WRC resource economics study began by focusing on the valuation of wetlands in the Carolina catchment in order to provide values that stakeholders could use to make more sustainable trade-off decisions between natural resources in Carolina. Attempting to value wetlands in an area with multiple users and presence of coal mining impunities revealed several challenges regarding natural resource economic valuation.

The Houdet (2018) natural resource economics study failed to show aspects that acknowledged Carolina as a complex-social ecological system (CSES). A complex social ecological system, in the context of this research, consists of resources (natural and socio-economic) whose flow and use are regulated by a combination of social and ecological systems. The Carolina CSES system faces a strong natural resource nexus of contestation that is between wetlands, coal mining and agriculture (Munnik *et al.*, 2018: 80). Further implications in the Carolina contestation nexus stem from the varying perceived values of different stakeholders regarding the local natural resources, especially water resources. Varying value perceptions are discussed later in the chapter.

The imbalances that exist among stakeholder activities and land-uses have different impacts on natural resources like water because the different stakeholders have differing environmental concerns and interests. This research assumed that political aspects within the social realm of resource use and governance also influence natural resource contestations. Some of the environmental impacts that are caused by stakeholders result in more severe impacts that eventually impact other stakeholders in the form of negative externalities. The negative externalities are often the result of more dominant stakeholders who have more power and political

influence (Brooks *et al*, 2014). The wetlands in Carolina are an example of natural resources that get affected by pollution but due to impunities, more dominant stakeholders are able to get away with negligent natural resource management. The negative externalities can eventually affect other local stakeholders and in the case of wetlands, water users downstream are also affected.

Figure 4.1. is a map that shows the study area that was chosen for the WRC resource economics study. This is the latest map that could be obtained by the WRC research team for the study area which is situated in Carolina (Houdet, 2017). The map was developed in 2006, so it is important to note that coal mining and agricultural expansion has taken place since then. The map is a good depiction of the complex water, agriculture and coal mining land-use relationship in Carolina. There is competition between coal mining and agriculture for both water and land-resources (Data World Pty, 2019). In the Mpumalanga area, coal mining and farming often overlap because the areas that have good water quality soils often overlap with areas with extensive mineral resources (Data World Pty, 2019).

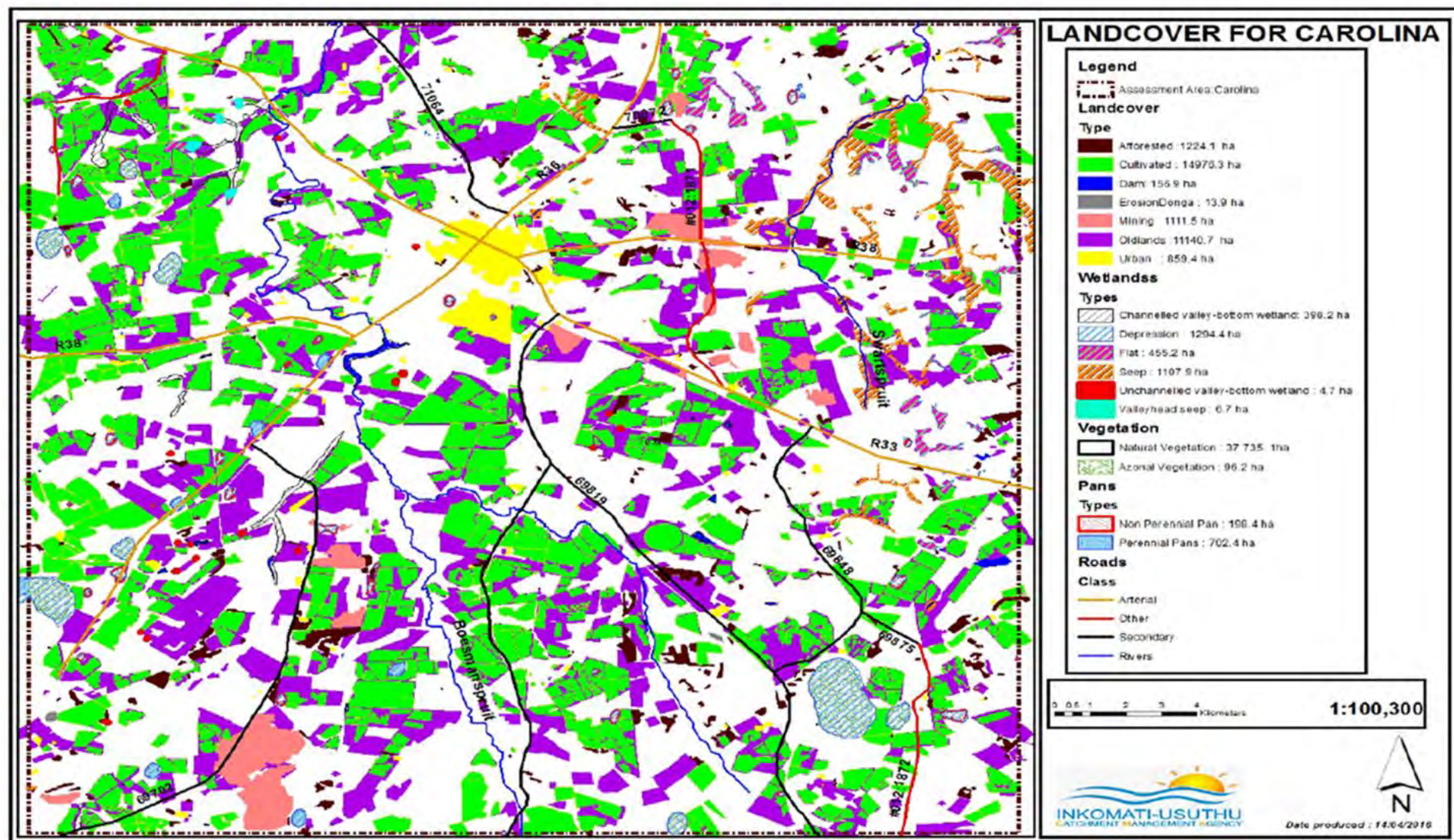


Figure 4. 1. Land cover of the study area in 2006 which shows the agricultural-mining mosaic surrounding the town of Carolina. (Houdet, 2017, 2018)

4.4. VALUING NATURAL RESOURCES IN THE CAROLINA NEXUS OF CONTESTATIONS

Community members commented that there are major ecosystem imbalances that arise from coal mining decisions. The economic values of the costs and impacts caused by coal mining were never and have never been made clear to community stakeholders (Munnik *et al.*, 2018: 4). Additional comments showcased that issues are not clearly explained to the community during environmental impact assessments and other decision-making processes. These discussions took place during one of the workshops (24 November 2015) that were held during the WRC K5/2230 project.

The resource economics study aimed to mitigate the concerns of the community members, but it was met with the most resistance from mining companies, in comparison to the other studies done as part of the Munnik *et al.* (2018) project. The local coal mining community withheld information necessary for the monetary estimates (Munnik *et al.*, 2018: vi). A value of the wetlands had to be estimated instead. It became evident that the court objective which was initially to internalize ‘mining in balance sheets, to ensure no net loss of wetland functions at landscape scale’, would be difficult to achieve due to withheld information. The difficulty of accessing mine specific information was discussed in a UKCMF workshop on 9 June 2016. At the workshop, it was decided that the resource economics study by Houdet (2017, 2018) should then focus on developing guidelines for each group of land-users in the Carolina catchment (Munnik *et al.*, 2018:19).

The final resource economic valuation study deliverable was presented to the UKCMF as a set of values and guidelines for each of the different land users (Munnik *et al.*, 2018: 172). The guidelines were aimed at potentially influencing the stakeholder groups in the area to make wiser decisions when undergoing activities where possible land use and ecosystem service disturbances could occur. Certain rules were presented for each of the land users in Carolina in the guideline. The guideline rules addressed the following concerns:

- That farmers have negative impacts on wetlands, according to mine managers;

- That mines should not be constructed in or near wetlands, or in areas that deliver water that keep wetlands maintained,
- Guidelines were produced to also serve as a starting point for discussion by Catchment Management Forums, communities and other groups.

The correlation between the guidelines and the numerical values that were estimated as part of the study are however difficult to assess and understand. The UKCMF stakeholders did not see the guidelines as effective or of priority (Munnik *et al.*, 2018: 17). An *anomaly* emerged after the results were presented which was that different land users have very different rules in terms of which natural resources are important and how natural resources should be managed (Munnik *et al.*, 2018: 17). For example, agricultural land users were not focused on the same environmental concerns (like soil quality) as mine land users. The anomaly that emerged about different land users having different rules potentially arises from differing value perceptions of resources such as natural capital. When undertaking a resource economics study where natural resources are concerned, it is very seldom for a ‘one size’ fits all panacea solution to be well accepted by stakeholders when it is not representative of the various stakeholder groups or community involved.

4.4.1. Resource Economic Valuation Difficulties in The Carolina Study

Subsuming nature into the formal economy using natural resource economic valuation faces various practical challenges, especially regarding the methods. Some challenges were identified in the Carolina resource economic valuation study regarding the methods that were selected. Some of the challenges have been mentioned including the limitations of access to data, time and budget constraints. This meant that a large part of the resource economic valuation study had to be conducted via a desktop study (Houdet, 2017). The desktop study led to a number of estimated values been produced by the study. For example, one set of estimated values were produced during the Carolina study assessed and disclosed the external costs and benefits of different land uses and their affect on ground ecosystem management practices (Houdet, 2018: 170). In the presence of limitations, Houdet (2018) used estimated annual externality costs from a previous study that was

done about the Kusile Power Station in a different part of Mpumalanga. The Kusile power station valuation study by Nkambule and Blignaut (2017) has also been discussed in section 2.9. This commonly used method of fetching data from previous similar studies can quickly lead to errors such as double-counting.

Within the Nkambule and Blignaut (2017) study that Houdet (2017, 2018) used, the Kusile Power Station values had also been estimated using other previous value estimates. Nkambule and Blignaut (2017) that indicated that values collected for the Kusile Power Station study were *estimated* using various other previous studies in different areas. Once those studies were also scrutinized, it was discovered that some of the studies used by Nkambule and Blignaut (2017) had also themselves retrieved value estimates from other previous studies. Errors such as double-counting stem from such scenarios where illogical calculation takes place and practitioners may sometimes not be aware of the limitations or errors faced by the value data they use for their own current studies (Fu, Su, Wei, Willet, Lu and Liu, 2010). Acknowledging the concept of interactions between social entities and ecological resource in a complex system holds potential counter-measures that could make resource economics valuation studies more appropriate.

One counter-measure that Fu *et al.* (2011) suggest for reducing double counting is to adequately select valuation methods that are appropriate for the study context. In addition, it is suggested that the appropriate socio-economic, political and cultural parameters should be understood and well-defined (Morse-Jones, Luisetti, Turner and Fisher, 2011). With a variety of uncertainties that exist in economic valuation and measurement, it is important to constantly gather and integrate appropriate information with the goal of learning and adapting to produce more appropriate economic values (Constanza *et al.*, 2017). The relationship between the economics and the environment need to be informed by ecocentric thinking rather than purely economic thinking. Natural capital and ecosystem services require more transdisciplinary ecological economic approaches that can understand and manage complex, interconnected systems in the anthropocene (Constanza *et al.*, 2017).

The following section details the idea of differing value perceptions, and the political and power dynamics influencing the community of Carolina. Harrington and Allan (2008) argued that place-based collaborations are focus on solving local problems with the local community meaning that values are then more likely to be more meaningful to the community, therefore providing greater

motivation to address local issues. To undertake a more in-depth resource economics study, understanding the differing value perceptions, political and power dynamics of the engaged sectors of community is essential. The local level may be insufficient in explaining external forces such as economic and social factors. However, local level stakeholders can gain more insight that can improve understanding around the local level natural resource decision-making possibilities and limitations. For example, making information more meaningful through collaboration during a resource economics study, can uncover how differing actors hold variable capacity to exercise power, influence, and authority (Harrington and Allan, 2008).

The researcher also engaged with the UKCMF to attempt to unpack the concept of differing values among stakeholders. With the ‘same resource, different values’ (Seymour *et al.*, 2011) concept in mind, the researcher aimed to unpack if political and power dynamics in the UKCMF also influenced the natural resource and decision-making processes in Carolina. The end goal of this chapter is to potentially point out how similar future natural resource economic studies in a CSES can better incorporate both the social and ecological aspects for better enhanced reception from local stakeholders and participatory governance groups like the UKCMF. This end goal is achieved in the following section where the findings of the UKCMF are discussed in alignment with the Houdet (2017, 2018) study and literature in chapter 2.

4.5. UPPER KOMATI CATCHMENT MANAGEMENT FINDINGS AND DISCUSSIONS

This section describes the results that were obtained from the UKCMF during the visit to the forum in November 2018 at the Featherbed Guesthouse in Carolina, Mpumalanga. This section details the political, environmental and social issues arising regarding the valuation of the environment in a participatory governance context, focusing on the Upper Komati Catchment Management Forum.

4.5.1. Emergent Themes

Chapter three (section 3.5.1.2.) provides a detailed description of how the themes in this section were identified by the researcher. The following four themes emerged from the UKCMF data collection.

- i. Carolina natural capital and land use nexus of contestation (section 4.5.3.)
- ii. Carolina current and future catchment conditions (section 4.5.4)
- iii. Political and power dynamic influences on a local governance scale, including within the UKCMF (section 4.5.5.)
- iv. Conducting a resource economics study in a participatory governance area (section 4.5.6.)

The first two themes focus on the details of the natural resources nexus of contestation in Carolina as described by the UKCMF stakeholders. The differing value perceptions around the nexus of contestation are also detailed and described according to the differing stakeholders. The last two themes (iii and iv) explore the political aspects surrounding the local participatory governance of natural resources. Views from UKCMF stakeholders on resource economics are further explored, with their suggestions on how to conduct more efficient resource economic studies in a participatory governance context. The themes and the sub-themes that emerged are shown in Figure 4.2 below.

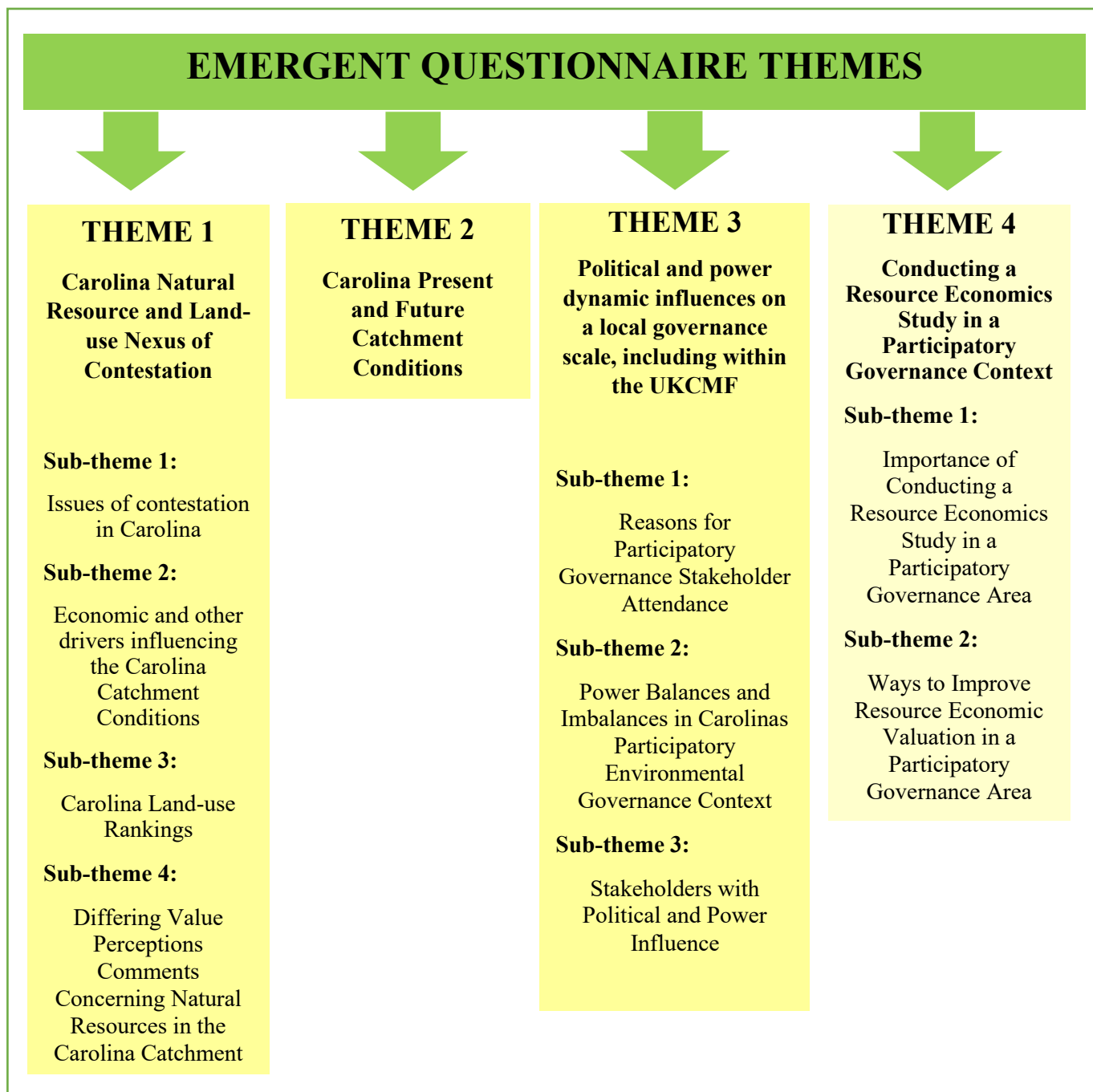


Figure 4. 2. Emergent Themes And Sub-Themes From The Upper Komati Catchment Management Forum Questionnaire

4.5.2. The Upper Komati Catchment Management Forum Research Participants

The Upper Komati Catchment Management Forum (UKCMF) is a participatory resource governance institution with a range of stakeholders who include communities of locality, practice and interest (Harrington and Allan, 2008). The stakeholders meet every quarterly to discuss concerns, new emergences and possible solutions regarding the management of natural resources in the area, particularly water and wetlands. **Figure 4.3.** provides details of the stakeholders who took part in the Forum questionnaire study that was conducted for the purpose of this thesis, in November 2018. In total there were 27 stakeholders.

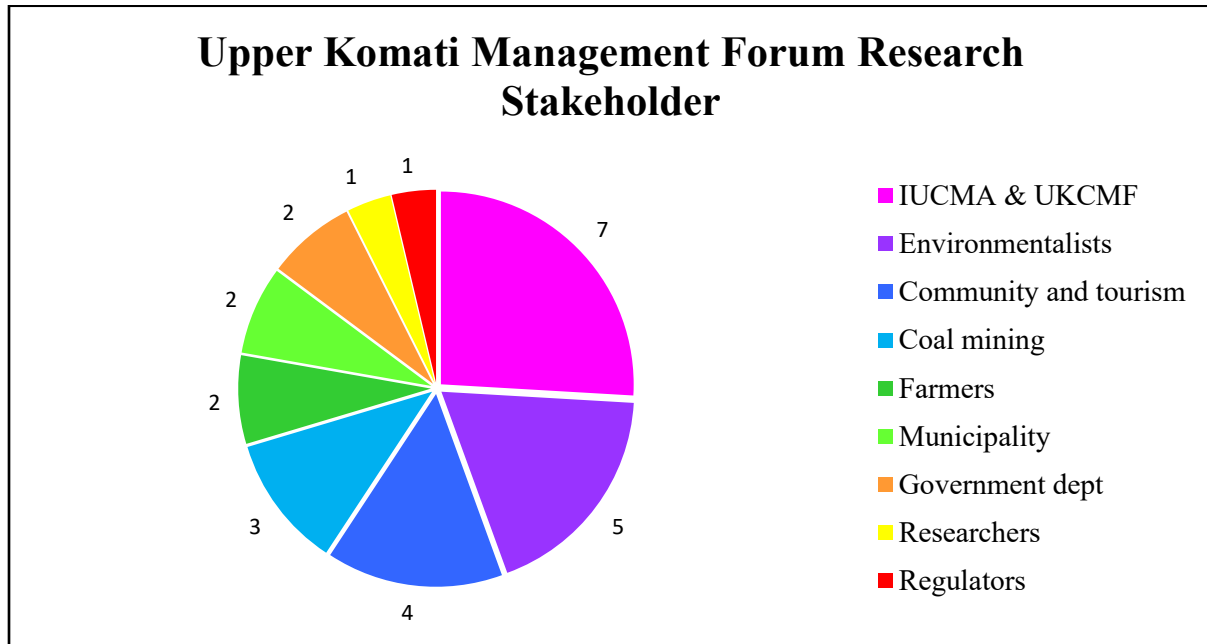


Figure 4. 3. Stakeholder Representation and Distribution At The Upper Komati Catchment Management Forum

4.5.3. Theme One – Carolina Natural Resource and Land Use Nexus Of Contestation

4.5.3.1. *Issues of Contestation In Carolina*

An acknowledgements that was made in the Munnik *et al.* (2018) project was that Carolina faces a nexus of resource contestation. However, the nexus of resource contestation was not thoroughly explained in the Munnik *et al.* (2018) study. Wetlands, farming and coal mining were the main variables significantly influencing the nexus of resource contestations according to the Munnik *et al.* (2018: 148) project. A new finding emerged regarding the nexus of resource contestation after engaging with the UKCMF stakeholders. Externalities resulting from *Municipal activities* were said to be a large role player in the nexus of contestation. One of the UKCMF co-ordinators commented on municipal activities as a significant contributing factor to Carolina's resource contestation. Stakeholders representing coal mining also acknowledged the municipality as a contributing entity to the resource contestations. A comment from a coal mining representative stated that "water pollution is the main issue. However, the Albert Luthuli Local Municipality is the main contributor to poor water quality". An additional UKCMF co-ordinator pointed out that the problem was with the Municipality Waste Water Treatment Works (WWTW) which affects water quality. The findings regarding the WWTWs was interesting, however it was not a key area of interest in the Munnik *et al.* (2018) but instead the focus was on acid mining drainage.

