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**Traditional Ecological Knowledge in Sustainable Resource
Management in Papua New Guinea: The Role of Education and
Implications for Policy**

A thesis
submitted in fulfilment
of the requirements for the degree
of

Doctor of Philosophy

At

The University of Waikato

By

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THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

2016

Abstract

Traditional Ecological Knowledge (TEK) has been argued to have a significant role as a strategy for sustainable resource management. TEK in this context refers to all aspects of indigenous knowledge and practice related to human interactions with the environment, and is particularly important in developing countries, where significant tensions exist between indigenous ways of life and capitalistic economic development. This research explored the perceptions of indigenous Papua New Guineans about a relationship between TEK and sustainability, the role of education in using TEK in sustainable resource management, and the extent to which existing education and sustainable resource management policies emphasise TEK. Twenty-four participants were invited from stakeholder groups involved in natural resource management, such as community members, educators, conservation practitioners, policy makers and resource developers.

This qualitative study combined elements of both interpretivism and critical theory to understand and interpret participants' perceptions of the challenges, limitations and management strategies for sustainable natural resource management using TEK. These approaches were informed by the literature on TEK and sustainability in developing the research design. Data was collected in two phases through semi-structured interviews and follow-up workshops and critically analysed using analysis of themes that emerged from the data and the literature.

The findings indicated that TEK in the indigenous Papua New Guinean context led to a sustainable way of life through exercising the values of respect, responsibility and reciprocity for continuity. TEK was found to be a way of life that used holistic approaches of maintaining connection to land and other resources, and ensuring these were equitably accessed to meet social, cultural and physical human needs. This also showed that sustainability was embedded in every social and environmental aspect of TEK.

The findings indicated that TEK had a crucial role in educating about sustainability

through empowering and encouraging self-reflective learning among its users. A combination of formal, informal and non-formal education can engage and involve TEK users and learners to reflect on their beliefs and practices, develop positive attitudes and approaches towards sustainable resource management and keep TEK knowledge alive.

The findings showed that existing policies related to education and sustainable resource management do not sufficiently include emphasis on TEK. Policy has a role in empowering communities through reinforcing TEK principles in education, and in decision-making and implementation for sustainable resource management.

This study highlighted the importance of TEK as a significant approach to sustainability in the indigenous Papua New Guinean context for generations past. The application of TEK principles of respect, responsibility and reciprocity could be incorporated into formal and non-formal education. These principles could also achieve sustainable communities if consistently reinforced in policy across all sectors.

Acknowledgements

Dedicated to my late father Teunzac Âzâcnec Fisiwec, who taught me the indigenous values of life and relationships.

The completion of this thesis was made possible through the encouragement and support provided by various individuals, families and organisations. I therefore wish to acknowledge and thank the following:

- Members of various natural resource and education stakeholder groups and individuals in Papua New Guinea, who gave permission for me to undertake this study with their organisations/institutions, and those who actually participated in the study. I am forever indebted to your kind assistance.
- My supervisors, Dr. Chris Eames and Professor Priya Kurian for their advice and encouragement. I really enjoyed the conversations and debates in our meetings and learnt so much from you both.
- Dr. Zena Daysh Doctoral Fellowship for Sustainability and the University of Waikato, The Christensen Fund and Dame Meg Taylor for the financial support.
- The Board, Management and Staff of the Research and Conservation Foundation of PNG for cushioning my shortfalls and ensuring my studies went smoothly.
- Arison Ariaafa and Athur Tutuana for their scientific input.
- Raewyn Oulton and all the students and staff at Technology Environment Math and Science Education Research Center for their friendship and support that kept me sane.
- Susanne Maezama, Geua Boe-Gibson and Rosemili Teahenui and their families for their friendship and kindness.
- My family, friends and relatives throughout PNG, particularly my husband Samuel and son Emmanuel for their patience and understanding throughout

this long journey.

- Finally, I thank God for his blessings and provisions, and the opportunity to study in the beautiful Aotearoa.

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Chapter One

Introduction

1.1 Chapter Overview

Interest in traditional ecological knowledge (TEK) as an alternative approach to natural resource management has increased in the last decade as concerns for global environmental issues have also increased. Sea level rise, climate change and deterioration of ecosystems are some examples of such environmental problems threatening human livelihoods. This chapter provides an overview of the research project that explored indigenous perceptions of traditional ecological knowledge for sustainable natural resource management in Papua New Guinea (PNG). This chapter discusses natural resource management in PNG, the rationale, research questions, significance of the study and the thesis overview. It begins, however, with how I became interested in this work.

1.2 My Story

The extent of the influence of indigenous knowledge and practices in one's life is often so strong that it can manifest in one's personal construction of the world. My awareness of the existence of indigenous knowledge and practices can be traced back to my childhood. There were many instances that I experienced and observed these knowledge and practices at play when my parents would take the family for holidays to our tribal villages in the Finschhafen district of Morobe Province (see Figure 1.1 below). These villages were my genealogical connections through my parents because they were both born and raised there.

When we visited my paternal village, the most memorable part for me was the ability to explore the forests with other kids my age and forage for edible bush leaves, wild eggs, fruits and nuts, as well as non-edible resources like firewood. I often enjoyed those times because I got to learn the names of different plants and animals from my young relatives as they playfully pointed out different objects and called its name. What was intriguing for me about these interactions was the fact that my young relatives knew the local names of most trees, shrubs, birds, mammals, snakes and insects. They knew where the wild fowl laid its eggs or

where the tree kangaroos gathered for the night. They, like the adults, could confidently describe from memory a spot in the forest from where they saw the droppings of a cassowary or hoof marks of a wild pig. Being a young child at that time, I remembered always trying to do exactly as they advised when we were out in the bush because they had more knowledge about their environment than I did. This was my early exposure to traditional ecological knowledge (TEK) which was shared and learnt as part of the children's activities.

My second set of experiences was throughout the rest of my childhood and adolescence whereby the values and practices of respect for elders, and other kinsfolk were drilled into us. Respect was something we had to demonstrate through our conduct or actions and speech. For example, elders and other kinsfolk had to be named or called by a title that reflects one's relationship, either through one's patrilineal or matrilineal relationship. For example, when addressing both my mother's father and her uncle, I am expected to call them both with the title 'grandfather'. Similarly, both my mother's biological sister and her cousin sister would be called 'small or big mother' depending on whether they were older or younger than my mother. Also, your maternal uncles were your mother's brothers (both biological and cousins) whereas your father's brothers were your small or big fathers depending on whether they were older or younger than your father. This practice of using titles to emphasise relationships with one's kinsfolk as either your mother, father, brother, sister, uncle, and grandfather reinforced the significance of relationship building and the value of respect for me. These values are expected to be applied in every aspect of one's life, including the environment from which much needed food and other resources are obtained. By practising these values of respect for relationships, it is anticipated that one develops stronger life principles and values that one can apply to everything that one encounters in life.

The third set of experiences I had was associated with my work as a conservation educator for a non-government organisation (NGO) in PNG for more than a decade. This is where I was reintroduced to my earlier learning about the significance of the environment and natural resources and became more aware of the dependence of some of the rural communities on their natural resources. I

observed that people in these communities used their traditional ecological knowledge (TEK) to access food and other resources regularly (Tiu, 2007). Despite this high dependence, their livelihoods were threatened by increasing interests in resource extraction, both in terms of logging and mining. These, and the external pressure of owning material goods and accessing better services, have closed in on these communities. This has also placed an unnecessary strain on them to open up their traditional lands for development.

These personal experiences illustrated TEK as a practice-based knowledge implemented by all members of the community for their own survival. It also reinforced the values of respect for strengthening relationships. However, this knowledge and these practices are dependent on the wellbeing of the environment which is being threatened by increasing unsustainable economic activities. This unsustainable trend was introduced under colonisation and maintained after independence by the national government as a revenue generation activity. This action is having adverse effects on people, their natural resources and TEK, particularly when sources of food, water and shelter are threatened.