Sixteen of the twenty-seven stakeholders who were representing the UKCMF coordinators, environmentalists, community and tourism, government department and regulators, said the issues of contestation are mainly between farming and mining. Mining received the most critique for 'destroying land and water'. A governmental representative expressed that "government must oppose mining licences in the area". Seven of the twenty-seven stakeholder members chose not to answer as they were not really aware of the contestations. After it emerged that WWTW was a concern among stakeholders, the researcher noted that, in this thesis research, it would not be possible to measure extent of damage caused by the WWTW during the process of this research.

4.5.3.2. *Economic Activities Influencing the Carolina Catchment Conditions*

Participants were asked to identify which drivers they believe negatively impact the catchment conditions the most. The options included current mining, abandoned mining and agriculture. Waste Water Treatment Works was also included as an option as it had been identified as a potential option by the researcher after conducting a literature review. Although participants were asked to select one option, many stakeholders pointed out that they were aware of more than one option.

Figure 4.4. is a diagram that shows the responses received from the UKCMF stakeholders when they were asked which economic activities they believe negatively influence catchment conditions. The different options, including the combinations, that were selected by the stakeholders are shown on the horizontal axis and the number of stakeholders who selected the various options (including the combination options) are shown on the vertical axis.

The findings displayed that current mining is perceived to have had the greatest negative impact on catchment conditions, followed by abandoned mining. Various literature (McCarthy, 2011; Munnik *et al.*, 2018: 14) has shown that both current mining and abandoned mining have negative impacts on Carolina's catchment conditions. Mining also appeared often where stakeholders selected combination options. WWTW also appeared as a driver that stakeholders believed was negatively influencing catchment conditions. Agriculture alone was not viewed as a driver that was negatively influencing catchment conditions, it did however appear where stakeholders selected a combination of options. Agriculture and mining are both economic drivers that can negatively influence catchment conditions. However, mining has longer-term impacts such as waste management which are irreversible, making it a serious concern to mining communities (McCarthy, 2011).

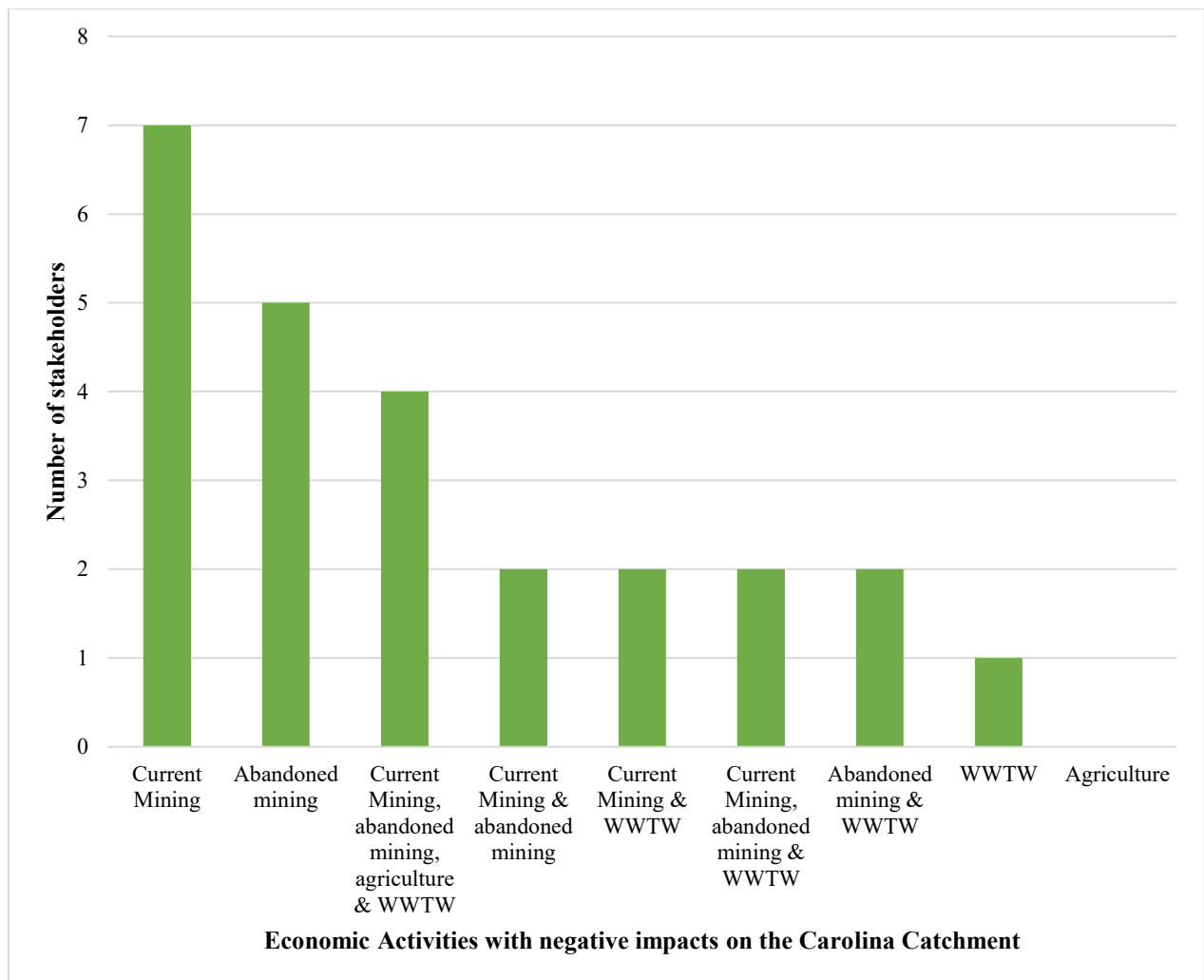


Figure 4. 4. Economic Activities Significantly Influencing the Carolina Catchment Conditions

4.5.3.3. Carolina Land-use Rankings

The stakeholders were asked to rank the six land use types that were mentioned in the WRC resource economics report, on a scale of most important to least important as shown in **Table 4.1**. The land-uses that stakeholders were asked to rank from most to least important included wetlands, dams, mining, natural grasslands, urban land and afforested land. In the context of this research, ‘important’ was described as a land-use type that was beneficial to the Carolina community (socially, economically, and environmentally), therefore needing to be conserved. **Table 4.1**. shows the various stakeholder groups ranking of Carolina land-use types from least to most important. Some stakeholders mentioned that an important land-use type for them was one which

provided direct survival benefits that contributed to human wellbeing (e.g. dams). While another said importance was based on economic contribution (e.g. mining provided jobs and income).

Table 4.1. vividly shows that not all stakeholders value land-uses the same as the different stakeholders completely have quite diverse views on which land-use types are most and least important. Some saw wetlands as least important, including coal mining representatives and regulators. Due to time constraints, it was not possible to find out why stakeholders valued or ranked land-uses types in the way that they did. A possible reasoning for these ranking differences might arise because of the different interests the communities who are part of the Carolina catchment have. The different communities of locality, practice and interest are most likely concerned with land-uses that contribute to their activities or existence.

While the Munnik *et al.* (2018) project was concerned with wetland and water conservation, not all stakeholders appear to be as concerned about them. These results were collected about a year and a half after the Houdet (2017, 2018) resource economics report had been delivered to the UKCMF stakeholders. This raises the concern of how it is that economic valuation can become a more effective tool for shifting stakeholder mindsets through the values produced. A study aimed at wetlands was undertaken, presented to the community and published, yet wetlands are still not a top priority for the Carolina UKCMF stakeholders.

The findings displayed in Table 4.1. relate to the concept that Seymour *et al.* (2011) relayed when examples were made of how various stakeholders can view a basket of resources according to a different ranking. The finding of different land-use rankings is something that stakeholders are potentially not aware of when partaking in participatory natural resource management engagements. Understanding how various natural resources are valued by various stakeholders can enhance practitioners understandings of why stakeholders perceive environmental values the way that they do.

Table 4. 1. Land-use Type Rankings According To Stakeholder Groups						
Stakeholder Type	1 (most important) 6 (least important)					
	1	2	3	4	5	6
IUCMA & UKCMF Representatives	Urban	Wetlands	Mining	Natural Grasslands	Afforested land	Dams
Environmentalists	Natural Grasslands	Dams	Urban	Wetlands	Mining	Afforested land
Community and tourism	Urban	Dams	Mining	Natural Grasslands	Wetlands	Afforested land
Coal mining	Afforested land	Urban	Dams	Natural Grasslands	Mining	Wetlands
Farmers	Afforested land	Wetlands	Natural Grasslands	Urban	Mining	Dams
Municipality	Afforested land	Wetlands	Urban	Natural Grasslands	Dams	Mining
Government Department	Dams	Natural Grasslands	Wetlands	Afforested land	Mining	Urban
Researchers	N/A					
Regulators	Afforested land	Urban	Mining	Dams	Natural Grasslands	Wetlands

4.5.3.4. Differing Value Perception Comments Concerning Natural Resources in The Carolina Catchment

The researcher then aimed to get commentary from the different stakeholder groups about how differences in value perceptions effect natural resource management. **Table 4.2.** provides summaries of what the stakeholders mentioned about differing value perceptions in a natural resource governance context. It quickly became evident that many stakeholders believed that the differing value perceptions result in tensions among stakeholders. It appeared that different value perceptions arose from the differing stakeholder interests and this was evident as some stakeholders mentioned that profit interests and conservation interest do in fact clash.

The evidence that arose about the fact that varying value perceptions contribute to tensions amongst stakeholders can be linked to the importance of transdisciplinary research. Merging economic and ecological theory such as the Ostrom's SES (2009) or the Cascade Model (2011) with natural resource economic theory can help both local stakeholders and practitioners involved in participatory natural resource management deliberations. The multi-tier and segmented variable approach taken by the transdisciplinary approach can guide how the various stakeholder groups function in relation to the different natural resources which then allows natural resource economic valuation practitioners to understand the conceptual framing of the social (human) elements in relation to the environmental elements. Houdet (2018) mainly relied on a desktop type approach during the progression of his study with one related field site visit. The reason the UKCMF stakeholders may have not responded well to the values presented by Houdet (2018) could be due to the lack of engagement on a local scale. This moves the conversation towards the relevance of also then incorporating a discourse-based valuation method. Researcher are at danger of making assumptions about an area without enough local level knowledge.

Table 4. 2. Comments On The Different Perceptions of Natural Resource Values By Different Stakeholders.	
Stakeholder Type	Commentary about differing value perceptions pertaining to natural resources
IUCMA & UKCMF Representatives	Four out of seven IUCMA and UKCMF stakeholders believed that there are tensions that arise from differing value perceptions while the remaining three believed that differing value perceptions resulted in no tensions among stakeholders. Comments by the stakeholders pointed out that value tensions are mainly between mining values and environmental values. The local coal mining sector was said to be concerned with profits rather than environmental issues.
Environmentalists	Two of the five environmentalists believed that differing value perceptions resulted in tensions among stakeholders in the area. It was believed that this is the case because many different people are affected by the impacts of local economic activities. Most stakeholders were said to value ecosystems for protection while other environmental stakeholders such as the municipality didn't show any support.
Community and tourism	Only one of the four stakeholders in this group suggested that differences in value perceptions cause tensions. The remaining three stated that differing value perceptions did not cause tensions.
Coal mining	Two of the three coal mining stakeholders stated that different needs and agendas concerning different stakeholders lead to tensions because of differing value perceptions. One coal mining stakeholder said that farmers oppose mines because of pollution, but the farmers also pollute. The stakeholder justified that coal mining significantly contributes to economic upliftment by providing ten times as many jobs as farming, therefore making coal mining more valuable. Only one coal mining stakeholder stated that there are no value tensions because members all have the same objective to protect water resources.
Farmers	Both present farming stakeholders agreed that there are value tensions amongst stakeholders because economic benefits are placed above environmental values.
Municipality	None of the municipality stakeholders believed that differing value perceptions lead to tensions among the various stakeholders.

Government Department	Both present Government Department stakeholders did agree that unfortunately differing stakeholder value perceptions result in tensions. One government department stakeholder stated that it was caused by the lack of information and availability of the Nkosi Albert Municipality, Department of Mineral Resources (DMR) and other community parties.
Researchers	No comment was given by the present researcher.
Regulators	The regulator stated that members value environmental attributes differently and sometimes stakeholders only want to protect these environmental attributes, not allowing for any trade-offs as a result.

4.5.4. Theme Two – Carolina Present and Future Catchment Conditions

The WRC resource economics study provided values that intended to cover both the current and future conditions of the Carolina catchment. The results were obtained through desktop studies, one experts opinion and only a one day site visit. To get a sense of how community stakeholders viewed the overall Carolina catchment conditions in the present and in the future, stakeholders were asked to rate how they felt about the catchment in both the present and the future.

Table 4.3. and **Table 4.4.** below, show how the different stakeholders in the catchment rated the present and future catchment conditions in Carolina. The stakeholders in each group were asked to select whether they believe the catchment conditions are *very poor*, *quite poor*, *average*, *good* or *very good*. **Table 4.3.** shows the number of stakeholders in each stakeholder group, who selected each criteria for the *current catchment conditions*.

Most of the stakeholders viewed Carolina's current catchment conditions as either average or good, with average as the highest. Only one stakeholder representing environmentalists saw the Carolina catchment conditions as quite poor. Findings showed that twelve stakeholders believed the *future catchment conditions* would deteriorate to poor conditions (very poor and quite poor). However, ten stakeholders believed that the catchment conditions in 50 years would still be average. Only four stakeholders saw the conditions as improving to good or very good.

Table 4. 3. Current Environmental Conditions of the Carolina Area According To UKCMF Stakeholders					
Stakeholder Type	Very poor	Quite poor	Average	Good	Very good
IUCMA & UKCMF Representatives			3	4	
Environmentalists		1	4		
Community and tourism				4	
Coal mining			1	2	
Farmers			2		
Municipality			2		
Government Department			2		
Researchers					
Regulators				1	
Total for each category	0	1	14	11	0

Table 4. 4. Future Carolina Catchment Conditions in 50 Years According to UKCMF Stakeholders					
Stakeholder Type	Very poor	Quite poor	Average	Good	Very good
IUCMA & UKCMF Representatives	2	2	1	1	1
Environmentalists		1	4		
Community and tourism	1		2		1
Coal mining		3			
Farmers	1			1	
Municipality			2		
Government Department	1	1			
Researchers					
Regulators			1		
Total for each category	5	7	10	2	2

4.5.5. Theme Three – Political and Power Dynamic Influences on A Local Governance Scale, Including Within The UKCMF

The findings of this theme indicated that there are in fact power and political dynamics that impact participatory resource governance in the UKCMF and the Carolina catchment. There appeared to be certain stakeholders that are more dominant in the UKCMF and in the local Carolina catchment. Resource economics tends to ignore this political aspect when undertaking resource valuation studies. When this aspect is ignored, consultation can end up being limited to the most actively engaged sectors (dominant stakeholders) whose responses may not be representative of all the stakeholder groups as pointed out by Seymour *et al.* (2011).

There is no specific definition of ‘stakeholders’ that has been agreed upon. In the context of this research, *stakeholders* are identified as people who are i) interested in a project or activity, want to become involved in the process, or seek an opportunity to provide input, and ii) are more

generally interested in the process of information (Yossie and Herbst, 1998). Yossie and Herbst (1998) state that the various stakeholder groups in participatory environmental governance spaces have various self-interests as some may come into these spaces with genuine environmental concerns while others are there to protect their business or economic interests. A huge stereotype surrounding the coal-mining industry is that coal mining is more focused on producing profits rather than choosing cleaner mining options that might reduce profits (McCarthy, 2011). This research aimed to unpack the political and power dynamics that arise due to vested interests.

4.5.5.1. Reasons for Participatory Governance Stakeholder Attendance

According to Yossie and Herbst (1998), the following reasons are most likely to drive stakeholder engagement processes in resource management. Firstly, more stakeholders may want to engage in resource management processes because of a lack of public confidence in the environmental decisions being made by corporations and government agencies. Secondly, institutions that aim to provide transparency where their decisions affect environmental quality. Thirdly, stakeholders may engage in environmental decision making processes because there are greater societal expectations for improved environmental quality. Lastly, the concerns and interests of individuals and groups to participate in environmental decision making are due to stakeholders having a desire to expand their capabilities and understanding about environmental issues (Yossie and Herbst, 1998). Evidently, these were some of the main reasons why UKCMF stakeholders chose to be part of the Forum.

Table 4.5. provides comments on the reasons why different stakeholders participate in the UKCMF. It was evident that different stakeholders attended the UKCMF meetings for various reasons. However, many stakeholders held the desire to expand their capabilities and knowledge regarding environmental quality of the Carolina catchment. Some stakeholders like coal mining, municipality IUCMA/ UKCMF representatives were there mainly because their attendance was required as part of their profession. Other stakeholders such as community members were there because they wanted to learn more about the catchment conditions.

Table 4. 5. Reasons Different Stakeholders Participate In The UKCMF	
Stakeholder Type	Comments
IUCMA & UKCMF Representatives	Most of the IUCMA & UKCMF stakeholders are present for Water Research Monitoring (WRM) and to coordinate the Forum stakeholder relation and participation.
Environmentalists	Environmental representatives were either present to participate, give inputs and learn about Forum participation and catchment conditions such as the water quality issues and sanitation.
Community and tourism	Stakeholders in this group expressed that they care about the community and want to be part of discussions and understand issues that concern mining and water usage, as well as bring potential solutions.
Coal mining	Coal mining representatives stated that it is a legal requirement to attend as part of integrated water use licenses. The objective is for them to understand the state of water, ecosystem services and how to protect them.
Farmers	Two farmers were present. One claimed that they were part of setting the Forum up and hope to see it becoming successful. The other farmer stated they were from the Agriculture Research Commission (ARC) and that the Forum allows them to present products developed by the company relating to water, rainfall and subsequently agriculture.
Municipality	One municipal representative was there as an Environmental Health Officer. The other was there as they stated that it is the municipalities duty to ensure that the community has clean potable water
Government Department	The representatives are from the Department of Agriculture, Forestry and Fisheries (DAFF) and the Department of Water and Sanitation. The DAFF representative stated they were responsible for water for the local farmers and the DWS representative did not state their reason for participation.
Researchers	A research from ARC was present and aimed to gather information on the soil, climate and water conditions
Regulators	This stakeholder stated they were present as a regulator in the Forum

4.5.5.2. *Power Balances and Imbalances In Carolinas Participatory Environmental Governance Context*

Stakeholders were asked to select a category that most closely represented how they felt about the political and power dynamics amongst the different stakeholders in the UKCMF. The focus was aimed at unpacking the under and over-representation of certain stakeholder groups in a participatory governance context. A characteristic that was identified in the UKCMF was that certain stakeholders have ‘power over’ other stakeholders through their ability to influence and control people or events leading to certain outcomes (Hiemstra, Brouwer and van Vugt, 2012).

Power is a multifaceted social phenomenon at the core of human activities (Hiemstra, Brouwer and van Vugt, 2012). Those with power are often those with more resources meaning less powerful stakeholders often find it difficult to influence participatory natural resource governance forums. Failure to recognize power imbalances in participatory governance spaces like Carolina, can result in some stakeholders dominating others while less-powerful stakeholders get overruled or excluded (Hiemstra *et al.*, 2012).

Stakeholders were given five categories and asked which they believed best represented the power balances in the Forum. The categories included (i) *that certain stakeholders are dominant*, (ii) *that there are major power imbalances*, (iii) *there are moderate power imbalances*, (iv) *power balances are moderately equitable* and (v) *power balances are completely equitable*. Each category was given a score of one. Some stakeholders selected two options that they felt overlapped. Where a stakeholder ticked between two categories, a score of a half (0.5) was given to each category. For example if a stakeholder picked both (i) that certain stakeholders are dominant and (ii) that there are major power imbalances, then the score of 1 is divided between both categories as 0.5. **Table 4.6.** shows the relationship between the stakeholders and how they felt about the power dynamics in the Forum, which were then totalled according to each category.

It was evident that a greater number of stakeholders believed that there were power imbalances in the UKCMF. A majority of stakeholders from the IUMCA/ UKCMF, community and tourism ,

coal mining and farmers groups selected the options that pointed to the fact that there are dominant stakeholders and power imbalances.

Table 4. 6. Power Balances and Imbalances Among UKCMF Stakeholders

Stakeholder Type	Certain stakeholders are dominant	Major power imbalances	Moderate power imbalances	Moderately equitable	Completely equitable
IUCMA & UKCMF Representatives	2	3	1	2	
Environmentalists				1	1
Community and tourism	1	1	1		
Coal mining	0.5	1.5		1	
Farmers	1	1			
Municipality			1	1	
Government Department				1	1
Researchers					
Regulators				1	
Total selected for each category	4.5	6.5	3	7	2

4.5.5.3. Stakeholders With Political and Power Influence

To identify which stakeholders were potentially more dominant in the UKCMF, a question was included that intended to find out which stakeholders may have had greater power or influence. As identified in the study by Seymour *et al.* (2011), there is a tendency for resource economic valuation studies to represent the more dominant stakeholders. The question was framed so as to find out whether the more dominant stakeholders could be identified. It was identified through the responses that there was a ‘blame game’ type scenario occurring between stakeholders (**Table 4.7.**). While certain stakeholders pointed to other stakeholders for either ‘negatively’ or ‘positively’ dominant. The dominant stakeholders also pointed to other stakeholders (even less dominant) for being negatively influential.

Table 4. 7. Political And Power Dominance Issues According To Different Stakeholders	
Stakeholder Type	Comments
IUCMA & UKCMF Representatives	Five of the seven representatives in this group stated that coal mining stakeholders are more dominant. They believed that coal mining was the most dominant because of their influence over the water resources through mining activities and the fact that they regulated the Forum meetings regularly. One of the UKCMF representatives stated that dominant stakeholders are often those who have more knowledge than others.
Environmentalists	In this stakeholder group, both mining and agriculture were viewed as having negative influence because of their effect on water resources. One stakeholder felt that the municipality effect the Forum by not coming while another insisted that all stakeholders are well represented in the Forum.
Community and tourism	The community and tourism seemed to agree that the municipality and the UKCMF representatives were the most influential in a positive way as they make others comply with the Water Management Act (No. 36 of 1998).
Coal mining	The coal mining stakeholders expressed that national government departments such as the Department of Mineral Resources (DMR) and local government are dominant in a negative way. One coal mine manager expressed that local and provincial government makes the management of the catchment the responsibility of the mining and agriculture stakeholders. Also expressed was that departments such as DMR should prevent illegal mining activity through the legal authorization of permits.
Farmers	Farming representatives said government department such as the DWS and IUCMA representatives were dominant because organize the sessions and control the outputs of the meetings. Another farming representative said that old mines and municipalities negatively influence the catchment in a dominating way.
Municipality	No comments were given by the municipality stakeholders
Government Department	Representatives from the DAFF and DWS believe that coal mining has a dominant presence due to coal resources being dominant and because coal mines have money, therefore meaning that government does not oppose distributing mining licenses.
Researchers	No comments were given by researchers.
Regulators	The regulator that was present stated that coal mines drive the economy and coal mining stakeholders and their activities are most dominant.

Five of the nine stakeholders pointed out that coal mining was a dominant sector within the UKCMF and the Carolina area. In meetings they were viewed as dominant because of they were the ones mainly organising and ‘controlling’ the outputs of the meeting. The coal mining sector was said to be dominant in the Carolina area because of their influence over water resources and because of their contribution to economic activity. Government departments were also appeared to be a dominant stakeholder although there were only two stakeholders in the meeting. The coal mining stakeholders specifically pointed out both national government and local government as been dominant in a negative way. Certain stakeholders appeared to be more dominant than others and certain voices seem to be louder than others within the forum, this means that when experts consult participatory governance spaces like Carolina, not all stakeholder concerns may be considered.

Theme one, two and three showcased the underlying social and political dimensions that can often exist in a natural resource participatory governance setting. Although a resource economist undertaking a resource economic valuation study might not need to report on the social and political aspects, understanding the research context can unlock possibilities to ensuring more accurate and democratically representative results. Section 2.9. highlighted the political difficulties that exist in the South African context of coal mining. Natural resource economic valuation processes, especially when using a discourse-based valuation method, are subject to political powers like the Department of Mineral Resources and mining companies who are excused from natural resource deliberations by the politics of power. The absence of stakeholders (especially those with power) limits the ability of natural resource economic valuation practitioners in providing a study that represents all present stakeholders. This points to the need for tighter policies regarding how natural resource economic valuation takes place. I.e. Making it compulsory for mining related stakeholders to attend forums like the UKCMF or having their mining and water use licences revoked. These types of policies already exist in South Africa. However, the main problem with these policies remains in inadequate implementation.

4.5.6. Theme 4 – Conducting A Resource Economics Study In A Participatory Governance Area

As part of this theme, the researcher aimed to find out how stakeholders thought resource economic valuation studies could be improved in a complex social-ecological setting, considering that they had already been a part of one.

4.5.6.1. Importance of Resource Economic Valuation In Environmental Decision Making

Debates about environmental valuation are perplexing. For some, resource economics focuses on quantifying human and ecological values to support decision-making. Others reject environmental valuation for ‘placing a price tag’ on nature (Tadaki *et al*, 2017). The stakeholders could rate resource economic valuation as (i) very unimportant, (ii) unimportant, (iii) neutral, (iv) important or (v) very important. The findings in Table 4.5. showed that a majority of the stakeholder’s responses skewed towards important and very important (56% of stakeholders). About 18% of the stakeholders felt neutral about resource economic valuation, while another 18% of stakeholders either viewed resource economic valuation as either unimportant or very unimportant. The differences in opinions could be based on the differences in environmental valuation biases and beliefs. A comment from one stakeholder was that some stakeholders may see resource economic valuation as unimportant because the purpose of resource economic valuation studies are not clearly explained to all stakeholders, especially those without the knowledge.

Table 4. 8. Importance of Resource Economic Valuation In Environmental Decision Making					
Stakeholder Type	Very unimportant	Unimportant	Neutral	Important	Very important
IUCMA & UKCMF Representatives	2		2		3
Environmentalists				1	2
Community and tourism			3		1
Coal mining				1	2
Farmers		1			1
Municipality	1				1
Government Department	1			1	
Researchers					1
Regulators					1
Total selected for each category	4	1	5	3	12

4.5.6.2. Ways to Improve Resource Economic Valuation In A Participatory Governance Area

The findings presented in theme three aligned with the second assumption that there is *often a failure by resource economic valuation studies to consider the political and power dynamics in the study area*. The findings from stakeholder comments pointed to the need for more co-operation of all stakeholders, integration of all stakeholder concerns and awareness about the importance and process of economic valuation. Stakeholders from the IUCMA and UKCMF detailed that integrated water resource management requires equitable decision making by all role players therefore creating balance when dealing with economic values. The IUCMA/ UKCMF stakeholders emphasized a need for an integrate approach involving all local resource users while co-operating on a greater level with the community and other stakeholders when undertaking resource economic valuation. The environmentalist stakeholder group suggested more regular

forum meetings where critical discussion on the importance of ecosystem resources and the connecting values. The need for integrative actions were also mentioned the environmental stakeholders. Surprisingly, none of the community and tourism stakeholders made any comments on resource economics. It was evident that the community and tourism stakeholders did not really have a strong insight into economic values.

Only one farmer commented on this theme stating that the best way to undertake a resource economic valuation study was to involve all stakeholders in the resource economic valuation study processes so to enhance the understanding and co-operation of all the stakeholders. It was further elaborated that his approach could improve future sustainability and governance. The Nkosi Albert Luthuli Municipality stakeholders and the Government Department stakeholders believed that awareness and better public participation could play an important role in terms of capacity building to the community and other sectors. The present regulator was more concerned with finding a way to strike a balance by making sure trade-offs are made.

A concern in the field of resource economic valuation pertains to how valuation studies can ensure better valuation between the economic methods and practical application (Tadaki *et al.*, 2017). This research envisaged to explore the complex human political interactions that are a part of the social aspect that many resource economic valuation studies neglect. In the twenty-first century, human welfare is closely linked to the quantity and quality of available natural resources. Natural resources have come to be viewed as scarce resources. The choices that each stakeholder in the Carolina catchment make can have minor to major impacts of the area's natural resources. The possible trade-offs that lead to scarcity in natural resources such as clean water result in natural resource linked conflicts. Understanding the value of the choices made can improve decision making by stakeholders where natural resources are concerned. The understanding of values further means that accountability among stakeholders can become a more transparent process. In Carolina, the coal mining firms declined the offer to present their financial benefits and cost information. Educating members of the community on the costs of activities such as coal mining can be a more effect approach when they see choices been made by firms that lead to deteriorating

environmental values. Without the consideration of peoples' interests, sustainable natural resource conservation is not possible.

4.6. CHAPTER CONCLUSION

This chapter pointed out that there is great potential for natural resource economic valuation if a transdisciplinary approach is taken. First it was identified that undertaking a natural resource economic valuation requires a greater understanding between both the social and ecological elements within a study area. Interviews with the UKCMF highlighted that Carolina faces a natural resource contestation that is clouded with differing values and political dynamics which then result in tensions among stakeholders. Introducing a discourse-based valuation method means that participatory deliberation could potentially mitigate these tensions and providing a learning space for both natural resource economic valuation experts and UKCMF stakeholders. Deliberative process through co-operation among all involved parties can create improved awareness about the true value of natural resource economic valuation.

Economic policies particularly influence the nature of natural resources. Natural resources just like other forms of capital (including human capital, financial capital, social capital and political capital) respond to policies and governance. Natural resources are not just biophysical entities, but they are also economic commodities that are dynamic and embedded in complex social and political settings (Mburu, Abila, Diafas, Guthiga, Hatfield, Kiragu, Ritho and Cecilia, 2017). Therefore, effective and sustainable natural resource management approaches can be developed if the economic, natural and governance components are appreciated and integrated. Appropriate natural resource management are therefore derived by combining inputs from institutions, policies, economic signals and resource characteristics (Mburu *et al.*, 2017). The following section presents data on how government entities including the Water Research Commission (WRC) and the Department of Water and Sanitation (DWS), attempt to improve natural resource management using the economic, social and governance integration components. Practical comments from the Munnik *et al* (2017) project leaders are also presented regarding aspects of undertaking a resource economics study in a complex social-ecological context.

CHAPTER 5 THE NATURE OF NATURAL RESOURCE ECONOMIC VALUATION WITHIN BROADER NATURAL RESOURCE PROJECTS

5.1. INTRODUCTION

This chapter presents the findings of the semi-structured interviews that were held with six key interviewees. Two interviewees were from the WRC, two were from the DWS and there were two project leaders of the WRC K5/ 2230 Report. The findings in this chapter are discussed in relation to the literature presented earlier in this paper. More specifically, the findings are aimed at exploring objective four of this research which is *to establish how national entities carry out natural resource economic valuation of ecosystem services*. The hope of the researcher was to find out the level of awareness that national entities had of natural resource economic valuation shortcomings and how they tackle these in a manner that is in alignment with South Africa's environmental policy and objectives. The purpose of including the WRC K5/ 2230 project leaders, was to uncover, in a general discussion, their experience of conducting the innovative and challenging three-year Carolina project. Finally, other topics emerged as the interviews ensued, since the interviews were open-ended. These emergent topics also form part of the findings as they may provide insights that could be further explored in the future. Section 5.2. presents the emergent themes and sub-themes. This is followed by a presentation of the interview findings in section 5.3. The chapter ends off with a discussion of the findings and their importance to the research goal.

5.2. EMERGENT THEMES

Section 3.5.1.3. in chapter three provides a detailed description of how the themes in this section were developed. Four main themes emerged, coupled with sub-themes.

- i. Conventional versus modern approaches in resource economic valuation studies;
- ii. The relationship between natural resource economic valuation and South African environmental policy and decision-making;
- iii. Conducting a natural resource economic valuation study in Carolina, Mpumalanga;

- iv. From conflict to collaboration of natural resource management through participatory research.

The themes cover key economic and political topics that emerged during the interviews. Key economic discussions that emerged during the discussions included conventional economic valuation, the links between resource economic valuation and policy and decision-making, as well as modern approaches to resource economic valuation. The political and social covered areas such as the inclusion of stakeholders in resource economic valuation, political dynamics between stakeholders in resource economic studies and the selection criteria used by national resource governance institution for selecting economic valuation experts. **Figure 5.1.** shows the themes and sub-themes.

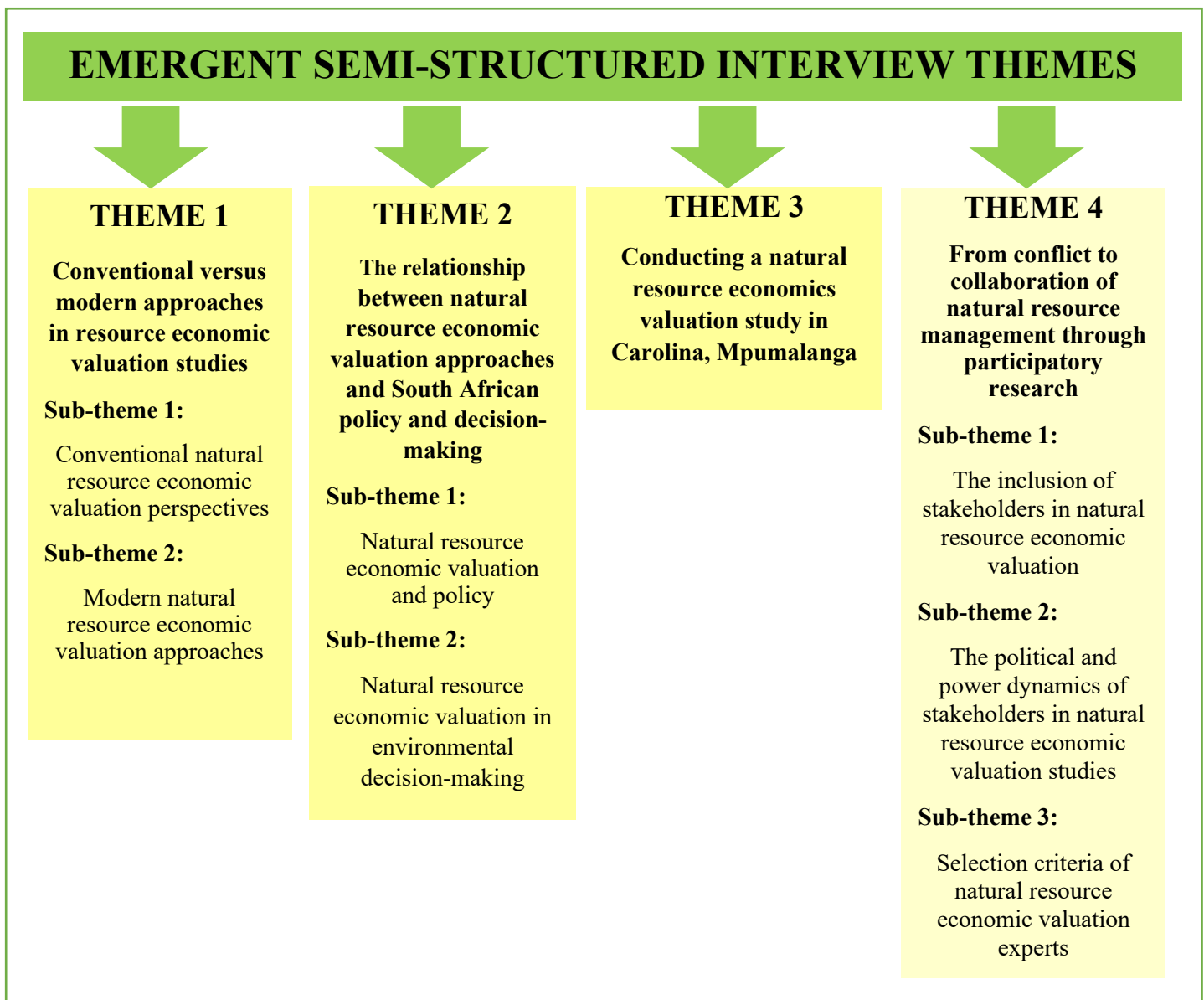


Figure 5. 1. Emergent Themes and Sub-Themes From The Semi-Structured Interviews With The Water Research Commmission, Department of Water And Sanitation and Munnik *et al.* (2018) Project Team Leaders

5.3 INTERVIEW FINDINGS

The findings from the interviews are presented according to the themes and sub-themes in **Figure 5.1**. The research respondent profiles are described in Table 3.2 in section 3.4.2.2., chapter three. As a recap, note that **Respondent 1 and 2 are WRC representatives, Respondents 3 and 4 are DWS Respondents and Respondents 5 and 6 are the WRC K5/2230 project leaders.**

5.3.1 Theme One – Conventional Versus Modern Approaches in Resource Economic Valuations Studies

5.3.1.1. Conventional Resource Economic Valuation Perspectives

Three respondents brought up the concept of ‘placing a price tag on ecosystem services’ (Respondent 1, Respondent 2 and Respondent 3). One WRC respondent said that:

“there is a value that you can place on the environment. You also sometimes cannot put a direct figure on the environment because we are not selling it, but the reality is that it must have a benefit before it can be protected. We look at the benefit to society and business”
(Respondent 2).

This response points to the fact that to be able to show that something is valuable, you must be able to validate its value. The same respondent critiqued traditional valuation methods by saying that the environment is often limited to values based on the benefits society obtains from it. A separate respondent from DWS made a similar point expressing that you often need to evaluate the environment in monetary terms so you can see how much, for example, the socio-economic benefit a water resource is bringing in so it can be partitioned and shared (Respondent 5). A WRC K5/2230 project leader stated that traditional valuation methods are inadequate because many traditional economic valuation methods reside within monetary equivalence of ecological processes and the measurements are often indirect surrogates of monetary value. Even if a resource economic valuation study expresses the price it would require to maintain a wetland, society will

not view that ecological infrastructure the same. Some ecological infrastructure does not have monetary value because it is not exchanged, so society will not have an easy recognition of what they would pay possibly responding with “I’d pay nothing because God gave it to us” (Respondent 5). One respondent gave a very good example of what situations occur when economic valuation is limited to traditional economic methods:

“It’s very hard cause you can say ‘don’t mine this coal because there’s a wetland above it and that wetland is worth R 10 billion in perpetuity, but the coal underneath is only worth R 2 billion’. But the difference is that the R 2 billion can be translated into GDP and into real money. So, you’re almost not comparing like with like. I think that kind of classical approach to economic valuation of nature hasn’t got us very far.” (Respondent 2)

An additional major problem with natural resource economic valuation is the attempts economic practitioners have made to value the future. Economic discounting methods of valuation are based on valuing natural resources now in relation to the future. The theoretical foundations of economic discounting remain a controversial concept for several reasons. Discount rates involve hypothetical models. Discounting into an uncertain future in a world made up of complex social and ecological systems, where there are many real-world factors (e.g. climate change) that could potentially affect nature, is a current concern (Muller, 2013). In this regard, factors determining discount rates according to economic theory and what environmental considerations need to be made are often blurry in terms of value details. Adding to this is the fact that discounting is often myopic meaning that it has often embodied a built-in bias against future generations (Muller, 2013). In an ever-changing world and economy, the need of future generation may be very different from our current perceived understanding of future values. This is not to say that discounting is not valuable but, in the attempt, to continue the expansion of economic valuation into an intergenerational sphere, has emerged more challenges (beyond those mentioned in section 2.2. and section 2.4.).

On the topic of general society’s relationship with the valuation process, most traditional resource economic valuation methods follow the revealed or stated preference techniques which either relies on market values or people’s individual values (i.e. willingness to pay or travel cost valuation

methods). What happens if people have a low willingness to pay for a key ecological infrastructure like a wetland? Will that mean that the wetland will then not be viewed as a priority in terms of natural resources that need to be sustained? Even if the wetland is valued via expert opinion, conventional natural resource economic valuation methods have long struggled to communicate values to stakeholders. The struggle to communicate the importance of values was observed with Houdet's (2017, 2018) report when UKCMF members expressed dissatisfaction with the report. It is because of the challenges such as those mentioned under this theme that natural resource economic valuation experts have begun attempting to use transdisciplinary approaches and why economist like Farber and Constanza (1987) began integrating different disciplines.

5.3.1.2. Modern Resource Economic Valuation Approaches

Regarding newer resource economic valuation approaches, a WRC respondent stated that the currency or the values captured are often human-centered. The newer approaches try to integrate social, economic and environmental factors, which makes it even more important to take a more human-centered approach. Respondent 1 commented on newer economic valuation approaches and stated that there will always be environmental valuation trade-offs and if these values that are traded off are understood more by general citizens, then there is the possibility that all stakeholder groups will care for the environment with a little more sensitivity. Respondent 2 who was also from the WRC supported the stance of human-centered approaches, justifying this by saying that:

“One may not be able to link their value to another person's value. Until there is a conversation and we collectively see the consequences of a damaged wetland for us all, only then we can have a better understanding of how to bring diverse views to commonality”.

In this regard the winners and the losers can work together to make decisions on how there can be lessened impact for the losers. The key factors highlighted by Seymour *et al.* (2011) about the fact that values are not often viewed in the same ranking by groups of people was a central concern

when respondents discussed taking a human-centred approach. This led to respondents suggesting the use of frameworks or guidelines that would guide the facilitation of natural resource economic valuation. Some frameworks that were believed to be shaping modern resource economic approaches were highlighted during the interviews by the different respondent Respondent 5 who has practical experience in leading projects wondered if introducing a systemic-relational ethical approach combined with imaginative economics could shift how natural resource management is undertaken. Respondent 3 from the DWS explained that there is a current Master Plan which is a cabinet driven plan by DWS that has been developed to guide the department in all aspects of water management. These aspects include but are not limited to, water quantity, water source, water resource and groundwater. The Master Plan aligns with the National Development Plan 2030 and the Sustainable Development Goals.

The following theme explores the concept of natural resource economic valuation in relation to South Africa's environmental policy in the attempt to showcase burning issues between the natural resource economic valuation and policy relationship. The theme also covers the relationship that natural resource economic valuation has in relation to decision-making.