With such dependence for many people on environmental resources, there is a need to re-consider the nature of economic development activities in PNG to ensure they are not in fundamental contradiction with sustainable practices that draw from and strengthen TEK. This means an understanding of people's perceptions of TEK and sustainability and how these could influence decision making about sustainable resources management in PNG, is necessary. This thesis addresses this gap through a theoretically-grounded empirical study of TEK and sustainability principles in PNG.

1.3 Natural Resource Management in Papua New Guinea

Papua New Guinea (PNG) covers the eastern half of the biologically-rich island of New Guinea (see Figure 1.1), which has a high diversity of ecosystems and landscapes that are home to a variety of animal and plant species. While the island covers one per cent of the Earth's land area, it is host to over five per cent of the world's biodiversity, two-thirds of which are endemic (Conservation International, 2012). The high endemism is attributed to diverse ecosystems which in return

influence a high cultural diversity. PNG's cultural diversity is exhibited by the 839 indigenous languages (Lewis, Simons, & Fenning, 2016) spoken by over 800 different cultural groups. Papua New Guinea's 7.4 million population (The World Bank Group, 2016) is scattered, with over 80 per cent being wholly rural and dependent on subsistence living. Of the total population, over 90 per cent are considered indigenous Papua New Guineans, while less than 10 per cent comprise of migrants. The rural population directly draws food and other resources from forests, rivers and seas and is likely to be affected if these resources are impacted. This creates a tension as the national government pursues economic growth and development through extractive industries which is impacting people's rural livelihoods as well as its biological and cultural resources. The adverse effects of these activities on the environment and people have accelerated in the decades since 1972 when there was extensive and rapid deforestation and forest degradation throughout PNG (Shearman et al., 2008). Mitigation through sustainability principles and practices in national development strategies and plans are therefore essential to ensure a balance between economic growth and the wellbeing of the citizens of PNG. Yet there is currently little evidence of a systematic commitment to this approach to sustainable development in PNG.



Figure 1.1: Physical Map of Papua New Guinea
Source: Map from Ezilon.com

In addition, efforts towards natural resource management in Papua New Guinea have gained momentum since the early 1980s. These initial efforts in the 1960s and 1970s attempted to follow borrowed concepts, such as the Yellowstone National Park (USA) model, for establishing protected areas (Chatterton, Mitchell, & Yamuna, 2004) but this became problematic for two reasons. Firstly, unlike Yellowstone National Park, proposed sites for protected areas in PNG were located on customary lands which were outside of the State's jurisdiction and not readily available for external use. Such challenges associated with development initiatives in PNG are not new as they are linked to land ownership. In addition, debate on traditional lands for development have also existed for a long time, as Papua New Guineans have over thousands of years depended on their natural resources to sustain their livelihoods (Paglau, 1982; Sillitoe, 1998). Such a subsistence based existence has resulted in the production of TEK that is grounded in, and informed by, the material realities of the people and their values and worldviews (Agarwal, 1992).

Secondly, not only were these proposed sites located on customary lands but that they continued to be used by local communities to access various resources for personal and community use. One concern that was often overlooked in this regard is that these communities have over generation accessed resources freely using their local TEK and would continue to do so if uninterrupted by external influences. This implies that protected area legislation needed to ensure local communities continued to access resources sustainably, and that they are encouraged to be involved through participating in decision making for management of their natural resources.

The need to safeguard dependence of rural communities on natural resources, ensuring these resources are sustainably managed and people whose lives would be directly affected are involved in the decision making about large scale resource extraction, are areas of concern that this thesis explores. In particular, it was of interest to examine whether there was a relationship between the more Western concept of sustainability and indigenous TEK, and whether education and policy could be influential in the use of TEK for sustaining natural resources for the people of PNG.