5.3.2. Theme Two – The Relationship between Natural Resource Economic Valuation and South African Policy and Decision-Making

5.3.2.1. Resource Economic Valuation and Policy

Respondent 1 from the WRC expressed that at the beginning of his career, environmental impact assessments (EIAs) were in the infancy stage. Much of the EIAs incorporated a certain degree of resource economic valuation. However, Respondent 1 also added that “I never saw any of the EIAs swinging any regulatory decisions”. And from where the respondent sits in the water sector, they believe that they are not seeing enough economic values influencing policy. The same respondent expressed that they do not see policy statements being made about environmental protection that are based on some abstract number (economic values) around the worth of ecosystems. When asked about the link between environmental policy and economic valuation, the second WRC respondent (Respondent 2), said there is a gap between policy and environmental valuation that the WRC is trying to address. The respondent expressed that there is a “trialogue” which consists

of society, policy and the environmental and economic valuation of natural resources that could somehow try to close this gap and make the three nodes work together. Respondent 2 further explained that the research projects they undertake are set in alignment with both people and policy. If policy is not included, research may not be implemented at all. Respondent 4 from the DWS mentioned that policy played a very influential role in natural resource management and that natural resource economics could play a key role in creating better policies. Respondent 3 and 4 communicated that policy is also a source of conflict. Respondent 4 added an example as food for thought around policy-induced conflicts:

“We have this dilemma that you have different departments, and you have your NEMA act and NWA act. If you look at Environmental Affairs, it talks about its environment. Water-related affairs are part of the environment too. Then you have the Mining Acts, they talk to one and the same thing. Imagine a story where somebody applies for a license for mining. It becomes a competence of three departments. You need DWS, you need DEA and DMR. Politics comes into play. They give the person mining rights; they check if there is value added and that it is against us our policies in terms of water resource management. Mining leads to AMD then there is the degradation of the environment. Now where do you strike the balance? Our power industries are giving us light but at a price, e.g., your Kusile Power Station. You find that the political, the social and economic clash in terms of trade-offs, so we try to balance it.”

Respondent 3 from DWS also added to the discussion about policy-induced conflict, pointing out that NEMA (no. 107 of 1998) is the umbrella legislation and therefore all environmental affairs must be guided by NEMA. Even though this is the case, the respondent expressed that there are still power dynamics and imbalances between governmental departments and between government and forums. In this regard, the respondent added that there are *Batho-Pele Principles* of government that are used as a guideline by government and government officials needed to follow the *Batho Pele Principles* (Local Government Action, 2019). The first principle which is ‘consultations’ is where the respondent said policy can become more aligned to people and the environment. If resource economic studies can follow a process that includes consultation

processes, then economic values could potentially mean more to citizens, giving them more authority instead of relying on government or researcher opinions. The need for tightened policy was discussed in chapter two and should natural resource economic valuation studies follow a *discourse-based valuation* method, policy is one of the best options to ensure co-operation by natural resource stakeholders from different levels of authority in society. However, South African politics has never been a linear path and to ensure the co-operation of stakeholders in advantaged positions may require a top-down approach where government makes it a priority to ensure efficient deliberation for the sake of natural resource sustainability.

5.3.2.2. Resource Economic Valuation in Environmental Decision-Making

Regarding the importance of resource economics in environmental decision-making, only one respondent commented directly. The other respondents indicated that resource economic valuation in environmental decision making is important but left no additional comments. Respondent 5 said that:

“I think that resource economic valuation is critical because economic valuation speaks into the prime language of value in society and that's exactly why our current methods are so inadequate, because financial monetary value is our common currency, it is the way everything is seen. That simple translation of ecosystem function into straight monetary values in turn, de-values the ecosystem”.

Respondent five further expressed that they felt that resource economics was an area that they felt needed the most work that would make the values more effective and real. In addition, it was pointed out that fostering co-development with communities and ecological understanding means that there are better chances of probing and surfacing values. By following these steps, resource economists have the potential to connect resource economic valuation studies more closely to environmental decision-making.

The following theme discusses how the Munnik *et al.* (2018) project leaders and team conducted the Carolina natural resource economic valuation study and issues that transpired regarding the project.

5.3.3. Theme Three – Conducting a Natural Resource Economics Study in Carolina, Mpumalanga

This section provides a short-detailed description of the difficulties of conducting a resource economics valuation study on a local level. A discussion took place with the WRC K5/2230 project leaders as this theme is covered using the Carolina resource economics study.

According to the project leaders, the aims of the three-year study were given to them by the WRC. Respondent 5 stated that it was a project where the aims of the project were given to them and thereafter the project team placed the aims into a systemic understanding and started to tackle individual parts of those aims until they ended up with a recognition that the laws were so complex and inaccessible that some kind of social impact would be the most effective route to moving towards a more sustainable landscape. Respondent 6 said that in their understanding the WRC wanted an understanding of the licensing of mining activities to be tighter and more effective and more effectively protect wetlands. What was exceptional about the Munnik *et al.* (2018) study was that both respondents emphasized that civil society helped to drive the investigation rather than the government. Respondent 6 said that:

“we chose to work with the Catchment Management Forum as an inclusive space of civil society, government regulators, farmers, community. It was an open Forum and a transparent one so that made the whole research process transparent”.

The three-year research was not fundamentally based only gathering data and coming up with results. Respondent 5 expressed that:

“our approach was to capacitate civil society to better engage with the regulatory processes leading to mining and water use licenses”.

There were seven aims in the three-year project and aim five was the natural resource economics study. Both respondents were asked to express how they felt about the outcome of the study on a scale of *very bad* to *excellent*. The respondents both said that the outcome of the resource economics study was *between good and very good*. Respondent 5 provided a brief description of issues that were related to aim five of the WRC K5/2230 report:

“The outcome we delivered to them was a process of enabling local stakeholders to act (including the DWS), but it did not deliver a recipe for licensing. That was one of the disjoints and then popped into that was the idea that wetlands are key ecological infrastructure. So, they also wanted to know the economic value of wetlands, so the framing of the project as constructed by the WRC, had 7 aims that were not entirely connected. We put the aims into a systemic picture, and we started to build an understanding of the role of wetlands and in relation to regulation of mining where the idea was that economics could be a lever towards controlling impacts on wetlands.”

Most of this research thesis advocates for making resource economic valuation more appropriate. The WRC K5/2230 project is an example of a project that tried to implement a more participatory and transdisciplinary approach to economic valuation. However, the project faced several constraints and limitations like most projects. The constraints came from within the working team and external factors. Respondent 5 said that they aimed to do a transdisciplinary project, but they really did an inter- and multi-disciplinary project. Interdisciplinary research consists of practitioners working alongside but remaining in their own individual fields (in terms of theory and methods) rather than crossing boundaries the way transdisciplinary research does (Max-Neef, 2015). Respondent 6 emphasized that the art of transcending boundaries of disciplines is often difficult. Respondent 6 reiterated that *“I was working with one consultant’s input, another consultant’s input, a student’s input, another input. In my head using political ecology, some I*

integrated better than others”. As shown in previous chapters, this is often the difficulty that economic studies often face when placed in a framing with other fields such as political ecology. The external factors that affected the Munnik *et al.* (2018) project were mainly because of the intractability of the mining sector which lead to a lack of data access. The project took place around 2015 while the AMD event happened in 2012, this also meant that the long recovery time regarding the ecosystem may have caused some errors in data.

The following section describes how conflict can be turned into collaboration by *discourse-based valuation* when undertaken correctly.

5.3.4. Theme four – From conflict to collaboration of natural resource management through participatory research

5.3.4.1. The Inclusion of Stakeholders In Resource Economic Valuation Studies

Respondents from both the WRC and DWS indicated a need for citizen inclusion during economic valuation studies. It was expressed by Respondent 2, that citizen science provides a bottom-up approach to natural resource management. Respondent 3 of the DWS expressed that stakeholders are often invited to partake in environmental studies from the onset once project goals and ideas have been developed for a study. Respondent 5 who was a WRC K5/2230 project leader expressed that they tried to take an integrated social-ecological approach where they aimed to not only understanding the biophysical attributes but also the social networks in Carolina, therefore, adding value to the project results. One respondent from the WRC described what they believed the inclusion of a stakeholder means when discussing natural resource valuation studies:

“There's this great example of a group of tourists somewhere in India on the coast. They were camping somewhere close to the coast and they wake up early and the sun's just coming up over the sea and they go down onto the beach and sit on the beach to watch the sun come up. One of the locals that comes out onto the beach and he's looking at them a bit strangely and he's acting a bit uncomfortable and eventually he kind of pulls down his pants and poops because that's his toilet. The sea comes up and washes the stuff. So, he's thinking what are these people are doing in my bathroom? And these people are thinking

this is a wonderful place and what on earth is he doing pooping on the beach. So, it's a completely different set of how people value the same thing. How one person's perspective is this is my bathroom while the others are like this is our beautiful view. So, I think we must be quite comfortable with the fact the people are always going to value things differently. Then the question is how we begin to make trade-offs between those different valuations. Then it becomes almost a political question of whose value prevails. Who is the one who gets to say my value is right and everyone else is sub-ordinate to that? I think that's where it goes from being an economic issue to being more of a political or social issue around how we mediate between these sometimes-conflicting valuations."

(Respondent 1)

The above comment underscores that research and communication can help understand this connection better and consequently identify the causes of conflict while generating social learning about how to manage natural resources and reduce conflicts. *Discourse-based valuation* should therefore provide clarity about 'values' and the nature of conflicting valuations. The steps and rules of discourse-based valuation are described by Fedra, Kubat and Maja (2007), Wilson and Howarth (2002) respectively. As described in section 2.7.1., when these rules and procedures are correctly followed there is potential for equal sharing of information about what various stakeholder's value. Moreover, section 4.5.3. described the fact that there are differing value perceptions among stakeholders within the Upper Komati Catchment Management Forum (UKCMF) which in turn resulted in tensions among stakeholders. The UKCMF stakeholders pointed out that they believed that co-operation and inclusion of stakeholders could provide more well conceptualized natural resource economic valuation approaches.

5.3.4.2. The Political And Power Dynamics Of Stakeholders In Resource Economic Valuation

Conflicts over natural resource can occur on a local, regional, societal and global scale. Conflicts over natural resources may have class dimensions, placing those who own the resource against those who own nothing. In addition, power differences between groups in areas of natural resource contestations can be enormous. There are several reasons for these power and political dynamics

between natural resource users which are often overlooked by economic valuation studies. Respondents pointed out the power and political dynamics that exist in natural resource governance participatory processes. Respondent 1 commented on how the weaponization of knowledge can result in power imbalances between stakeholders. The respondent further questioned whether knowledge is more valid because it comes from a western scientific knowledge and whether the indigenous knowledge base of someone else is not valid because it is not published. For example, the issue of weaponization of knowledge was evident in the UKCMF where some of the stakeholder's (including the coal miners and government department representatives) said that national government departments like Department of Mineral Resources, are aware of the challenges mining poses on natural resources but still do not enforce stricter policy regulations. This can be seen in Table 4.7. It was further pointed out by Respondents 1 and 2 from the WRC, that racial and socio-economic dynamics influenced the possibilities of coherent participatory resource economics and management processes. Racial dynamics were not explored in this thesis however the Carolina case study as described by the Munnik *et al.* (2018) described that those impacted most by the poor mining regulation were the township residents of Carolina. Respondent 1 commented that socio-economic dimensions may be about richer stakeholders having access to what poor people don't but there was more to consider on how beneficial but unequal socio-economic dynamics created unequal influence. The respondent provided an example stating that:

"We have this debate around water resource management as well because if you are a well-resourced mining or forestry company and you're fighting for water or fighting to open a mine. You're going to be able to bring in lawyers and all kind of experts who will be able to make your case for you, whereas if you are a poor community, you're not going to be able to do that. And what does that mean about the fairness of which the decisions are made because who is making the case for you when you are a poor community and you don't have your own lawyers and experts to be able to scrutinize the arguments been put forward." (Respondent 1)

Respondent 2 from the WRC commission further indicated that historical racial issues meant that certain races were provided with opportunities to partake in participatory governance way before other granting them the advantage and more authority in participatory spaces. DWS Respondent 3 highlighted the fact that profit meant that the interests of certain profit-producing stakeholders were considered before other poorer stakeholders. The respondent pointed out that economic giants like mining and agriculture had more insight into the natural resources of an area although their activities are the ones that threatened the very same resources. Stakeholders such as mining companies have more economic resources which enables contracting of environmental experts and quality legal advice.

5.3.4.3. Selection Criteria of Resource Economic Experts In Resource Economic Valuation

Considering that it was evident that several conditions feed into delegating a deliberation among stakeholders for participatory resource economic valuation, it was in the interest of this research that an understanding be created on how national entities select their economic experts.

There was evidence that there is a tendency by national entities to outsource resource economists. This was reported by the WRC, DWS and the WRC K5/2230 Project team. Respondent 2 from WRC said that “...there are very few resource economists in the country”. The WRC and DWS pointed out that they select project teams that have access to economic specialists. If the project requires an economist, the project leaders are the ones who scout for a resource economist. Respondent 5 and project leader of the WRC K5/2230 project team said that “there are few not just doing contingent evaluation. So, I would go hunting for an economist”. One concern that then arose to the researcher was how outsourced economists are able to carry out an appropriate and inclusive resource economics study if their understanding of the study area is either lacking or non-existent. Respondent 6 respondent from the K5/2230 project team made it clear that the resource economics study in the three-year project may have lacked the desired results because the resource economists were outsourced on a contractual basis and thereafter moved on. As identified in the current two sub-themes, there are often several underlying political and power dynamics. Respondent 4 from the DWS highlighted that economic valuation is a socio-economic issue because you have “people using the resource to survive but, you also have people who are using

the resource at the same time and contaminating the resource. He further described the importance of understanding a study area and the social aspects because if one wants proper quantification to happen then they must be able to describe their study area setting to be able to really evaluate different potential scenario outcomes in the area too.

5.4. DISCUSSION OF FINDINGS

What was interesting in terms of the data gathered is that the researcher was able to explore objective four with the interview data while gaining additional insights from interviewees about topics related to other objectives in this thesis paper. Some stimulating findings that relate to this research were identified by the researcher. Literature throughout this thesis pointed out the fact that there are many shortcomings attached to resource economic valuation (Constanza *et al.*, 1997; Constanza *et al.*, 2014; Thiel *et al.*, 2015). The results of this study offer some interesting insights into economic factors considered by national resource entities when undertaking resource economic valuation studies. Firstly, the study results show that there appears to be a consensus among people who work in natural resource related spaces which is that that conventional resource economic valuation has its limitations as an environmental evaluation tool. For example, stakeholders in the UKCMF were aware that desktop based economic valuation studies are prone to under- or overvaluing of natural resources by economic practitioner (section 4.5.6.). Secondly, national environmental entities are incorporating a more citizen-based approach when undertaking natural resource valuation studies. Thirdly, these entities are aware of the social and political barriers that can limit efficient citizen-based valuation studies. Finally, to overcome these challenges, the DWS and WRC described that being more critical of the project teams selected to do the environmental assessments is an important requirement for efficient resource economic studies to take place.

A common conversation that ensued with respondents was whether an environmental valuation is an acceptable method when undertaking environmental assessments (EA's). Although resource economic valuation is not without its limitations and critics constantly question the notion of monetizing natural resources (Nunes and van den Bergh, 2001), it was established that resource economics is an important tool in EA's. For example, economic valuation can be a link that translates *value perceptions* to *policy and decision making* in practical contexts like the Cascade

model (van Oudenhoven *et al.*, 2012). Further into discussions, it was evident that the respondents from the interviews felt that *conventional* resource economic valuation methods struggled to communicate the economic values to citizens. Section 2.4 of this research paper highlighted the shortcomings that conventional resource economics faces from an aggregation perspective. However, the respondents mainly pointed out that the problem with the conventional valuation approach was the tendency to often communicate environmental values in monetary terms thinking citizens would respond to prices. Several studies have shown that conventional resource economic valuation approaches often fail to communicate economic values that represent the values held by local communities (Seymour *et al.*, 2011; Prior, 1998; Constanza *et al.*, 2014). These non-monetary values are unit values such as loss of land in hectare as given by Houdet (2017, 2018). However, the way the values were reported by Houdet are not clearly explained in terms of what those values mean and how they came to be about. Had Houdet (2017, 2018) clearly described the how the values were developed and what they meant, then the members of the UKCMF could have possibly accepted the values and guidelines by Houdet more openly.

Even if natural resources are translated to monetary values, the question becomes how those values can be used to constructively influence natural resources management. Economists have tried to implement alternatives to environmental valuation such as multi-criteria analysis (MCA) which mix monetary and non-monetary benefits rather than purely monetary values. An example is Bogaka (2015) who used the MCA approach to analyze the environmental impact that coal production has on the environment and specified that valuation requires a lot of data to be undertaken. The values produced for such studies usually appeal to individuals focused on financials and not community members. There is limited evidence of economic valuation changing the way people perceive natural resources even when the values are presented in a non-monetary way. As a response to the shortfalls of economic valuation, environmental entities have begun to alter the way in which they approach environmental economic valuation studies. Interview respondents pointed out that the WRC now supports the stance of human-centred approaches when undertaking valuation studies. Similarly, Respondents from the DWS revealed that they are in the process of implementing guidelines such as the *Master Plan* which follows a strong citizens inclusion approach into their assessments. These findings align with the discourse-analysis approach which was introduced in section 2.6 which states that natural resource economic values

should not stem from an aggregation of separately measured values (individual preferences) but from free and open public debate (Wilson and Howarth, 2002).

The natural resource economic valuation study in the Munnik *et al.* (2018: 153) may not have produced the most effective resource economics values. However, the mere fact that the project leaders chose to include local stakeholders in the development of the project is the beginning of a more modern approach to environmental studies in South Africa. A study that took a similar approach to the multi-disciplinary approach that the WRC K5/2230 project leaders took place in the Ettrick Valley Floodplain in Scotland. The study by Kenyon and Nevin (2001) describes the Upper Ettrick Habitat Restoration Project, which is one of the largest floodplain restorations that have taken place to date. To restore the floodplain where various habitats were in danger, the project leaders ensured that the project was carried out in partnership with the local community. Final recommendations that contributed to the success of the project were because of a citizen's jury that was set up for the project. The citizen jury was given the opportunity to assess the project site and provide qualitative information on its value and importance to the local community. Similarly, the UKCMF played a role like the Upper Ettrick Valley Floodplain citizens jury. However, a future recommendation for South African local resource economics valuation studies may be to coordinate a similar site visit with the local community where local value perceptions may be further realized. This is not to say that methods such as cost-benefit analysis are completely invalid. It is simply implying that no matter the route an economic study takes, local economic values are important because local knowledge can bring to light what a researcher may not have singularly identified.

Undertaking a discourse-based valuation type study in South Africa where the political climate has passed through volatile eras requires that researchers consider not only the ecological aspects when undertaking an environmental study, but also the social and political aspects. Respondents from the DWS and WRC pointed out that conflict around natural resources does exist among South African national environmental entities. Since each entity focuses on different aspects of natural resources (i.e. vested interests), this can quickly lead to conflicts between entities. The WRC and DWS respondents pointed out that the issues of 'conflicts between stakeholders' are visible even when they conduct study projects in different areas. These conflicts are coupled with political and power barriers that limit equitable natural resource discussions among stakeholders. DWS and

WRC Respondents pointed out that power and political dynamics in Forum and community settings, between stakeholders, are often due to the *weaponization of knowledge, racial and socio-economic dynamics* as well as the focus on *profit gains*. A study by (Nie, 2003) highlighted the similar issue of power and political dynamics that were identified in these findings. Nie (2003) explained that political conflicts are often ‘wicked’ as they go beyond economic or even scientific ways of analysis and methods of problem-solving. The conflicts are often value-based political conflicts which are grounded on competing deep-core human values.

The WRC and DWS Respondents explained how they have attempted to minimize the ‘wicked problems’ that override resource economic valuation such as the difficulties associated with economic data collection, the differing value perceptions by stakeholders within a study and the various vested interests of each stakeholder group. To combat these problems, the DWS and the WRC made clear that many national environmental entities tend to outsource resource economist. On the other hand, one of the WRC K5/2230 project leaders pointed out that there are a limited number of resource economists in the country, therefore, making it difficult to conduct economic valuation projects. However, accessing resource economists is done by selecting a project team that has access to their own resource economist. Thereafter, project teams that undertake projects for the WRC or DWS must showcase an understanding of the study area in their project proposals. In the past, people undertaking environmental projects could simply enter an area and collect data and then go on to focus on the rest of the valuation project isolated from the study area through the use of desktop studies. In today’s modern society, national entities are clearly becoming more and increasingly aware of including local stakeholders. However, although national entities recognise the importance of including different stakeholders in natural resources valuation, there is still a need to improve their capacity in conducting natural resource economic valuations.

The following chapter synthesises the findings from chapter four with these findings and the literature from chapter two to explain how this research was able to explore each of the four objectives to answer the main assumption.

CHAPTER 6 SYNTHESIS

6.1. ANSWERS TO RESEARCH OBJECTIVES

This thesis has tried to critically investigate conventional and more modern resource economic valuation approaches (with a focus on Houdet, 2017) in order to explore whether a citizen-based participatory approach to resource economic valuation can help us better understand how the values that different stakeholders assign to ecosystem-services influence natural resource management. Houdet (2017, 2018) was explored among the discussions within chapter 4 and 5. To support the investigation objectives one, two and three had been developed. The findings of each objective are described below:

6.1.1. Objective 1

Objective 1 of the research was to determine the reasons for natural resource contestations in Carolina. It was discovered via the Upper Komati Catchment Management Forum (UKCMF) that:

- Mining (both current and abandoned) has the highest negative impact on the Carolina catchment conditions. Mining impacts other local economic activities such as agriculture when resources, such as water, which are needed for uses like irrigation, become contaminated.
- Water waste treatment works negatively affect Carolina Catchment conditions, specifically Carolina's water resources. This was not a concern to the Houdet (2017, 2018) resource economics valuation study as the Munnik *et al.* (2018) study was concerned rather with acid mining drainage. It was however a concern among community members and may be a good area to explore in future regarding other economic activities impact water resources within the Carolina catchment.

6.1.2. Objective 2

Objective 2 aimed to discover the values that different stakeholders assign to natural resources in the Carolina area. This research discovered that:

- Different stakeholder value different land-uses according to their individual concerns and interests. After stakeholder groups were asked to rank land-uses from most to least important, it became evident that stakeholders apply different values to land-uses (e.g. wetlands, mining and natural grasslands).
- Findings from the UKCMF highlighted that the differences in value perceptions cause tensions among the stakeholder groups within Carolina.
- The various stakeholders viewed current and future catchment conditions differently. Stakeholder groups varied in their selection of what they thought of the catchment conditions.

6.1.3. Objective 3

Objective 3 was to analyze the complex political and power dynamics at play between diverse stakeholders in Carolina. Findings aligned with objective three showed that:

- Stakeholder take part in participatory natural resource governance forums for various reasons. Some of the UKCMF stakeholders are obliged to attend because of their professional positions. For example, coal mining representatives had stated that it was a requirement of water-use licenses. Other stakeholders such as community members, genuinely hoped to learn more about the Carolina catchment.
- Many stakeholders felt that there are power imbalances within the UKCMF because some stakeholders are more dominant than others. Most of the stakeholders believed that certain stakeholders are dominant, that there are major power imbalances and others felt that there were moderate power imbalances.
- Most of the political and power dominance by certain stakeholders are those who are government representatives (national, regional and local) or those who belong to private institutions such as mining.

6.1.4. Objective 4

Objective 4 was to critically discuss the nature of natural resource economic research with broader natural resource projects. Findings from objective four showed that:

- National entities including the DWS and WRC acknowledge and agree that conventional resource economic valuation studies fail to capture the differences stakeholders have in terms of value perceptions. To overcome this shortcoming, the DWS and WRC are adopting more citizen-based approaches. Hence, the WRC K5/2230 project Carolina where the community was involved from beginning to end.
- Resource economic valuation aims to influence environmental policy and measure the impact of environmental policy. However, it was discovered that there is a gap that has been identified by the WRC and DWS that is between policy, society and environmental values. Each institution has its own set of guidelines aimed at targeting the gap. The problems that exist with the implementation of policy are problematic because the lack of enforcement by mining regulations such as Department of Mineral Resources impact the functioning of natural resource economic valuation and management on a local scale as seen in the UKCMF. This in turn may impact the deliberation processes required for effective discourse-based valuation.
- Well-designed participatory governance approaches have the potential to turn conflict surrounding natural resource economic valuation into collaboration among stakeholders. This can be done by making resource economic valuation studies more inclusive for stakeholders across communities.
- The DWS, WRC and K5/2230 project team leaders pointed out that there are certain common factors they have identified in resource economic valuation studies that take place in participatory governance spaces. These are (1) weaponization of knowledge, (2) racial and socio-economic dynamics and (3) profit driven interests. These factors need to be considered when undertaking a resource economic valuation study.
- Institutions such as the DWS and WRC outsource resource economists due to a lack of resource economists available and because there are no permanent contracts available within such institutions.

Many natural resources economic valuation studies stem from national resource governance institutions who try to promote environmental sustainability. Projects like the WRC K5/2230 project are conducted on a local scale by a team assigned by the national resource institutions. Conventional resource economic valuation studies have been criticized for lacking the ability to provide environmental values that represent the actual complex social- ecological system that a study is focused on. Objective four of the research provided a report which showed that there are major issues with natural resource economic valuation on a national scale too. The findings in this research showed that there are clearly a range of factors that are not acknowledged by the field of resource economics during valuation studies. On a local scale, there are complexities in how local stakeholders perceive values of various natural resources. On a national scale, resource governance institutions deal with issues of conflicts and they are also aware of the difficulties that local scale project teams face during the process of trying to conduct a resource economic valuation study.

The problem with outsourcing resource economists for valuation studies is that the values that are delivered are often uncritically collated and due to time limitations, the values are often aggregated. The DWS and WRC are currently adopting a more citizen-based approach to counter the shortfalls of resource economic valuations studies. Working with citizens has the potential to identify the potential gaps that resource economist may not be aware of during their valuation studies, allowing for more critically developed economic values. Yossie and Herbst (1998) and Harrington and Allan (2008) point out that stakeholders engage in natural resource governance for a range of reasons based on their interests and relationships with natural resources. This can make engagement with stakeholders difficult when undertaking a participatory resource economic valuation study.

Seymour (2011) recommends that researchers take the time to understand different stakeholder value perceptions rather than simply drawing from those with the greatest dominance. The benefit of moving away from purely desktop based and aggregated valuation is that participatory research promotes discussions that make stakeholders aware of their value differences which can potentially decrease tensions arising from differing value perceptions. Sagoff (2011) states that the challenges of this transdisciplinary exercise will not be met by uncritical puzzle solving. As mentioned by Sagoff (2011), there are several conceptual challenges that need to be overcome to redirect environmental policy (and inherently economic valuation) away from uncritical acceptance of

concepts and theories of ecology and economics. Several conceptual challenges were mentioned throughout this thesis and discourse-based valuation methods are one response to more critical ways of valuing the environment. To be critical is to question the application of conventional natural resource economic methods and approaches in a complex social and ecological reality, building more appropriate and sustainable valuation models where they do not exist.

6.2. RECOMMENDATIONS FOR FUTURE RESOURCE ECONOMIC VALUATION STUDIES FROM STUDY PARTICIPANTS

- Members of the UKCMF recommended that resource economic valuation studies that take place in stakeholder participatory settings should ensure that there is the opportunity for all the stakeholders to co-operate equally during research. The members further recommended that all stakeholder concerns will be acknowledged during a study. In order to get more citizen support during resource economic valuation studies, it was recommended that awareness on the importance of resource economic valuation be promoted. The concern of most stakeholders in the UKCMF pointed towards a need for greater engagement of all involved stakeholders regardless of their profession in order for an increased knowledge sharing base among stakeholders which can potentially create improved collaboration by all stakeholders instead of having segmented conflicts (e.g. social movements by community members like those in the Carolina township versus local municipality).
- Research participants from the WRC, DWS and K5/2230 project team emphasized the importance of understanding citizens value perceptions and local natural resource knowledge. This approach can be useful for researchers, especially since many natural resource studies, especially in the coal mining sector, face a limitation of access to company data.

6.3. PERSPECTIVES FOR FUTURE WORK

South Africa has several catchment management agencies which have been established across the country. These catchment management agencies encompass several catchment management forums. This research explored the Upper Komati Catchment Management Forum which is convened by the Inkomati-Usuthu Catchment Management Forum (IUCMA). The research findings led to a wide range of findings about conducting a resource economic valuation approach in a participatory governance setting. The shortcomings that have been identified in this research relating to resource economic valuation, have identified up a range of issues that are not considered in current South African resource economic valuation studies. Moving forward there is a definite need for natural resource economic valuation studies that acknowledge complex social-ecological economic thinking. The findings in this research can guide future research by providing a starting point on issues that economic researchers may need to be aware of when attempting to conduct an economic study in an area with a complex resource contestation nexus.

6.4. PERSONAL REFLECTION AND LESSONS LEARNT

Before working on this thesis, I gained an interest in how it is that I could use my economic background to add value to people in communities like Carolina who have experienced or are experiencing pollution (especially water pollution) as a result of mining activity. Natural resource economic valuation studies have been undertaken in many areas like Carolina, yet people in many of these areas still deal with the same problems long after studies have been conducted. Throughout my undergraduate years, I had learned that resource economic valuation was meant to be a tool that can be used to understand the impacts that activities like mining have on the environment and human welfare. I further learned that economic valuation was meant to be a tool that can be used to guide natural resource decision making process and environmental policy. Since then I have been interested in finding out what approaches could possibly add value to the natural resource economic valuation techniques. I have been fortunate to have supervisors who are just as passionate about using research to achieve social justice. Adding to this fortune was the fact that I was able to discover participatory approaches like the *discourse-based* valuation method. I hope to continue looking into natural resource economic valuation that not only creates values but sparks learning processes and knowledge sharing within communities. Time was the main constraint in

this research; however I aim to continue down the path of discovering more participatory approaches to natural resource economic valuation. Finally, this research has enhanced and grown my research and critical thinking skills through constant reading, writing and communicating with people who share the same passion for environmental justice and human welfare.

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APPENDICES

APPENDIX A – GENERAL DOCUMENTS

A1 INVITATION TO PARTICIPATE IN STUDY



RHODES UNIVERSITY

Grahamstown • 6140 • South Africa

DEPARTMENT OF ECONOMICS

Tel: [+27] 046 603 8301

Fax: [+27] 046 603 7353

E-mail: c.vaneyssen@ru.ac.za

29 October 2018

Rhodes University
P O Box 94
Grahamstown, 6140

Dear [Name]

Re: Invitation to participate in research study

You are invited to participate in a research study entitled ‘The Political Ecological Economics Of Coal Mining And Water Resources: A Participatory Economic Valuation Approach In Carolina, Mpumalanga’. The aim of this research is to determine and explore ways for developing innovative economic approaches to natural resource valuation (focusing on water) in a complex social-ecological context. Your participation and cooperation is important so that the results of the research are accurately portrayed.

The research will be undertaken via questionnaires and semi-structured interviews and the data to be collected from this research will be by means of a qualitative research method. Your identity and that of your institution will be treated with complete confidentiality. The collection of this data will require about 30-45 minutes of your time to complete.

We will provide you with all the necessary information to assist you to understand the study and explain what would be expected of you (the participant). These guidelines would include the risks, benefits, and your rights as a study subject. Furthermore, it is important that you are aware that this study has been approved by a Research Ethics Committee of the university.

Participation in this research is completely voluntary and this letter of invitation does not obligate you to take part in this research study. To participate, you will be required to provide written consent that will include your signature, date and initials to verify that you understand and agree to the conditions. Please note that you have the right to withdraw at any given time during the study without penalty.

Thank you for your time and I hope that you will find our request favourable.

Yours sincerely,

N.N.

Ms Ngobile Nzimande
Research Student

D.F.

Mr David Fryer
Supervisor

A2 INFORMED CONSENT FORM



RHODES UNIVERSITY
INFORMED CONSENT FORM
Department of Economics

Project title:	The price of coal?: The political ecological economics of coal mining and water management in Carolina, South Africa.
Principal Investigator(s):	Ms Nqobile Nzimande

Participation Information

- I understand the purpose of the research study and my involvement in it
- I understand the risks of participating in this research study
- I understand the benefits of participating in this research study
- I understand that I may withdraw from the research study at any stage without any penalty
- I understand that participation in this study is done on a voluntary basis
- I understand that while information gained during the study may be published, I will not be identified and my personal results will remain confidential
- I understand that I will receive no payment for participating in this study

Information Explanation

The above information was explained to me by: Ms Nqobile Nzimande

The above information was explained to me in: ☐English ☐Afrikaans ☐isiXhosa ☐isiZulu
☐Other:

and I understand this language well.

OR, it was comprehensively translated to me by Ms Nqobile Nzimande

Voluntary Consent

I, _____, hereby voluntarily consent to participate in the above-mentioned research.		
Signature:	OR , right hand thumb print	Date: / /
	Witness signature:	

Investigator Declaration	
I, Ms Nqobile Nzimande, declare that I have explained all the participant information to the participant and have truthfully answered all questions ask me by the participant.	
Signature:	Date: / /

Translator Declaration	
I, Ms Nqobile Nzimande, declare that I translated a factually correct version of: <ol style="list-style-type: none"> 1. all the contents of this document 2. all questions posed by the participant 3. all answers given by the investigator 	
In addition, I declare that all information acquired by me regarding this research will be kept confidential.	
Signature	Date: / /

**APPENDIX B – UPPER KOMATI CATCHMENT MANAGEMENT FORUM
INTERVIEW DOCUMENTS**

B1 UPPER KOMATI CATCHMENT MANAGEMENT FORUM QUESTIONNAIRE:

Date: 12 November 2018

Venue: Featherbed Guest House (Carolina)

1. Please describe why you are a member or take part in the Upper Komati Catchment Forum:

2. Please mention what type of stakeholder group you represent (e.g. mine owners, farmers, a community member, environmental organization etc.)?

**Please note that you do not have to name the organization specifically but please feel free to :)*

3. How would you describe the current condition of the Carolina Catchment environment? (Please circle one)

Very poor	Quite poor	Average	Good	Very good
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4. If things continue the same as they currently are (e.g. mining activities), what do you think the catchment condition would be in 50 years?

Very poor	Quite poor	Average	Good	Very good
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5. Please may you identify drivers which drivers you think contribute largely to the catchment condition?

Agriculture	Current Mining	Abandoned Mining	Waste Water Treatment Works
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6. Please may you describe how you have seen or heard of certain economic activities such as coal mining affect other ecosystem services provided by rivers in the area?

7. The forum consists of several stakeholders (e.g. farmers, mine owners, community members)

7.1. Do you believe there is power imbalance or equitable distribution of power amongst stakeholders in the forum?

Certain stakeholders are dominant	Major power imbalances	Moderate power imbalances	Moderately equitable	Completely equitable
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7.2. Given your response to 6.1, please briefly describe which stakeholders may have the greatest influence and why you believe they have this influence (e.g. wealth, employment creation, etc.)

8. What issues of contestation are you aware of in the area surrounding natural capital and ecosystem services (e.g. mining versus agricultural contestations over land use or water pollution)?

9. Please rank how important you believe environmental valuation is in terms of its contribution to environmental decision-making processes:

Very unimportant	Unimportant	Neutral	Important	Very important
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10. Do you think that some tensions are caused by the way different members of the Forum value certain ecosystem services or environmental attributes? (Please briefly explain)

11. In your view, what is the best way to have a valuation system that promotes sustainable and inclusive water governance?

12. Please may you rank these land-use categories (using numbers 1-6) within the Carolina area based on their importance to you?

**1- most important and 6 less important*

Land Use Categories	Ranking (1-6)	Please briefly comment on your reason for your ranking score for each land use
Afforested land		
Wetlands		
Dams		
Mining		
Urban		
Natural Grasslands		

Do you have any comments you would like to include?

Thank you for your time! ☺

**B2 UPPER KOMATI CATCHMENT MANAGEMENT FORUM FINDINGS ACCORDING TO
THEMES AND STAKEHOLDER GROUPS**

	Stakeholder Representation		Carolina natural resource catchment conditions										Carolina NR Contestations	NR Governance Politics		NREV & Governance			
#	Stakeholder Type Q1	Reason for forum attendance Q2	Current condition of catchment Q3	Catchment condition in 50 years Q4	Drivers that significantly influence catchment conditions Q5	Economic activities influencing rivers in the area Q6	Land-use ranking Q12						Issues of contestation in Carolina Q8	Power imbalances among forum members Q7.1	Stakeholders with greatest influence Q7.2	Importance of NREV in environmental decision making Q9	How different value perceptions result in tensions Q10	Best way to value environmental resources Q11	
							Afforested land	Wetlands	Dams	Mining	Urban	Natural Grasslands							
	1 IUCMA & UKCMF	WRM (WQ montoring)	Good	Quite poor	Abandoned mining	High levels of sulphate in water	4	1	1	2	3	3	2	N/A	Certain stakeholders dominant	Dominant stakeholders have more knowledge than others	Neutral	Different value perceptions result in tensions	Co-operation between water users as well as water sectors
	2 IUCMA & UKCMF	WRM & responsible for stakeholder relation and participation & coordinate forums in the 6 sub-catchments	Average	Good	Abandoned mining	AMD is the biggest problem effecting ground and surface water & is harmful for human consumption	6	1	1	1	2	2	3	Agricultural enterprises are not in favour of mining activities	Major Power Imbalances	Mining stakeholders have much influence and water users in agriculture are not well represented	Very unimportant	Each sector believes their role in the economy is important and they want higher stake	IWRM requires equitable decision making by all role players therefore creating balance
	3 IUCMA & UKCMF	In the finance department under revenue management (stakeholders are customers of the IUCMA)	Good	Very poor	Current Mining & abandoned mining	Water quality deteriorate								Abandoned mines affect land use & water quality status negatively	Moderately equitable	Mining stakeholders more influential as they attend meeting the most and there are more mining activities in the area	Very unimportant	N/A	N/A
	4 IUCMA & UKCMF	Regulator	Average	Very poor	Abandoned mining	Poor water quality	3	6	6	6	6	6	6	Water quality issues where one impacts on the use of the other	Moderate Power Imbalances	Mining & agriculture because their activities impact water resources	Very important	No	Co-operation between water users
	5 IUCMA & UKCMF	WRM	Good	Average	Current Mining & WWTW	N/A	3	6	6	6	4	4	5	Pollution from mines	Moderately equitable	None	Very important	No	An integrated approach
	6 IUCMA & UKCMF	IUCMA representative	Average	Quite poor	Abandoned mining & WWTW	Raw sewage from WWTW (Municipality)	4	6	4	4	6	6	4	Agriculture vs mining & mining vs municipality	Major Power Imbalances	Mining is fairly represented	Neutral	There is tension between mining values and environmental values	Awarness about values
	7 IUCMA & UKCMF	WRM	Good	Very good	Current Mining, abandoned mining, agriculture & WWTW	AMD into water sources	4	5	5	5	4	5	5	Pollution from mines & waste water treatment (booster pumps)	Certain stakeholders dominant	Mining has a strong influence because they are regulating the forum meetings & other stakeholders don't attend regularly	Very important	Mining is concerned with profits compared to environmental issues	N/A
	8 Environmentalists	To participate & give inputs that will better the catchment forum	Average	Quite poor	Current Mining	Mining activities have destroyed some of the ecosystem services	3	2	1	1	4	4	4	Mining sector vs agriculture over land use and water pollution	Moderately equitable	The mining sector	Important	Most stakeholders value ecosystems for protection but stakeholders like the municipality don't show or provide support	To have regular forum meetings where critical discussions on the importance of ecosystems take place
	9 Environmentalists	To participate & give inputs that will better the catchment forum	Average	Average	Current Mining	AMD cause pollution and causes human health hazards								N/A	Moderate Power Imbalances	Water licensing stakeholders		N/A	N/A
	10 Environmentalists	Want to understand water quality issues as a local water user	Average	Average	Current Mining	Coal mining affects rivers e.g. Inkomati river	4	4	5	5	6	6	5	Mining vs agriculture contestations from mining pollution		Municipality effect the forum by not coming often		No	Integrative actions
	11 Environmentalists	To learn more about water and sanitation Because they have a project on the environmental issues around the Chief Albert Municipality	Quite poor	Average	Current Mining	Ecosystem effected during rainfall, water from mines go into rivers	4	3	4	4	6	6	6	Water pollution	Certain stakeholders dominant	The farmers	Very important	Yes there is tension because there are many types of people effected	Put everyone together
	12 Environmentalists	Albert Municipality	Average	Quite poor	Abandoned mining	Coal mining has health hazards	1	5	4	4	4	3	6	N/A	Completely equitable	All stakeholders are well presented in the Forum	Very important	No	N/A

13	Community and tourism	Care about the community & want to be part of discussions and coming up solutions	Good	Very poor	Current Mining	Coal mining								Mining destroying land	Moderate Power Imbalances	Some stakeholders make others comply with water management act	Neutral	N/A	N/A
14	Community and tourism	To understand issues that concern mining & water usage	Good	Average	Current Mining	N/A	5	5	4	3	4	5	Issue of water pollution & mining			Researchers doing presentation	Very important	N/A	N/A
15	Community and tourism	To be cooperative	Good	Average	WWTW	Mining affects Carolina	3	2	5	6	6	4	Water pollution	Major Power Imbalances	Certain stakeholders dominant	Municipality has the greatest influence	Neutral	Differences in value perceptions cause tensions	N/A
16	Community and tourism	To get information	Good	Very good		N/A	3	6	6	6	6	6	N/A		IUCMA		Neutral	N/A	N/A
17	Coal mining	To represent coal mining	Good	Quite poor	Current Mining, abandoned mining, agriculture & WWTW	Mining impacts the ability for environment to provide ecoservices e.g. impacting wetlands	6	1	2	3	4	5	Mining is perceived as polluters vs other land uses e.g. farming	Moderately equitable		Equal representation	Important	Claims that farmers oppose mines as pollution not realising that farming has the potential to pollute. Mining employs 10x more people than farming and contribute significantly to economic upliftment	N/A
18	Coal mining	It is a legal requirement. The objective is to understand the state of water, ecosystem and how to protect it	Average	Quite poor	Abandoned mining & WWTW	N/A	4	2	6	3	5	1	Water pollution is main issue. Mining industry is more regulated than agriculture sector. Municipality is main contributor to poor water quality state	Major Power Imbalances		DMR - should take more responsibility for permit authorisation issues regading mining operations and preventing illegal mining	Very important	Not really - members have the same objective to protect water resources	Improve current regulations and commitment from all stakeholders
19	Coal mining	It is a condition in IWULs to take part in CMFs & to be part of a soLution & prevent environmental degradation because of mining and industry	Average	Quite poor	Current Mining, abandoned mining, agriculture & WWTW	N/A	2	1	2	1	2	2	Municipality does not attend or contribute to Forum even they they are one of the biggest problems in the catchment	Certain stakeholders dominant & Major power imbalances		local, provincial government doesn't support the mining economy & make the management of the catchment the responsibility of the mining & agriculture only	Very important	Yes, different needs and agendas	Working together- all industries & government sectors. Transparency & information & decisions
20	Farmers	From ARC. Forum helps to present products developed by the company relating to water, rainfall and subsequently agriculture	Average	Very poor	Current Mining, abandoned mining & WWTW	Coal mining reduces quality of ecosystem services	6	5	1	2	3	4	N/A		Certain stakeholders dominant	The members of the DWS and IUCMA because they organise the sessions & control the outups of the meetings	Very important	Yes, some stakeholders do not realise the importance of the ecosystem services provided by the river & other water sources. Economic benefits are paced above the environment	The best way is to involve all stakeholders in the development of these processes so that to understand & co-operation can be achieved to practice the sustainability & governance aimed for
21	Farmers	Facilitated setting it up and want to see it being successful	Average	Good	Current Mining, abandoned mining & WWTW	Coal mining	6	6	6	6	6	6	Contestations involving all stakeholder groups	Major Power Imbalances		Old mines & municipality	Unimportant	Yes	N/A
22	Municipality	It is the municipalities duty to ensure that the community drink clean potable water	Average	Quite poor	Current Mining & WWTW	Activities like coal mining contribute to the killing of aquatic plants and animals							N/A	Moderate Power Imbalances		N/A	Very unimportant	N/A	N/A
23	Municipality	Environmental health officer	Average	Very poor	Current Mining	Economic activities lead to a decrease in ecosystem services & water borne illnesses emanating from mining activities	5	3	2	2	3	3	None	Moderately equitable		N/A	Very important	No tensions noted within the Forum	Awariness should form a major role in terms of capacity building to community & sectors