1.4 Research Questions

This study addressed three interrelated questions which guided the data collection and analysis processes. These are as follows:

1. What are Papua New Guineans' perceptions of a relationship between TEK and sustainability?
2. What are Papua New Guineans' perceptions of the role that education and policy can play in the use of TEK in sustainable resource management?
3. To what extent do existing policies related to sustainable resource management include an emphasis on TEK in PNG?

The first question examines the argument that core values of traditional ecological knowledge reinforce sustainability principles (WCED, 1987; Semali and Kincheloe, 1999; Berkes, 2008; McGregor, 2004; Stephenson and Moller, 2009). The second question examines the notion that education may have a role in achieving sustainability through TEK (Huckle and Sterling, 1996) and that policy could also have a crucial role in ensuring that this happens. The third question draws on the notion that achieving sustainability through TEK would be dependent on appropriate policies to support implementation (WCED, 1987; Huckle & Sterling, 1996).

1.4.1 Significance of the study

Environmental degradation resulting from deforestation is a concern for the natural resource sector in Papua New Guinea. Commercial logging, mining of minerals, subsistence agriculture and plantations are some human activities that have contributed to deforestation and environmental degradation. For example, mechanised logging accounted for the degradation of approximately 362,400 hectares of forests in 2001 (Shearman et al., 2008). On the other hand, commercial mining contributes to increased accounts of land degradation leading to "poor water quality and scarcity of arable land for farming and traditional livelihoods" (Fisher, 2016). The degradation caused to the environment has adverse effects on people, their communities, sources of food and water (Banks, 2002; Macintyre & Foale, 2007; Oates, 2011), and this could mean the loss of their TEK, which is what they use to access resources. In addition, much of the current situation is based on

colonisation, and the key dilemma of balancing development, driven mostly by offshore multinationals, with sustainability for the long term future of PNG. Also that 80 per cent of people are still rural and depend on natural resources. This prompts the need to ensure that the communities' ability to access resources using their TEK remains viable and is able to be continued for the benefit of the present and future generations.

An understanding of TEK and its implications for sustainable use of resources is therefore crucial and in the specific context of Papua New Guinea, the existing scholarship on sustainability and TEK has not examined in any depth the nature of the relationship between the two, and this study addresses this gap. Thus, this research offers a theoretically-grounded empirical study of the relationship between TEK and sustainability in the specific context of PNG. Secondly, this study has the potential to contribute to policy practice in the form of both education for sustainability and broad sustainability policies, with the central focus on TEK to achieve sustainable natural resource management. Insights from this study could potentially inform and transform current policies in PNG that have marginalised TEK, and in the process help rethink (and address) the dominant mode of unsustainable economic development.

1.5 Overview of Research Design and Delimitation

The design of this study is qualitative in nature and employed aspects of critical theory and interpretivism.

An interpretive approach was used in this study to explore research question one. The purpose of this was to interpret and understand participants' perceptions about the relationship between TEK and sustainability.

Elements of critical theory were also used for research questions two and three. The reason being that these questions were looking specifically at the role of education and policy and how these have been influenced by colonisation and development issues. The notions of colonisation and development are very crucial in this context for various reasons. Colonisation has instilled in indigenous Papua New Guineans the perception that their own traditional knowledge and practices

are inferior to those of the Western context, and to a feeling of disempowerment which can lead to their exclusion from decisions, and therefore a need to rectify this. On the other hand, development raises the local people's expectations that benefits will be equally shared across all members of the community but in reality, it does not happen. Often those with the power and money appear to benefit more than those who don't. This creates issues of power imbalances and inequality.

This study did not involve participants who were non indigenous to Papua New Guinea and purposefully chose those who had some knowledge and experiences in natural resource management.

1.6 Thesis Overview

This thesis is organised into nine chapters. Chapter One provided the context of the study and introduced its aim and purpose. This chapter also discussed the research questions, background of natural resource management in PNG, overview of the research design and delimitations and the thesis overview.

Chapter Two provides a detailed literature review on the nature of traditional ecological knowledge, its principles, and application in natural resource management. It also discusses the relationship of traditional ecological knowledge (TEK) to sustainability, education for sustainability and the role of TEK in education for sustainability.