24	Partners	Successful	Average	Is good	WWTW	Coal mining	D1	D1	D1	D1	D1	Other stakeholder groups	Imbalances	Municipality	Unimportant	Yes	N/A
22	Municipality	It is the municipalities duty to ensure that the community drink clean potable water	Average	Quite poor	Current Mining & WWTW	Activities like coal mining contribute to the killing of aquatic plants and animals						N/A	Moderate Power Imbalances	N/A	Very unimportant	N/A	N/A
23	Municipality	Environmental health officer	Average	Very poor	Current Mining	Economic activities lead to a decrease in ecosystem services & water borne illnesses emanating from mining activities	5	3	2	2	3	3 None	Moderately equitable	N/A	Very important	No tensions noted within the Forum	Awariness should form a major role in terms of capacity building to community & sectors
24	Government dept	Represent the DWS-Usuthu river, Nootgedacht, Vygeboom, Boesmanspruit, Vaa Water and Gladespruit, Vygeboom & Komati river Work at the DAFF & responsible for water for the farmers	Average	Quite poor	Abandoned mining	Agricultural activities & mining activities			6			Mining is the main influential component	Completely equitable		Important	lack of availability of the municipality, DMR and other community parties	Moving from fossils to green
25	Government dept	ARC focusing on soil, climate and water	Average	Very poor	Current Mining & abandoned mining	Mining affects farming and farmers have concerns		1	2			Government must oppose mining license applications	Moderately equitable		Very unimportant	Unfortunately	Better public participation
26	Researchers	Regulator or responsibility in CMF	Good	Average	Current Mining, abandoned mining, agriculture & WWTW	Coal mining degrades water resources	6	1	3	4	5	N/A		N/A	Very important	N/A	N/A
27	Regulators	Regulator or responsibility in CMF	Good	Average	Current Mining, abandoned mining, agriculture & WWTW	Coal mining degrades water resources	6	1	3	4	5	Mining vs agriculture. Farmers always complain that mining destroys water resources	Moderately equitable	Mining drives the economy of the region	Very important	Members value environmental attribute different & sometimes all to protect & not allow any trade-offs	Strike balance by making sure trade-offs are made

APPENDIX C – WATER RESEARCH COMMISSION INTERVIEW (WRC) DOCUMENTS

C1 WATER RESEARCH COMMISSION INTERVIEW

1. Please describe your role (job) at the WRC?
2. What purpose does environmental valuation play in your institution?
3. From my understanding, environmental economic valuation and environmentally linked policies and legislations have an important inter feeding relationship.
 - 3.1. From your understanding, please may you briefly describe the relationship between environmental valuation and legislation/ policy implementation or development?
4. There is recognition in South Africa of the importance of integrating environmental, social and economic considerations within environmental assessments and at higher levels of decision-making, but existing legislation does not stipulate how this integration should occur (Crookes & de Wit, 2002: 130).
 - 4.1. What processes do you think influence the success of efficient environmental valuation?
5. What factors or limitations do you think cause under or over representation of certain stakeholder groups in environmental valuation processes?
6. Who are the experts involved in the development and application of expert valuation within your organization?
7. What criteria are these experts selected according to?

8. Expert valuation: a process used to determine how much stakeholders value ecosystem aspects, places experts as intermediaries for public-preference input into the environmental policy process. While the rise and refinement of expert valuation might capture ecosystem values more comprehensively, some questions I would like to ask are:

8.1. How does your organization ensure that expert valuation is inclusive of democratic expression amongst different stakeholder groups in a study?

8.2. People may value ecosystem services differently and in the environmental valuation process there are challenges in incorporating these differences. Do you believe there is a way to overcome this challenge?

9. Brief discussion on the WRC K5/ 2230 (2017) report:

9.1. What was the purpose of this project?

9.2. What was your organization hoping to fulfil through this study?

Do you believe the study fulfilled its purpose?

C2 WRC TRANSCRIBED INTERVIEW DATA

RESPONDENT 1 WATER RESESRCH COMMISSION

1. Please describe your role (job) at the WRC?

Respondent 1: I'm one of the research managers. WRC has about 12 of us and we divide up the work that WRC funds on RND into different portfolios. Each research manager has their own portfolio. My one is focusing on water governance. I deal a lot more with the kind of institutional issues around governance.

2. What purpose does environmental (economic) valuation play in research funded by WRC?

Respondent 1: By economic valuation you are talking about putting an economic value on goods and services. I'm a little bit of a skeptic about economic valuation. Before joining WRC, I spent 13 years at SANBI - professional biodiversity institute. And I worked a lot at the science policy interface around biodiversity, ecosystem services. And I don't think putting a price tag on an ecosystem or a service makes that much of a difference in development decision making because it's not a real value. It's not something that someone can get rich from, it's not something that someone can turn into cash very readily. So, it ends up being a very abstract number, so like the way you summed it up is people saying so what should we do with this thing (values). For decision makers, it's very hard cause you can say 'don't mine this coal because there's a wetland above it and that wetland is worth R 10 billion in perpetuity, but the coal underneath is only worth R 2 billion'. But the difference is that the R 2 billion can be translated into GDP, into real money. So, you're almost not comparing like with like. I think that kind of classical approach to economic valuation of nature hasn't got us very far. But having said that, I do think there is still a role for economic valuation, but not in that sense of putting a price tag on an ecosystem. Where I think we're getting much more traction now is about saying, we acknowledge that this wetland is valuable because it provides us with x, y and z. And too keep this wetland in a good healthy state to do that, it's going to cost us this much. So it is not some theoretical price tag, it's that if we need to maintain this wetland, we might need a bit of restoration and we could put a price tag on that, that it's going to cost us so many million to do these rehabilitation activities. So, there's still a kind of value that's been attached but it's a real value around what will it take to keep this system providing us with these services. We can then use those kind of things to translate that value into

things like water use charges that users pay and that can be re-invested in the maintenance and that's a real charge so you know it's going to cost R 2 million to keep this wetland healthy. We can then convert that R2 million into a water use charge that people will pay, not on some abstract/notional value but on a very real value. Just like you would do on a dam where you know that every year we've got to invest in maintenance, this is how much it's going to cost, that cost would be spread among the users, we can do that in the same way. I suppose it depends on how you bring in the concept of value. The UN secretary general appointed the UN high-level panel to look at valuing water. They came up with that we can't look at one dimension, there are so many other dimensions of value that transcend the economic. I feel like that is a whole lot more embracing instead of trying to distill it down. People (like Victor) always give us a hard about how we are commodifying water, when we try and do just that one dimensional sense of economic value. I think we have a long road to walk still but experience is suggesting that these price tags have not been hugely useful.

3. From my understanding, environmental economic valuation and environmentally linked policies and legislation have an important relationship.

Please may you describe the relationship between environmental valuation and policy development or implementation?

Respondent 1: In a previous life, I was at the Department of Environmental Affairs and this is at a time when EIA's were in the infancy. A lot of what went into EIA's was this kind of economic valuation, so people would do these kind of economic studies to say this the development proposal, this is the impact it's going to have, now you've got to weigh up and you do the cost/ benefit. I never saw any of those swinging regulatory decisions. But I have not been involved in that space for well over ten years now, so I'm not sure if that has changed. From where I sit now in the water sector, I'm not seeing any of that economic valuation stuff really influencing policy. What we have done now is that we have started to speak about the concept of ecological infrastructure, so we're packaging ecosystems as a form of infrastructure in order to get across that you've got to invest in those ecosystems just the way you would invest in maintaining your pipes so that they don't leak or maintaining your dams so that it doesn't collapse. To try get that message across to the engineers, we've adopted something called unit reference values which is what engineers use to compare between different development options. So, it basically works out what will be the

value of the water over the lifespan of this infrastructure and work it down to kind of rand per cubic meter. You can do the same for ecosystems. Whether that would be considered environmental valuation, I'm not sure. So, if you're looking more in the kind of classic sense, I think that it's kind of rendered itself almost irrelevant to policy to tell you the truth. I don't see policy statements been made about environmental protection that are based on some abstract number around the worth of these ecosystems. I think as a country in transition, with a strong developmental agenda, those are not the arguments that swing decisions because it's not real money, it doesn't translate to rand. I don't think environmental valuation is having a big impact on legislation or policy development or implementation for that matter. I think we've got a little more sophisticated since then and I explained some of the things that we've done to try and make it more relevant. But in that kind of classical sense, I can't think of any examples because at the end of it, it's about who does that value accrue to and can that value be translated into hard cash.

4. There is recognition in South Africa of the importance of integrating environmental, social and economic considerations within environmental assessments and at higher levels of decision-making, but existing legislation does not stipulate how this integration should occur (Crookes & de Wit: 130).

What processes do you think influence the success of efficient environmental valuation?

Respondent 1: Have you come across the work that is been done for the various water firms that are been set up, the nature conservancy and the work they are doing? This is this nature-based solutions stuff. Nature based solutions is kind of a global term that is emerging. We call it ecological infrastructure and it's basically the same. What the nature-based conservancy is doing is that they are looking at setting up these water funds. There's economic valuation work been done, especially for Cape Town because there is such receptiveness there now. They made an argument that you've got all these invasive plants that are sucking up so much water, if those plants were cleared, there'd be more water available, so it's a different option. So the kind of economic valuation work been done there to try integrate these different things was to say if you do this thing, if you clear all those aliens in that catchment, it's likely to result in this many more cubic meters of water in that dam available for human use. So that's the benefit. You can put a value on what that water will be worth because you know how much it gets sold for; how much we pay for the water. So that has a benefit of value and then in terms of cost, you know how much it's going

to cost you to clear that water, so that's the kind of environmental. But the outcomes and benefits are very specifically human benefits. You are not really worried about what the biodiversity is going to do when the aliens are cut down and how are we going to measure that. You're thinking about the benefit to people in terms of how many cubic meters of water are going to end up in that dam. So, your kind of proxy or currency is a human centered one rather than an environmental centered one. The environment is just a means to an end. I think those are the things that are proving far more successful in integrating these thing and it's not uncontroversial because you do get accused then about turning nature into a service provider and just looking at it in terms of what commodity does it provide and how much of those commodities are worth to us. Those seem to be things that are swaying people at the moment.

When talking about social, economic and environment factors, it's about taking far more of a people centered approach. And working out in the case of say, hydrologic, how many cubic meters of water is this going to translate too, and then environmental factors are kind of there in the background, but they are not the main point. And of course, the social benefits are very easy to measure because you know that water has a value and you could put a cost to that, and it has all these developmental and health benefits and that kind of thing. I think if we start to measure the wrong things, that's where again it goes back into the realm of the abstract. If we able to measure the right things, even if they're just a proxy or a surrogate, because you're not measuring, you're change in species composition. You're measuring the water in the dam and the measure of water in a dam is almost a proxy for what happens in that ecosystem, the improvement in its health when you take out the aliens.

5. What factors or limitations do you think cause under or over representation of certain stakeholder groups in environmental valuation processes?

Respondent 1: I think some of the work that we are doing now around the politics of knowledge kind of gets us into a decolonial debate around whose knowledge is valid. Is my knowledge valid because it comes from a Western scientific paradigm? Whereas, some else's knowledge which might come from an indigenous knowledge base is not valid because it is not published, and it is not legitimate. Where the kind of prevailing knowledge system does not see it as valid. It's almost what people talk about as the weaponization of knowledge, where who has that knowledge and who doesn't and how does it get used. I think our history in this country, it's easy to see the way

that stuff stacks up. There are people who have historically had access to their educational abilities to help to generate and use that knowledge and then there are people that have been kept on the outside. I think it has socio-economic dimensions. So often richer people, richer communities have access to that, whereas the poor don't, that has racial dimensions to it as well, it has gender dimensions to it. In mining for example, the poor communities who stand to lose out, do not have access to the kind of knowledge and expertise that the mining company would, which makes it very difficult for them to engage on an equal footing. There's that kind of politics of knowledge and how it's withheld and how it's used as a weapon. But it's also the broader question about who has power and agency in society. We have this debate around water resource management as well because if you are a well-resourced mining or forestry company and you're fighting for water or fighting to open a mine. You're going to be able to bring in lawyers and all kind of experts who will be able to make your case for you, whereas if you are a poor community, you're not going to be able to do that. And what does that mean about the fairness of which the decisions are made because who is making the case for you when you are a poor community and you don't have your own lawyers and experts to be able to scrutinize the arguments been put forward. I think typically what you see are the groups that have representation in these processes are the ones who have a voice, agency, access to resources. They are the ones who are making themselves heard and typically it tends to be the wealthier and then you can link the racial, the way race and socio-economic are intertwined in this country. Maybe there's a rural urban bias to that as well.

6. Who are the economic experts involved in the development and application of expert valuation in research projects funded by the WRC?

Respondent 1: We're a funding agency so we don't necessarily have our own scientists or economists, so we fund that work as it happens. Those who are funded will bring economists into their teams if they need them. I suppose what is relevant is to look now at the composition of the research managers and actually we don't have anyone with research expertise. I think it's a problem in the WRC that we don't prioritize economic expertise in the skillsets that we need amongst our research managers. I think it's not been given enough priority as a skill set that we need to have in house. The missing link is when those teams are submitting economic proposals to us, how do we know which is the good proposal and which isn't? How do we work out what's good economics and bad economics if we don't have some baseline level of economic competence in our ranks?

7. Are you and the relevant reference group critical of the theory used in research projects funded by the WRC? Secondly, what criteria do you or the relevant reference group look for when ecosystem services are valued?

Respondent 1: If we look at it from the project side. What would be taken into account if we were reviewing project proposals by economist, the criteria we would look at would be things like their track record, are they active, have they published in this stuff, do they have a profile in their community of practice amongst their peers. We would look at the amount of experience that they have, and we would also look at some of the equity issues, so we would look at things like race and gender. As a government agency, part of our job is to contribute to transformation. It's not just the skills set, it's also looking at the demographics and the importance of building capacity. So what we're seeing as a problem is that we have these old guys and there's not one waiting to fill their jobs in terms of succession.

8. Expert-valuation: a process used to determine how much stakeholders value ecosystem aspects which places experts as intermediaries for public-preference input into the environmental policy process. While the rise and refinement of expert valuation may might not capture ecosystem values more comprehensively, some questions I would like to ask are:

8.1. How do you and the relevant reference group ensure that expert valuation is inclusive of democratic expression amongst different stakeholder groups in the country?

Respondent 1: From the perspective of projects, we fund like WRC K5/2230. What we would do then is to get a proposal in, and the proposal is to do some kind of valuation and they propose a methodology. Part of the review of that proposal is subjecting that to peer review. We would ask the expert reviewers to scrutinize every aspect of the proposal to make sure that it's sound in terms of whatever the norms are for that discipline and we would hope that in that review process, that they would flag if there is some kind of flaw methodologically that some groups are having less voice than others or are less able to contribute more than others. That's in theory but it's also about who you ask to review a proposal. If you have a proposal submitted by a middle-aged white male economist and they don't necessarily think about all the dimensions that they should be thinking about because they come from a particular world view. But if we give that proposal to a bunch of other middle-aged white male economists to review, they might have the same blind spots. The other thing that we do is we put a reference group together. The reference group is another

mechanism for subjecting the work of that expert to some form of ongoing peer review. So, there's no guarantees, every review process is going to have its imperfections and its blind spots just depending on who's in the room. But it does provide us with some level of comfort that this work is being scrutinized by the peers of the expert. We will not publish a project until those comments have been satisfactorily addressed.

8.2. People may value ecosystem services differently and in the environmental valuation process there are challenges in incorporating these differences. Do you believe there is a way to overcome this challenge?

Respondent 1: Read the UN high-level panel document on valuing water. It summarizes this thing so nicely. It says that not everybody is going to value something the same. There's this great example about a group of tourists somewhere in India on the coast. They were camping somewhere close to the coast and they wake up early and the suns just coming up over the sea and they go down onto the beach and sit on the beach to watch the sun come up. One of the locals that comes out onto the beach and he's looking at them a bit strangely and he's acting a bit uncomfortable and eventually he kind of pulls down his pants and poops because that's his toilet. The sea comes up and washes the stuff. So, he's thinking what are these people are doing in my bathroom? And these people are thinking this is a wonderful place and what on earth is he doing pooping on the beach. So, it's a completely different set of how people value the same thing. How one person's perspective is this is my bathroom while the others are like this is our beautiful view. So, I think we must be quite comfortable with the fact the people are always going to value things differently. Then the question is how we begin to make trade-offs between those different valuations. Then it becomes almost a political question of whose value prevails. Who is the one who gets to say my value is right and everyone else is sub-ordinate to that? I think that's where it goes from being an economic issue to being more of a political or social issue around how we mediate between these sometimes-conflicting valuations. It's not that everyone is attaching an economic value. Some people might be very culturally or spiritually attached. You'll have one person saying it's worth money, the other person saying I have a great spiritual attachment to this place and you can't even put those into the same currency to be able to compare them so that's where you have to start trading off, not just competing economic valuations but completely different dimensions of what actually constitutes value. In this country we attach different values to different things, there's

cultural, recreational and economic values attached to things. The dimensions are so varied. But what values do is they allow us to start conversations with each other. To say this is what's important to me. This is how I value this, and this is why it's important. What we then do with that is tricky because we have to make a decision at the end of it. So, there's trading off that needs to be done and with understanding values it can be done with more sensitivity. Then we can see that there will be winners and losers, so we can make decision based on how we can least impact the losers and compensate. Rather than a whole group of people just remaining invisible.

9. Brief discussion on the WRC K5/ 2230 (2017) report

9.1. What was the purpose of this project?

Respondent 1: There was a piece of work done by SANBI as I wasn't at the WRC when this was done. SANBI looked at how it can strengthen decision making by giving better information to the mine and the regulators around what wetlands are there as this whole thing was centered around wetlands. The original prosecution that happened that led to the fine was around a wetland been destroyed. And which wetlands are more important than others from the services that they are providing. I think the role of the study that was done, led by Rhodes, was to look at some of the social dimensions around decision making in coal mining. How decision making happens in relation to authorization of mining. Looking at the processes for involvement of communities or local government or conservation organization in the decision-making process that would lead to issuing of a mining license or water use license for a mine. It was looking at civil society organization around those types of issues. So, part of this was to capacitate civil society to better engage with the regulatory processes leading to mining and water use licenses. I remember lots of fights in the reference group.

9.2. What was your organization hoping to fulfill through this study?

Respondent 1: The court case set the parameters for what the study aimed to fulfill.

9.3. Do you think the study fulfilled its purpose?

Respondent 1: Purpose is understood as aims in this discussion. You can tell if it fulfilled its purpose by knowing if anyone ever read the guideline after or has it been used in decision making or did it just sit on the shelf. In terms of the bigger purpose to influence decision making, it's really

difficult to say because I don't know if anyone ever used these products. Some of the recommendations and conclusions didn't seem to be supported by the data.

9.4. What sort of limitations did the study encounter?

Blank

Additional Comments

UN High-Level Panel

Nature based solution

RESPONDENT 2 (WATER RESEARCH COMMISSION)

1. Please describe your role (job) at the WRC?

Respondent 2: I'm a research manager at the Water Research Commission, focused on the environmental protection of aquatic eco-systems. I've been there for about 9 years now. As a research manager, our jobs is to look at the research areas, prioritize what needs to be done in consultation with others who see the future along the NDP 2030 or SDG 2030 or Africa Agenda 2060. We align the research with the needs of the country and the world. The idea is to be ahead of events, for example we must be able to say that a drought is coming and this is what it will be like. So we must be ahead and come up with early warnings. We fund research in various forms in this socio-economic complex kind of thinking. Tally is one of the senior experts in this field in the country who together with Charles Bruin came up with this idea that society and ecology and business cannot be treated separately and we had just funded her a R 5 million project to work on Integrated Water Resource Management (IWRM). We also funded her with Victor Munnik on the project to do with mining and communities in the country. So we are very pleased to be moving into this field rather than treating one problem, one solution, there is nothing like that, things are very complicated and integrated. So you need that integrated approach to deal with the complexity.