Chapter Three provides a detailed literature review on the role of public policy. This is followed by a discussion of traditional ecological knowledge and its relationship within sustainability policies in PNG. A review of education policy and specifically education for sustainability policy follows, before the chapter addresses the theoretical positions within this thesis.

Chapter four details the methodological framework of the study and the research methods used. It also explains the research design employed in this study including data collection and analysis methods.

Chapter Five begins the presentation of the research findings. This chapter focusses on the analysis of data on participants' perceptions of the relationship between TEK and sustainability gathered during the interviews.

Chapter Six is the second data chapter which presents the analysis of the interviews that examines the role of TEK in education and sustainability.

Chapter Seven is the third data chapter and presents the findings of the analysis of the workshop feedback regarding how TEK can inform public policy and decision making processes in natural resource management.

Chapter Eight is the final data chapter and presents an analysis of TEK and sustainability within policy documents related to natural resource management and education in PNG.

Chapter Nine discusses the findings of the study and draws some conclusions and recommendations for practice and future research.

Chapter Two

Traditional Ecological Knowledge, Sustainability and Education

2.1 Chapter Overview

There has been a growing awareness of traditional ecological knowledge (TEK) as a strategy for sustainable natural resource management. Not only is this driven by the mounting demands for alternative solutions to increasing issues of environmental degradation, poverty and inequality in many developing nations, but also by the changing phases in globalisation. This need to understand the complexities of global changes and interactions (Leach, Scoones, & Wynne, 2005) could enable a better understanding of the world we live in and provide us the opportunity to explore other sources of knowledge to address current global issues currently informed by science and technology.

In addition, indigenous groups of people tend to have subsistence lifestyles which are entirely or partly dependent on natural resources (Calvo-Gonzalez, 2016; Thondhlana & Muchapondwa, 2014). The quantity and type of resources required is greater for rural dwellers due to their high dependency on natural resources for immediate consumption. Urban or semi urban communities have lesser direct dependence on natural resources due to alternative sources which can be purchased as processed products from shops (Tiu, 2007). The approaches and techniques used by many rural communities to extract resources are based on traditional knowledge and practices which are often less destructive of the environment. It is this aspect of indigenous practices and the potential it has for sustainable natural resource management that has received a lot of attention (See also Berkes, 1999, 2008; Berkes, Folke, & Gadgil, 1995; Dudgeon & Berkes, 2003; Houde, 2007 and Usher, 2000). This chapter discusses the key principles of TEK that could enhance sustainable natural resource management practices.

One of the key issues that I also explore in this chapter is the notion that resource extraction by many indigenous communities is for the purpose of meeting basic

needs for survival, also referred to as physiological needs by Maslow's Hierarchy of needs (Koltko-Rivera, 2006) which includes others such as self-transcendence, self-actualisation, esteem needs, belongingness and love needs, and safety needs. A need area not listed by Maslow, but common among indigenous people and existent in the TEK literature, is spiritual needs. For example, McGregor (2004) describes how she often begins the teaching of her course 'Indigenous Traditional Ecological Knowledge' with the creation and recreation stories. These stories acknowledge the existence of a Creator who created the world and give instructions to people on how to relate to the Creator and all its creation and be responsible for its protection. McGregor's point is echoed in other studies on indigenous communities. For example, Berkes (2008) pointed out that social and spiritual aspects cannot be separated from indigenous knowledge. Similarly, Sillitoe (1993) described how the Wola people of PNG associate extreme bad weather and failed crops to a white-skinned spirit woman, as a display of their need to acknowledge a spiritual being for the bad conditions they experience. This acknowledgement of superior beings denotes the spiritual need that seeks to be fulfilled by accepting and recognising another being as the source of creation and human existence. Spiritual need is about connections, and spirituality is an essential component of the environment embraced by many indigenous communities, that reinforces this notion of connectedness and is also influential in sustainable resource use and management.