2. What purpose does environmental valuation play in research funded by the WRC?

Respondent 2: I think it's the same thing as ecosystem value. What is the value of this ecosystem and the value to who? Again it goes back to that complexity. It can be valuable to a valuable to a conservation authority who wants to just look at the biodiversity and say wonderful. To a guy who is just sitting next to that wetland with that biodiversity, it doesn't matter if he is hungry. What is the value of that wetland to that person? Sometimes we cannot put a direct figure because we are not selling the environment but the reality is that it must have a benefit before they can protect it. So this is how we do the valuation of the ecosystem or environment, we look at the benefit to the society, to the environment itself and to business. So, it's quite broad. Yes we are starting to fund research in that base, we talk of environmental accounting, water accounting, ecosystem accounting because there is a value you can attach to the environment, but it is not the price tag .

3. Environmental economic valuation and environmentally linked policies and legislation have an important relationship.

From research your knowledge, and from funded by the WRC, your, please may you briefly describe the relationship between environmental valuation and legislation/ policy implementation?

Respondent 2: The research is very much in a triangle, there is a research community of practice. There is society and there is policy and if you look at the way we are trying to approach it, we are trying to address a gap that is often existing between understanding of these three points in the triangle. So we try to close that gap in the dialogue, while making these guys work together. If we take a research idea, we then bounce it with the policy people and say in terms of your act and your regulations, what do you think of this. So we start from there to conceptualize the idea in a workshop for example. Then from there the researcher can produce a proper proposal and submit it. It feeds straight to the client's needs and policy. Otherwise if you do that without the policy, it may not be implemented at all because its problem may not be talking to them at all so its gap is unintentional but it often is there because we don't talk. So the best thing when we start a research idea, we include the potential beneficiaries.

4. There is recognition in South Africa of the importance of integrating environmental, social and economic considerations within environmental assessments and at higher levels of decision-making, but existing legislation does not stipulate how this integration should occur (Crookes & de Wit, 2002: 130).

What processes do you think influence the success of efficient environmental valuation?

Respondent 2: If we did not talk to the implementors, we probably do not know what they want other than the perception. And it's the taxpayers' money, and a waste of the resource if that is the case. So we try by all means to make sure we talk to the policy. We do the research with the end in mind, when we start, we have the end product in mind. We do this because it makes the product very valuable and we also want to make that impact that is measurable with our funding.

5. What factors or limitations do you think cause under or over representation of certain stakeholder groups in environmental valuation processes?

Respondent 2: In the earlier days when we were talking about nature conservation, it was like a white man's things. That people who participate in tourism are whites, they go and visit those place, and the blacks don't go there. It was like a something for certain other people, not other people. Now we are trying to say that those stakeholders who have in the periphery must come to the center. If we talk about tourism for example, who benefits from tourism? You can never leave the lady and the little boy sitting next to that wetland, not watching those birds, not benefiting and that is for somebody who must travel from Pretoria to see. They will never protect it. So we want to bring everybody, those who were voiceless must have a voice, hence our research is also focused on establishing small-medium enterprise so that they can get into the business and see tourism as valuable and therefore see the value attached to the ecosystem in that way. Indirectly we'll be protecting those birds and frogs and everything else that you are interested in but now we are showing and proving evidence of a value to the people who have been in the periphery.

6. Who are the experts involved in the development and application of expert valuation in research projects funded by the WRC?

Respondent 2: This is a relatively new field, the people who have been funded for years have been very much focusing on the processes. How many frogs are in that wetland, what are they doing or biology? The people who are in the resource economics are very few in this country, we are so excited when we can see young people growing into this field. We call them innovation disruptors, so we welcome you to disrupt this very stable and conservative community of science that just focuses on one side of things. We want to break the silos and go across anthropologists, politicians, ecologists and everybody. So this is what we hope will help the country, that

complexities. So there are very few of them and very busy and we are not happy to fund one person again and again. So we want the new people to come into this space. So through workshops and dialogs, we try to create that interest and say to the social scientists that we as Water Research Commision are here to support you working with ecologists. So in the last 5 years and looking forward, we want that complexity, that multidisciplinary in our projects. We hardly fund a project where you want to count how many frogs are in a wetland. You hardly get that because we want you to tell us the benefit beyond just frogs in the wetland.

7. What criteria are these experts selected according to?

Respondent 2: To an extent, we have covered in this question in the previous discussions. But, once more, being as few as they are, we try to make sure they talk to the other guys in the country and through workshops we establish a research agenda. Short-term, medium-term and long-term so that when they go back to their universities and students, they can have something to think about. We would like to see this group growing very fast.

8. Expert valuation: a process used to determine how much stakeholders value ecosystem aspects and it places experts as intermediaries for public-preference input into the environmental policy process. While the rise of expert valuation might capture ecosystem values more comprehensively, some questions I would like to ask are:

8.1. How do you/reference group ensure that expert valuation is inclusive of democratic expression among different stakeholder groups in a study?

Respondent 2: We try to make sure that if you are sitting in a catchment, you have got the voiceless and people who have a bigger voice. It's for us who are trying to address this imbalance, to make sure that there is a representation. For example, where we talk of citizen science, we pull exactly the citizens from the ground, the farmers, the people who are sitting in that catchment to take the lead and say please monitor this aspect, this pollutant or this variable in this system for this reason and this reason. Like this is what will happen if you don't monitor the catchment, so there must be consequences and impact. We have a community of practice in KZN and Limpopo. Those guys started with highly disturbed systems in terms of raw sewage flowing into the system including Umngeni Dam. They started with a certain number and that number is less than half now because they look at the sewers and trace the problems and talk to the communities. Now those

sewers are closed and are running normally. This is what happens when the citizens collectively own the challenge and collectively look for a solution . These guys are not paid a cent other than airtime, just to say please report when you see a problem. And they have been doing this now for more than 5 years. We now want to spread that across the country and make sure that this citizen science spreads in this country. It's the bottom up approach towards the same water resource management story. Now we are saying citizens, take it over because the departments are just mandated, they are the trustees, at the end of the day, you are the ones who are affected immediately when the things are wrong. So in a reference group, it is very difficult to bring people who don't have a background training in that particular subject. When it is a dialogue, when it is a conference, when it is a workshop, then we bring them in board and we make them talk.

8.2. People may value ecosystem services differently and in the environmental valuation process there are challenges in incorporating these differences. Do you believe there is a way to overcome this challenge?

Respondent 2: If the poor guy in a catchment is using soil from the wetland to make bricks, that is a value to him. The other guy who goes there and rehabilitates that wetland is doing it for another value. If we don't understand and talk to each other then our values will criss-cross. The same area may have people there to try fix the wetland and put up a fence and then maybe stop someone else from making their bricks. This will cause conflict and the one needing bricks will cut a hole through the fence and continue making bricks for the foundation of my house, because one may not be able to link their value to another's value until there is a conversation and collectively see the consequences of damaged wetland for us all then we can have a better understanding of how to bring the diverse views to commonality .

9. Brief discussion on the WRC K5/ 2235 (2017) report:

9.1. What was the purpose of this project?

9.2. What was your organization hoping to fulfil through this study?

9.3. Do you think the study fulfilled its purpose?

9.4. What sort of problems or limitations did the study encounter?

Respondent 2: WRC funded the project which was led by me directly from Water Research Commission. Initially, it was because of the farmers (bottom-up) in the mined Mpumalanga who took the mine developer mentioned in the report to court and won the case. The miners were charged and part of that money was given to WRC to fund the research under the protection of wetlands and the balance was sent to other institutes to deal with other aspects. WRC funded SANBI to come up with the mapping of the wetlands because some of the wetlands were not identified but they were there. SANBI then came up with the improvement of the accuracy of where the wetlands were. The next step was how can we make sure that when you receive a license as the department, how do you authorize that license without damaging the wetland. Now you know where the wetlands are and you know where the developer wants to go. Now you can come up with the licensing, hence multi-sectoral, they had to talk between themselves - Department of Water and Sanitation (DWS), Department of Environmental Affairs (DEA) and mining. This project did a very good job but we just have to take it further and it is been printed now. And make enough noise around it because we are talking on behalf of those who cannot talk. I am very proud of this as we achieved all the objectives we wanted to do, and even more complicated stuff came up here that we do not manage wetlands from the surface. Wetlands depend on the hydrological flows, there's something called hydrogeology in this report which says this is how water flows in the catchment. So if you are going to mine here and the wetland is downstream, you must be careful how delineate and protect that wetland, as you may think you are protecting the wetland only to realize that you have cut water flow.

Additional comments:

Respondent 2: My challenge to the project leaders is that they need to take this report and run some workshops particularly with these communities and every other one involved in mining. We can take it to Xolobeni in Bizana because there is titanium mining story there and I'm very happy now that the courts have said the communities can stop mining activities in their area so this report is very important to take it and make noise around. This is empowering the disempowered. I love this report.

APPENDIX D – DEPARTMENT OF WATER AND SANITATION (DWS) DOCUMENTS

D1 DEPARTMENT OF WATER AND SANITATION RESEARCH INTERVIEW

1. Please describe your role (job) at the DWS?
2. What role does environmental valuation play in your institution?
3. From my understanding, environmental economic valuation and environmentally linked policies and legislations have an important inter feeding relationship.

From your understanding, please may you briefly describe the relationship between environmental valuation and legislation/ policy implementation or development?

4. There is recognition in South Africa of the importance of integrating environmental, social and economic considerations within environmental assessments and at higher levels of decision-making, but existing legislation does not stipulate how this integration should occur (Crookes & de Wit, 2002: 130).

What processes do you think influence the success of environmental valuation processes?

5. What factors or limitations do you think cause under or over representation of certain stakeholder groups in environmental valuation processes?
6. From my understanding, several companies have been found violating environmental regulations. However, there are many legislative laws that have been developed to stop these violations from taking place. An example is the growing incident of acid mining drainage produced by mining companies.

Do you think that power dynamics or imbalances amongst certain stakeholder groups play a role in poor implementation of this policy?

7. Please may you describe the environmental economic valuation process that your organisation follows?
8. Who are the experts involved in the development and application of expert valuation within your organization?
9. What criteria are these experts selected according to?
10. Expert valuation: a process used to determine how much stakeholders value ecosystem aspects, places experts as intermediaries for public-preference input into the environmental policy process. While the rise and refinement of expert valuation might capture ecosystem values more comprehensively, some questions I would like to ask are:

- 10.1. How does your organization ensure that expert valuation is inclusive of democratic expression amongst different stakeholder groups in a study?
- 10.2. People may value ecosystem services differently and in the environmental valuation process there are challenges in incorporating these differences. Do you believe there is a way to overcome this challenge?

D2 DWS TRANSCRIBED INTERVIEW DATA

RESPONDENT 3 (DEPARTMENT OF WATER AND SANITATION)

1. Please describe your role (job) at the DWS?

Respondent 3: I am a water resource scientist. For example, I'm currently reviewing the data in Limpopo. In a nutshell, our job is to try and identify hot spots before they occur so that interventions can be done. We are the custodians of the water resource in a sense, together with others as there are many role players. Once I've looked at an area and the hotspots, I will convey the information to another hot spot that will it either through regulation or through legal action.

2. What purpose does environmental (economic) valuation play in your position and in institution?

Respondent 3: We're not looking so much at economics. What we do want to know is a deviation, and simply we want to determine fitness for use. And fitness for use can be used as a variety of user groups. The main ones are found in the water quality guidelines .So you will have for example domestic use, irrigation, agriculture, industrial, ecosystems. We not yet looking at the economics and this is why I think your work is interesting. There are people who I can refer to you who are doing it in the little way.

3. From my understanding, environmental economic valuation and environmentally linked policies and legislation have an important relationship.

From your understanding, please may you briefly describe the relationship between environmental valuation and legislation/ policy implementation or development?

Respondent 3: It probably starts with the constitution, the constitution says you have a guaranteed right to an environment that is safe etc., and all of those things are the foundation. What we also want to do as our role as water quality planning, by maintaining fitness for use or at least maintaining it in a state that is still fit for use. All of them have an undertone, for example, if it's useful by agriculture that means those people can run a business. If it is fit for use for domestic, it means people don't have to now buy from your own pocket, bottles of water from PicknPay because you cannot drink your tap water because it's not capable of being treated anymore. There is a link between it but I am not really the strongest person to answer that.

4. There is recognition in South Africa of the importance of integrating environmental, social and economic considerations within environmental assessments and at higher levels of decision-making, but existing legislation does not stipulate how this integration should occur (Crookes & de Wit, 2002: 130).

What processes do you think influence the success of environmental valuation processes?

Respondent 3: I think money talks. The short-term outweigh any considerations in the long term. If you look at many mining activities, they were driven because there's either a stakeholder or they make claims of job creation. They make claims, but do they actually deliver on them? If you look at it long term, a farm can be a farm for 1000 years while a mine will be there for 20 years and most of the profit goes into the stakeholders pockets. They most often deploy people from outside the area, and once they move on, is that land still utilizable? If you now work to try farm on that land again, will you have comparable crop yields or will the crop yields decrease or you're going to get a product that you cannot even market because of acidity or anything like that. I think in a different context, political interference can sometimes be a huge problem. If you look at for example, local authorities, we're now in an election year, there's nothing going to be done about for example, the Soweto debt on electricity is R 18 billion and no one's cutting them off because of elections. This is now affecting Eskom which now also affects water. I think there is a growing awareness amongst perhaps your NGO groups and people like that, that we cannot continue using the environment indefinitely. How long before we see that address into a zero-tolerance approach.

In the Department a huge group of people are paying attention to the development of the Master Plan. The Master Plan is almost a cabinet driven type of plan that they intend to set up to guide the department in all aspects of water - water quantity, water source, water resource, quality, quantity, groundwater and everything like that, so it is a very important document. Why I mention that is because that Master Plan is also aligned to the SDGs which is international. Quite a number of the SDGs talk directly or indirectly to water. That gives us almost the priority to make sure that things are done by having it into this plan.

5. What factors or limitations do you think cause under- or over-representation of certain stakeholder groups in environmental valuation processes?

Respondent 3: First thing is that money talks, so that anybody with a financial interest, will make the time. The people who are just passionate about it but don't make money, this is typically the people protecting the environment. They don't make money out of it meaning they are now doing it on a volunteer basis that limits the amount of time they can assign to this. The other one that I have noticed is more related to the role of Forums. Different areas have different formats but there is a feeling amongst some of them. That they are wasting their time. They will attend meeting, after meeting, after meetings and the same issues would be raised such as no improvement measurable. So after a while, they start asking themselves, why am I attending this, it's a waste of my time. That is why for people to make that time available, they need to see a return on that. Either by a way of decisions been affected by visible improvement or by the sense that the matter is been addressed. That I saw can have a definite under representation after a while. In some of the deep rural areas, even something as basic as transport. The local communities can't attend the meeting 100 km's away. So that is where you need to have a look at what other mechanisms have you got available. The Forum can only be once every now and then at one venue. This is places where social media can start playing a role. I know in some areas, they have started using WhatsApp groups or whether they have other forms in which a group of people can communicate with one another to raise issues and to see the response. Typically there's, for example, pollution in the Umngeni River. Someone sees it and puts it in that WhatsApp group, the same day someone from Umngeni Water will respond and says I will look into it. The next day we send samples to the lab etc. That is a good example, you don't actually have to go there and almost everybody has access to something at some point.

6. From my understanding, a number of companies have been found violating environmental regulations. However there are a large number of legislative laws that have been developed to stop these violations from taking place. An example is the growing incident of acid mining drainage produced by mining companies.

Do you think that power dynamics or imbalances amongst certain stakeholder groups play a role in poor implementation of this policy?

Respondent 3: There is definitely power dynamics and imbalances between government and forums. If you take a look at DMR, their mandate is to promote mining. They measure success and probably get merit assessments back on how good they do that but they don't then really worry

about the impact that mining potentially may have. I believe there are works in place to try get that sorted out, but you've got the intergovernmental task teams (IGTT). That is high-level representatives from different role players in the mining industry. DMR and DEA also sits on that. The NEMA is your umbrella legislation, so everything is guided by NEMA. That is the one thing that comes to mind. The next question comes in - you get mining companies and you get 'mining companies'. I think some of them are really trying hard. Especially your bigger companies but we have a problem sometimes with what we call the cowboys. They come in and get an area to work, they come in and rip into it and never mind what they promised in their NPR reports. At the end of the day, they just declare bankruptcy. There is a mess, they move 5 km's down the line and open a new mine and do the same thing again. I don't know how often that happens, this is kind of the feedback that I am getting. There are good people and there are bad people. Another difficulty is a lot of the time, and in the case of Carolina as an example, that spill, there isn't today clarity about where it came from because there's a number of mines that could have been involved. I've seen it in the area of Newcastle where it involves the underground water, but the mines are immediately adjacent to each other and you can't stop underwater flow, it will flow. Now it pops out here at the underground river and now the mine which is mining this says it's not all our water, but the guy upstairs says prove it. This is a headache, it is not very easy to assign a liability. For that reason, there has been talk about regional closure plans at the end of mining. We invite the different mines to get together and sort it out but I am not aware on any status on that, I don't know if any groups or mines have done that. The closest they came to that intention was in Carolina. After the Carolina incident, there was a court order that to compile a regional plan. I don't know what is the status of that plan but is it now actually been implemented.

7. Please may you describe the environmental economic valuation process that your organisation follows?

Respondent 3: The closest that comes into this question is during the classification process. You have the classification and termination of resource quality objectives. I think during this process, they have an aspect of resource economics. I don't know how big it is, it's been a while since I sat in a meeting. But typically they will then look at various levels of for example, medicinal plants, sustainable fishing for communities living around the resource. So, they are the people who deal

with that. Those are the closest we have at this stage to a resource economics. I don't know much more about.

8. Who are the experts involved in the development and application of expert valuation within your organisation?

Respondent 3: I don't know if we even have people internally. We don't have enough work to occupy them full-time, so we can't really have a post for an economic resource valuer. There is a tendency to outsource, they do report to a project team and the guys will try to make sense of it as best as they can .

9. What criteria are these experts selected according to?

Respondent 3: blank

10. Expert valuation: a process used to determine how much stakeholders value ecosystem aspects, places experts as intermediaries for public-preference input into the environmental policy process. While expert valuation might capture ecosystem values more comprehensively:

10.1. How does your organisation ensure that expert valuation is inclusive of democratic expression amongst different stakeholder groups in a study?

Respondent 3: A specific project, this is a good example of the classification projects. They have a very strongly defined stakeholder consultation process. It's not just about publishing an advert in the government gazette and those people respond. They have an outreach where they will have meeting after meeting with the stakeholders, inviting them to comment from the outset about the project goals and the ideas are to be guided within. Sometimes it does not work well as you may have people in that field with their own agendas. So, they can become very difficult to manage. I've seen it myself where those people always want to de-rail your process because of what they are trying to achieve. It is a very structured process, consultation is perhaps the right word for it. It doesn't mean that you must do what they tell you but you will hear them out, you will hear what their opinion is, what they are saying, what their ideas and priorities are. And in one meeting you will often have a group with opposing views, at the end of the day then the department and the experts can stand back and then we or they make the decision. That is for me one way of doing it, it is definitely in some of the bigger projects. It is not always the case if you talk about all our

projects. We have another group of people that we are dealing with water and quantity and so the focus of their outreach is more to deal with the organisations dealing with bulk water supply, water management in the sense of local authorities, water boards and so on. So, they will not have necessarily an outreach to the community up there. They feel that community must have someone who service them with water so they need to be there. So that is a different grouping again. It will be driven by the topic, I think it's part of the Batho-Pele principles of government. You need broad terms, you need to consult. The Batho-Pele principles are sort of a guideline for us.

10.2. People may value ecosystem services differently and in the environmental valuation process there are challenges in incorporating these differences. Do you believe there is a way to overcome this challenge?

Respondent 3: Speaking broadly, it is true that people have different values. The miner looks at the soil and says I have to dig through this. The farmer says I can see cattle grazing and my children's children can one day can have cattle. Miner says, 'profit, big time profit'. So, it is a difficult one to consolidate. If you look at an area prior to mining, one needs to say there is an economic value, let's forget about cultural and legacy and history, but there is an economic value to this land and if no interference, this will probably stay that value and it can provide. So it's important to not just measure the money, but the number of people, because farming can provide jobs for many, whereas mines not. It will go in perpetuity and probably the funds will be an inflation related increase. Once the mine steps off, what's the value of that land now? There are many issues affecting it, a lot of the time people don't want to now do anything there because doing anything on that land makes you liable to it. If that mine has acid mining drainage leaking out of it, you now come and grade one heap down, you've actually kind of assumes responsibility for the whole site. So it's very difficult after the mine has moved out, to get somebody to take. The mine are in law responsible for any impact forever but they walk away. I'm not aware of any situations where the mine has closed down, the area is great, it's flat and now they are farming.

Additional Comments

Respondent 3: The Master Plan

RESPONDENT 4 (DEPARTMENT OF WATER AND SANITATION)

1. Please describe your role (job) at the DWS?

Respondent 4: Water resource scientist at DWS. Our role here is to provide protection of water resources by determining classes (water classification) and resource quality objectives. The function is to really make sure that there is enough water for the fishes and aquatic ecosystems. Making sure that aquatic ecosystems have enough water, but at the same time, there is enough water for people (users). And there needs to be enough water for trans-boundary use. E.g. we share the Orange River, with Lesotho, Botswana and Namibia. We also need to agree on how we share and manage the water. Our function is to make sure we are the guardians that provide protection of water resources but we protect it in such a way that we allow people to use it, but at the same time we look at the National Water Act - conserve, protect, in a sustainable manner

Informal discussion: We do water resource classification studies throughout the 9 provinces in the country. We have water management areas.