This chapter discusses the principles of sustainability believed to be embedded in TEK and explores ways in which education could be used as a tool to develop and strengthen the relationship between TEK and sustainability. It provides a review of the literature on TEK, its relationship to sustainability and education. Section 2.2 discusses the nature of TEK, current research on TEK and its application in natural resource management. Section 2.3 provides a discussion on the principles of sustainability, its definitions and current research related to TEK and natural resource management. Section 2.4 discusses the literature on education in Papua New Guinea, the nature of formal and non-formal education in PNG and the linkages between education, sustainability and TEK in natural resource management. Section 2.5 provides a summary of the chapter.

2.2 Traditional Ecological knowledge

The ability of humans to construct knowledge enables us to develop various perceptions of the world we live in. This knowledge consists of different ways we perceive our natural, physical and spiritual world and comprises both conscious and unconscious intuitive knowledge (Haverkort & Reijntjes, 2010). Conscious knowledge is directly accessible and can be expressed in many ways. For instance, the knowledge about constructing traditional canoes or seasonal cycles used for cultural or land use purposes (Prober, O'Connor, & Walsh, 2011). Conscious knowledge differs from subconscious intuitive knowledge whereby the latter is linked to our deeper being and is often difficult to access although it can be possessed without the need to justify its existence. Chudnoff (2011) described it as “knowledge developed from a belief based on an intuition” (p. 360). For example, the Cree hunters of Canada have an understanding about maintaining a respectful relationship with animals because of the belief that animals control the success of the hunt (Berkes, 2008). This subconscious intuitive knowledge extends to include individuals, family, community, society, world and cosmos levels and is enhanced by one's relationship with the natural and physical environments. Traditional ecological knowledge (TEK), which is central to this thesis, is one such knowledge that comprises both conscious and subconscious intuitive knowledge.

The term traditional ecological knowledge (TEK) was described by Fikret Berkes, a non-indigenous scholar, as ambiguous (Berkes, 2008) and it does not have a universally accepted definition. Ambiguity in this context is associated with the way Western biases often attempt to define TEK as a homogenous system instead of the plurality it is comprised of (Mazzocchi, 2008). Battiste and Henderson (2000) argue from an indigenous perspective that it would be misleading to define TEK when there are non-existent criteria for comparison, and that TEK cannot be separated from its holders (Cajete, 1994). Other indigenous scholars also described this need for defining TEK as Western-oriented and not representative of indigenous views (Johnson, 1992; McGregor, 2004a; Roberts, 1996). These indigenous scholars' sentiments on the influence of Eurocentric views on defining TEK raise the concern about the need to capture indigenous perspectives of TEK and what that means for them. On the other hand, the use of the terms ‘traditional’

and ‘ecological’ also adds to this ambiguity. The term ‘traditional’ could be misleading as it can imply a static outdated knowledge, even though societies change through time and develop new approaches (Usher, 2000). Traditional also refers to knowledge and practices of aboriginal or indigenous origin (ibid). ‘Ecological’ on the other hand, encompasses knowledge about the “distribution and abundance of life, and their interactions with other organisms and their environment” (Mazzocchi, 2008, p.43). Mazzocchi also argues that presented in the Western scientific context, the term “lacks sufficient emphasis on cultural and environmental connections embedded in spiritual, social and linguistic frameworks” (ibid). A combination of the terms traditional and ecological presumably implies that ‘TEK is about aboriginal or indigenous knowledge of the environment and the interrelationships that exist between all organisms and their environment’.

With different perspectives in the literature on what constitutes TEK (Battiste & Henderson, 2000; Berkes, 2008; Cajete, 1994; Usher, 2000), there is a need to understand how different scholars attempt to define it. Definitions of TEK vary depending on the context in which it is used. For instance, Usher (2000) describes TEK as “all types of knowledge about the environment derived from the experiences and traditions of a particular group of people” (p. 185) while Reid, Teamey and Dillon (2002) asserted that it is associated with the “diversity of knowledge, innovations, and practices that indigenous communities hold about the biophysical, socioeconomic, and cultural-historic aspects of their local environment” (p. 1). Other scholars (Dudgeon & Berkes, 2003; Ens, Finlayson, Preuss, Jackson, & Holcombe, 2012; Turner & Berkes, 2006) use an operational definition of TEK as:

...a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. (Berkes, 2008, p. 7)

And:

...a body of knowledge built up by a group of people through generations of living in close contact with nature and includes a system of classification, a set of empirical observations about the local environment, and a system of self-management that governs resource use. (Johnson, 1992, p. 4)

The above definitions reinforce concepts of relationship, interactions, and resource management. Relationship in this case includes all aspects of a human relationship with other humans, and the living and nonliving components of their environment (McGregor, 2004b). Other key ideas that emerged highlighted TEK as environmental knowledge, produced from interactions with nature and used by a particular group of people (Johnson, 1992), and that TEK was culturally transmitted (Cajete, 1994). The key emphasis was the construction, accumulation and application of knowledge by a group of people for the purpose of understanding their environment to access resources for survival (Johnson, 1992). Knowledge construction occurred in different ways and forms but generally drew from beliefs and practices transmitted through different means. These were also reinforced by perceptions of both spiritual and sustainable interactions one had with the environment (McGregor, 2004b) which enabled humans to develop respect for animals, plants, ecosystems, landscapes and seascapes; and prompted protective behaviours towards these objects.

In reference to other indigenous scholars' arguments about TEK being undefinable, I acknowledge the difficulties that exist whereby TEK is place specific and local TEK for a particular region differs based on their environmental context. This is also reflected in the literature as highlighted above and portrays varying perspectives on what constitutes TEK. In addition, the literature on TEK (Battiste & Henderson, 2000; Berkes, 2008; Cajete, 1994; McGregor, 2004b) acknowledges existence of knowledge that is specific to indigenous peoples. For the purpose of this thesis, I use the term TEK to refer to 'all aspects of indigenous knowledge and practices related to human interactions with the natural, physical and spiritual environments developed over time and passed on through generations using various means'. The significance of this definition lies with the value of relationships based on respect for all environmental features, as Hart

(2010) stated, “relationships signify the coming together of people and entities to help and support each other to develop a sense of communal respect” (p. 3). These are vital for strengthening the efforts of traditional sustainable natural resource management. This also reinforces a link between sustainability and TEK as indicated in the following discussion on the nature of TEK, current debates in TEK research and natural resource management in PNG.

2.2.1 Nature of TEK

The diversity in the definitions of TEK discussed above provides insights into the differences in its characteristics and roles. For example, Usher (2000) categorised TEK for resource management as “knowledge about the environment, knowledge about use of the environment, values about the environment and the knowledge systems” (p. 186). Houde (2007) described TEK as being about “factual empirical knowledge, knowledge of management systems, factual knowledge of past and current environmental uses, environmental ethics and value statements, knowledge about cultural identity, and culturally based assumptions and beliefs or cosmology” (p. 10). Berkes (1999) considered four interrelated levels of analysis involving TEK that includes “local empirical knowledge essential for survival such as species distribution and life cycles, understanding of ecological functions and processes such as land and resource management systems, social institutions and organisations, and environmental perceptions through worldviews” (p. 17-18). Perspectives of TEK suggested by Usher (2000), Houde (2007) and Berkes (1999) imply that TEK is indigenous environmental and ecological knowledge. Other perspectives from Berkes (1993), McGregor (2004) and Cajete (1994) described TEK as holistic knowledge, spiritual knowledge and being culturally transmitted. These characteristics of TEK provide an “integrated system of knowledge” (Berkes, 1993, p. 8) which enables it to be holistically applied in different situations to achieve sustainable lifestyles. Each of these characteristics are discussed in the following sub-sections.