2. What purpose does environmental (economic) valuation play in your position and in institution?

Respondent 4: It becomes important but it is a new thing which needs to be done. The resource provides for use, it provides for jobs, it provides for socio-economic activity, and then it becomes important to evaluate for that resource. That's the key but the how part of how we go about using it. It is very critical as you cannot work with what you don't know. You need to know and then from there you can manage. So, you need to evaluate in terms of monetary, what is this socio-economic that this water resource is bringing in, how much is it worth and thereafter you can partition and share. * Look on the slides on why we must do economic valuation and analysis.

Informal discussion: There is a process to classify and set water resource quality objectives. What becomes important for how you are going to value the resource and place a value on what's going on there. In step 2, you describe the area and then you delineate the study. Once you have done that, you quantify your basic human needs, water and your ecological water requirements. Then you go identify and evaluate the scenarios. In this step, when you are doing this, you get to a point whereby understanding the area that you are working. You would know, for example if you have a power plant, which is built and is going to produce electricity and use a lot of water. You must strike a balance between the existence of that power plant in that area, and then the use of that water by that power plant and the impact that it has on the ecology. That is socioeconomics because

you have people using the resource, but you also have people who are using the resource at the same time contaminating the resource. That is when you do the balancing act to see how much value this power plant contributes within the area. You do that and translate that into your rand value. At the same time, what is the value of the water been used in that resource. You can also translate that into the fishing and everything.

What we do is we make sure that we strike that balance that will provide protection of the resource and also allows the users to go on and do their daily activities in terms of deriving goods and services from the system, that is socio-ecological or socio-economics part of it. We'll run models, and we call that scenarios and when you run those scenarios you look at, 'if you do this' and then how does this affect the resource for your ecology and how does that affect your socio-economics. What is the value of that and then we select one of the best models that would strike a balance between the two. So that whatever is in the water is happy, and at the same time the users - so that they can use the water whether you are discharging, obstructing, but there should be that balance. That is the work we are doing to make sure everybody is happy, and we make sure the river is used on a sustainable basis for future. We also try to strike a balance with the political side of it, for example, mining provides job creation. We say you can do this but at the same time, there should be a cut-off line that would never allow you to move beyond. That's why we use licensing, they are assisting and that's why we use compliance and enforcement.

3. From my understanding, environmental economic valuation and environmentally linked policies and legislation have an important relationship.

From your understanding, please may you briefly describe the relationship between environmental valuation and legislation/ policy implementation or development?

Respondent 4: Remember I said we Gazette water resource classification and resource quality objectives. Ideally it means that it is policy, it becomes policy. Once something becomes policy, the element of regulation comes in. Before it becomes regulation, policy becomes binding to everybody. Which means there are certain set rules that need to be followed to use that resource. Regulation becomes key and important because you need to regulate based on the policies that you have set. Regulation has its aspects then you would have your compliance and regulation too and then you'll have enforcement. Before enforcement, you have to set directives. E.g. to tell people

that they are not complying and what it is that you do to sort of improve and comply. Policy and regulation are important because it is the custodian that guides us to do things right.

Policy, regulation, compliance, enforcement and then you need to monitor and evaluate.

4. There is recognition in South Africa of the importance of integrating environmental, social and economic considerations within environmental assessments and at higher levels of decision-making, but existing legislation does not stipulate how this integration should occur (Crookes & de Wit, 2002: 130).

What processes do you think influence the success of environmental valuation processes?

Respondent 4: We have this dilemma that you have different departments, and you have your NEMA act, NWA act. If you look at Environmental Affairs, it talks about its environment, Water affairs is the environment but water. Then you have the Mining Acts, they talk to one and the same thing. Imagine a story where somebody applies for a licence for mining. It becomes a competence of three departments. You need DWS, you need DEA and DMR. Politics comes into play. They give the person mining rights; they check if there is value added and that it is against us our policies in terms of water resource management. Mining leads to AMD then then there is the degradation of the environment. Now where do you strike the balance? Our power industries are giving us light but at a price, e.g., your Kusile Power Station. You find that the political, the social and economic clash in terms of trade-offs, so we try to balance it.

5. What factors or limitations do you think cause under- or over-representation of certain stakeholder groups in environmental valuation processes?

6. From my understanding, several companies have been found violating environmental regulations. However, there are a large number of legislative laws that have been developed to stop these violations from taking place. An example is the growing incident of acid mining drainage produced by mining companies. Do you think that power dynamics or imbalances amongst certain stakeholder groups play a role in poor implementation of this policy?

7. Please may you describe the environmental economic valuation process that your organization follows?

Respondent 4: The seven-step process.

8. Who are the experts involved in the development and application of expert valuation within your organization?

Respondent 4: This field is new if you look at it. Water resource classification is a specialized field which needs a combination of a lot of different specialists, which the Department appoints. But the department has different specialists but to pull them together to do a project, it means it must cross across different directories. Our work is done through professional service providers. We appoint service providers to do the work for us. We prioritize that we want to do a study in a certain area for a specific reason. Then we go do a literature search review and then do a gap analysis about the area. There we define the area e.g. agriculture, forestry etc. We put all the documents together that talk to the work that has been conducted in that area over the years. We define the aims for the professionals. We have the social and ecological implications. Then we give that to the PSP (service provider) to say please do an inception report. The inception report details and outlines the work that has to be done based on our terms of reference.

9. What criteria are these experts selected according to?

Respondent 4: Documents used by the DWS have criteria like track records.

10. Expert valuation: a process used to determine how much stakeholders value ecosystem aspects, places experts as intermediaries for public-preference input into the environmental policy process. While expert valuation might capture ecosystem values more comprehensively:

10.1. How does your organization ensure that expert valuation is inclusive of democratic expression amongst different stakeholder groups in a study?

10.2. People may value ecosystem services differently and in the environmental valuation process there are challenges in incorporating these differences. Do you believe there is a way to overcome this challenge?

APPENDIX E – WATER RESEARCH COMMISSION K5/ 2230 PROJECT DOCUMENTS

E1 K5/ 2230 PROJECT INTERVIEW QUESTIONS

1. Please describe your role on the WRC K5/ 2235 project team?
2. Under objectives and aims in the WRC Report K5/ 2235, there are eight aims which are mentioned. Based on your understanding following the Ermelo mining case concerning Carolina:
 - 2.1. What was the overarching or main aim of the report?
3. Do you believe that the results presented in the report met the goals and aim of the project?
4. In terms of valuing environmental assets, what are your viewpoints on traditional methods such as cost-benefit analysis and willingness-to-pay? More specifically in the context of complex social ecological systems?
5. Please may you describe how important you think environmental valuation is with regards to environmental decision-making processes?
6. Your work entailed chapter 5 of the report which was a natural resource study.
 - 6.1. What was the purpose of the study in this chapter?
 - 6.2. Do you believe the study fulfilled its purpose?
 - 6.3. If not, what do you think was the reason for this?
 - 6.4. How did time, resource and budget constraints affect the study?
 - 6.5. In your study you mentioned that experts were selected to go to the field. Who were these experts and how were they selected?

E2 K5/ 2230 PROJECT TRANSCRIBED INTERVIEW DATA

RESPONDENT 5 (K5/ 2230 PROJECT)

1. Please describe your role on the WRC K5/ 2230 project team?

Respondent 5: I was the lead project investigator/ leader and supervisor and supervisor of the two Master students who were doing their master's degree as part of the project.

2. Under objectives and aims in the WRC Report K5/ 2230, there are eight aims which are mentioned. Based on your understanding:

2.1. What was the overarching or main aim of the report?

Respondent 5: The Water Research Commission (WRC) wanted an understanding of the licensing of mining activities to be tighter and more effective and to more effectively protect wetlands. There were a number of ways of doing that and we did not start with the licensing and then say how we tighten the licensing to achieve this. We were using a complexity, transdisciplinary complex social-ecological systems framing. In order for licensing to have any affect, we felt you need to have an understanding of the system, so we took a systems approach (complex social-ecological systems approach) and treated Carolina and its catchment as the system. This was a project where the aims of the project were given to us so that's what I think the WRC had in mind, but they gave us a specific group of aims. We took those aims and put them into a systemic understanding and started to tackle individual parts of those aims until we ended up with a recognition that the laws were so complex and inaccessible that some kind of social compact would be the most effective route to moving towards a more sustainable landscape. The outcome we delivered to them was a process of enabling local stakeholders to act (including the DWS), but it did not deliver a recipe for licensing. That was one of the disjoints and then popped into that was the idea that wetlands are key ecological infrastructure. So, they also wanted to know the economic value of wetlands, so the framing of the project as constructed by the WRC, had 7 aims that were not entirely connected. We put the aims into a systemic picture, and we started to build an understanding of the role of wetlands and in relation to regulation of mining where the idea was that economics could be a lever towards controlling impacts on wetlands.

2.2. Please rate how well you would say the repo achieved the overarching aim?

Respondent 5: Good

3. Please may you rate how well would you say the report reached its aims?

Aim 1: Conduct an analysis of available resource and catchment-based tools aimed at sustainable development of water resources and management.

Respondent 5: Very good

Aim 2: Investigate and evaluate the decision-making processes followed in issuing mining authorization.

Respondent 5: Very good

Aim 3: Determine the relationship between licensing processes and ecological infrastructure from a landscape and connectivity perspective.

Respondent 5: Good

Aim 4: Propose an integrative decision-making processes and institutional arrangement required to support licensing for sustainable use of natural capital.

Respondent 5: Between Very good and Excellent

Aim 5: Develop guidelines necessary to understand the socio-economic value of selected wetlands, demonstrating their importance to society.

Respondent 5: Between Good and Very good

Aim 6: Develop and test a multi-sectoral integrative monitoring framework linked to a decision support system that will cater for biophysical, economic and societal needs.

Respondent 5: Excellent

Aim 7: Develop appropriate capacity for officials involved in licensing, business, and affected communities.

Respondent 5: Poor

4. Please describe the constraints (e.g. budget, time) that may have made it more difficult to fulfil the project aims?

Respondent 5: The intractability of the mining sector, so lack of access to data. The complexity of the legislation that emerged. The time gap between the AMD event and the project - there was a long recovery time and there were a whole range of biological processes going on that you may not have monitored. The event happened in 2012 and the project took place around 2015.

5. In terms of valuing environmental assets, what are your viewpoints on traditional methods such as cost-benefit analysis and willingness-to-pay? More specifically in the context of complex social-ecological systems?

Respondent 5: I think our traditional valuation methods are inadequate. Our traditional economic methods reside within monetary equivalence of ecological process and the measurements are indirect surrogates of monetary value. So, you try and say 'what would you pay to keep this wetland on your landscape', where in society, ecological infrastructure doesn't have monetary value because it is not exchanged, it is not a currency. So, there isn't a currency of exchange with ecological infrastructure, so people don't have an easy recognition of what they would pay as their answer would be 'nothing because it's just there because God gave it to us'. It's like why should we pay for water, it falls out the sky? There isn't a societal convention that makes monetary equivalence for ecological process easy, so if you investigate it from that point of view, you get an extremely simplistic picture of the value and the method doesn't do anything to advance an understanding of the value of ecological functionality. So, for me it is both crude and shallow in what it is that it has any possibility in delivering but it is delivered with the assurance that comes with the social credibility of monetary assessment. So, when you come in and say this is worth R 5 billion, what people hear is R 5 billion and it's a lot and so they don't then say what does that mean? And so, the limitations of the method aren't regularly probed by either the people seeking the valuation or the system that is being valued having sufficient attention.

And then you can look at a wetland and you could say 5 cents, 50 cents R 5, up to R 5 billion and there's no comparative understanding. Nobody has in their heads, not even I as a wetland ecologist and I have done this for my whole professional career, I couldn't easily steep into the monetary valuation space without some mediating understanding of ecological processes and its value. So I think that there are big questions about all of those words - value, what price, priceless, there's a

whole lot of concepts around the concepts of putting straight monetary values on ecosystem services.

6. Please may you describe how important you think environmental valuation is with regards to environmental decision-making processes?

Respondent 5: I think that it is critical because economic valuation speaks into prime language of value in society and that's exactly why our current methods are so inadequate, because financial monetary value is our common currency, it is the way everything is seen, that too simpler translation of ecosystem function into straight monetary value de-values the ecosystem. So, I've always felt that this was the area that needed the most work that is effective and real - economic resource valuation that is co-developed with ecological understanding so that you have a chance of probing and surfacing values.

7. People may value ecosystem services differently and in the environmental valuation process there are challenges in incorporating these differences. Do you believe there is a way to overcome this challenge?

Respondent 5: I feel that I think the way we tackled this project was really innovative. In the sense that it was relatively easy to deliver a set of simplistic recipes that would end up on a shelf. I think that moving into a space where a user has such a big narrative of value in terms of product and employment like a coal mine and imagining ways to protect relatively common non-charismatic functional units like wetlands, damp spots in among the grass. It doesn't have any of the ecological surrogates that come with people wanting to experience and be immersed, it's a subtle eco-system service that is embedded in a non-charismatic landscape - big dry grasslands.

If your current method of valuation which is required by an aim is not going to give you something that you think is going to shift processes in the catchment, you have to do it. It doesn't carry the sense in the search of pushing forward the complexity of managing landscapes to have multiple users and that is what we are trying to do. We try to take an integrated socio-ecological approach where we understood the wetland function, where we understood the law, where we understood the social network. And then we used the Department of Water and Sanitation which is the regulating water agent, and their processes of a Catchment Management Forum (CMF), and specifically their process of a specialist working group on mining, pollution and Geert Grobler's

group. Bringing together all of the users particularly the regulator and creating a process whereby they might self-monitor and advocate was the approach we took, but (when I said the constraint) mining sits as this intractable monolithic entity that is impenetrable. They don't come to the meetings and if they do, they are junior people who are doing reclamation of wetlands. They are not the people making decisions about where the mines will be or where the mines will be sold now. There is a situation in South Africa at the moment, of the recognition that coal is not there forever and that things will be sold off to short term extractors with no intention of any kind of rehabilitation of landscape. Coal mining is at its most dangerous ecological impact stage in history because it's an angry dying animal.

So, for me, if there were imaginative ways of presenting economic value that could be presented more powerfully. So, for me, the failure of the project was to engage with the economics in imaginative ways, so the economic report sits in that report as a kind of discrete plonk of information in a report that really connects many of the threads together. I think what this project did was too open up to the research world, the value and challenges of taking integrated research approaches.

Side note for researcher- New sub-question: Imaginative ways to overcome this challenge

Respondent 5: Work that has been done in the institute on systemic relational ethics. Systemic relational ethics in terms of the environment says it enables potential use and contestant reduction. I would like to go back into Carolina and see if an imaginative economics and engaged systemic relational ethics approach would shift things.

8. What political factors do you think play a role in the under or over representation of certain stakeholder groups in environmental assessment and valuation processes?

Respondent 5: In the Carolina landscape, you have high-level and high-value contestation between mining and commercial agriculture. Mining and commercial agriculture are known economic giants and you have them contesting the long-term value of their activities because they compete directly. Mining activities directly threaten agricultural production and what emerged out of the study that agriculture was a better and lower impact long-term user of the landscape would have pleased the farmers. What was really increasingly evident in the Forum where voices of local environmental activists, people living close to the impacts of mining, and the people who lived-in

low-income housing? The lack of connection between them and their local wetland, the subtleties of the less economically powerful began to find some surfacing. So, in the Forum there were anti-coal activists who had come to speak about impacts and their voices. The Forum offered a space for that but Department of Mineral Resources (DMR) remains powerful by absence, so if you refuse to engage, you are even more powerful than if you engage. So, the ultimate power arrogance is to say I don't need to be at the table, it's my table anyway so you can waste your time playing at it if you like. So, mining holds an impregnable power space and the bottom-up process of opening things up does enable voice, it doesn't shift intrinsic (natural) power.

9. How would you integrate ecosystem evaluation into the project if you were to repeat it?

Respondent 5: I would like an economist with different methods so I would like to find at that stage, the resource economist. There are few not just doing contingent evaluation. So, I would go hunting for an economist. I would have put one of the master's students on the economics, we did the law side and ecosystem side so we needed a student and the kind of depth that that a student can get to in the economics side which we didn't have. So, the economics side was treated as a sort of small research consultancy. We aimed to do a transdisciplinary project, but we really did an inter- and multi-disciplinary project. There wasn't concurrent integration between the three enough and I think I would now use the systemic relational ethics as a central entity to bring those different threads of research together and I would do it a more continually engaged process.

RESPONDENT 6 (WRC K5/ 2230 PROJECT)

1. Please describe your role on the WRC K5/ 2230 project team?

Respondent 6: I was the on-sight project manager. I worked with the team including the recruiting parts of the team like Houdet and Van der Vaals.

2. Under objectives and aims in the WRC Report K5/ 2230, there are eight aims which are mentioned. Based on your understanding:

2.1. What was the overarching or main aim of the report?

Respondent 6: First of all I just want to point out that the Ermelo mining was a different case, that was the Golfview mine that led to a court case which led to amounts of money coming to the WRC

to be used to improve the understanding between the relationship between coal mining and wetlands. In order to avoid a similar bad experience between a wetland and a coal mine. So that was the first case. We visited the Golfview mine on the farm to see the damage and talk to the farmer and get the full history and went a little bit behind the scene to understand what happened there. It's described in the report. But basically it was an exceptional situation where civil society drove this investigation with the co-operation of a public prosecutor. So it was really driven by civil society as opposed to been driven by government. An important point to keep in mind because the civil society response this problematic issue of coal mining and its impacts on particularly water resources is not getting a strong response from government. The project took place in a context where civil society is a stronger driver of these responses than the government.

The case of Carolina was the 2012 AMD spill. In a way, they were both instances where a coal mining actually breached an ecological barrier and had impacts. So, the project actually discovered that connection and made more of it than the WRC did, because it was an important connection. We put it that way in the introduction as well.

The overarching aim of the report was actually to investigate means to prevent this type of damage from coal mining to occur again. This was really the driving force behind it and that is also why we choose to work with the catchment Forum as an inclusive space of civil society, government regulators, farmers, community and it was an open Forum and a transparent one so that made the whole research process transparent. The research process was an exercise in multidisciplinary and trans-disciplinary work. Multidisciplinary in the sense that individual disciplines were used to produce results, and they were brought together in a trans-disciplinary way. So, the overarching aim was the political one of coal and wetlands and the one on methodology of developing transdisciplinary work in both sectors including the public and different disciplines.

2.2. Please rate how well you would say the repo achieved the overarching aim?

Respondent 6: Good

3. Please may you rate how well would you say the report reached its aims?

Aim 1: Conduct an analysis of available resource and catchment-based tools aimed at sustainable development of water resources and management.

Respondent 6: Very good

Aim 2: Investigate and evaluate the decision-making processes followed in issuing mining authorization.

Respondent 6: Good

Aim 3: Determine the relationship between licensing processes and ecological infrastructure from a landscape and connectivity perspective.

Respondent 6: Good

Aim 4: Propose an integrative decision-making processes and institutional arrangement required to support licensing for sustainable use of natural capital.

Respondent 6: Very good

Aim 5: Develop guidelines necessary to understand the socio-economic value of selected wetlands, demonstrating their importance to society. Read page 42-52

Respondent 6: Between good and very good

Aim 6: Develop and test a multi-sectoral integrative monitoring framework linked to a decision support system that will cater for biophysical, economic and societal needs.

Respondent 6: Very good

Aim 7: Develop appropriate capacity for officials involved in licensing, business, and affected communities.

Respondent 6: Poor

4. Please describe the constraints (e.g. budget, time) that may have made it more difficult to fulfill the project aims?

Respondent 6: The political factor around mining is the main constraint and the second constraint was the way we didn't organize a team.

I think the constraint was that, for me, it was an early project in this trans-disciplinary work and there are a number of difficulties. Our first constraint was that we didn't run it in a way in which

we integrated the team. I was working with one consultants' input, another consultants input, a student's input, another input. In my head using political ecology, some I integrated better than others, it unfortunately went through one person instead of repeated team meetings where you develop the transdisciplinary in the team. It was separate sources integrated in one person, but the second space of integration was the dialogic space in the Forum which I think created more of an integration and it's really based on two important principles in transdisciplinary. The two meanings of the terms, the one is going beyond disciplines and the other is going beyond the academic space into the applied and public space. So, going into the applied and public space was a much better integrator as it meant that we were able to rely on peoples own local knowledge. The knowledge of the farmers and the local geology was very important, and as a result of those things, we developed the concept of hydro connectivity. Which we then found was already in use in some literatures.

5. In terms of valuing environmental assets, what are your viewpoints on traditional methods such as cost-benefit analysis and willingness-to-pay? More specifically in the context of complex social-ecological systems?

6. Please may you describe how important you think environmental valuation is with regards to environmental decision-making processes?

7. People may value ecosystem services differently and in the environmental valuation process there are challenges in incorporating these differences. Do you believe there is a way to overcome this challenge?

Respondent 6: For 5,6 and 7 please quote p42-52 of the report.

8. What political factors do you think play a role in the under or over representation of certain stakeholder groups in environmental assessment and valuation processes?

9. How would you integrate ecosystem evaluation into the project if you were to repeat it?