2.2.2 TEK as indigenous environmental knowledge

The perception that TEK is indigenous environmental knowledge is supported by many writers on indigenous and traditional knowledge (Battiste & Henderson, 2000; Berkes & Berkes, 2009; Butler, 2004; Dudgeon & Berkes, 2003; Mazzocchi,

2008; McGregor, 2004a, 2004b, Menzies & Butler, 2006). TEK as indigenous environmental knowledge has many implications. For example, Tiu (2007) highlighted three categories of environmental knowledge of forest-dwelling people of Papua New Guinea within these facets that have implications for sustainable natural resource management, which are summarised in Table 2.1. The first is forest knowledge which is essential for locating local resources; understanding animal and plant relationships and also using flowering and fruiting cycles to identify harvesting and planting seasons.

Table 2.1: Types of traditional environmental knowledge

Environmental knowledge	Significance in Natural Resource Management
Forest knowledge	<ul style="list-style-type: none"> • Locating local resources • Understanding relationship between animals and plants • Identifying harvesting and planting seasons
Indigenous family knowledge	Vital environmental information for <ul style="list-style-type: none"> • Land inheritance • Kinship (clan) alliance
Environmental practices	<ul style="list-style-type: none"> • Gardening: application of techniques in nutrient recycling and preventing soil erosion • Hunting: Limited harvest using traditional tools • Construction: production of durable artefacts and minimal resource wastages

(Source: Tiu, 2007)

The second category is indigenous family or genealogical knowledge which is significant in determining land inheritance and kinship alliance. The former is vital environmental information for many indigenous communities in PNG because of the land tenure system whereby over ninety percent of land is customary-owned. This ownership system enables individuals to be identified with a particular kinship group within which social obligations are met and shared. For example, as an indigenous person, I belong to the Zozola sub-clan within the Meheng-Zozola clan of the Wamorâ language group of PNG. My social obligation to the Zozola sub-clan is to interact with others in this kinship group, meet any cultural obligations including caring and supporting kinship members, participating in collective activities like planting or harvesting, and share land rights. Both land inheritance and kinship alliance are significant for

natural resource management as it enables decision making about land and resource use.

The third category is knowledge of environmental practices such as gardening, hunting and construction, which utilise techniques in soil management and sustainable resource use (Sillitoe, 1983). For example, some traditional gardening techniques promote nutrient recycling and prevention of soil erosion. Use of traditional tools in hunting also places a limit on the quantity of harvest, while traditional construction techniques encourage production of durable artefacts and minimal wastage of resources harvested, so that every part of a particular resource such as a tree is fully utilised.

As an environmental knowledge, TEK comprises factual or rational statements about weather, animal and plant behaviour. It focuses on historical information of patterns of land use, occupancy and harvest and recognises the value of animals and plants in the ecosystem (Usher, 2000). This recognition promotes respect for all organisms and their habitats or ‘places’, a term described by McGavin (2016) as “both the tangible and intangible aspects of landscape, seascape, starscape and spiritscape which encompass elements of ancestry, belonging, community, descent, emotion and identity” (p. 1). The different types of traditional environmental knowledge are derived from accumulation of information about the general knowledge systems of one’s place which govern the indigenous worldviews and are acquired from personal and general experiences, observations, oral history and traditions.

2.2.3 TEK as ecological knowledge

Second, TEK is based on ecological interactions. Unlike other types of indigenous knowledge, TEK has a specific focus on the interrelationships and interactions of living organisms with each other and their environment. The term ecological is borrowed from the branch of biology that is concerned “with interrelationships in the biophysical environment” (Berkes, 2008, p. 5). It emphasises the notion that TEK is linked to Western science as it focuses on the ecological systems in which humans and other living organisms dwell. This is also underpinned by Odum (1971) in the following statement:

Living organisms and their non-living (abiotic) environment are inseparable as they interact with each other. Any unit that includes all the organisms (i.e. community) in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity, and material cycles (i.e. exchange of materials between living and non-living parts) within a system is an ecological system or ecosystem. (p. 8)

Odum also adds that in “primitive societies, every individual needed to have definite knowledge of his environment i.e. of the forces of nature and of the plants and animals around him or her to survive” (ibid, p. 3). This view is exemplified by the indigenous people’s ability to develop in-depth knowledge of relationships between their cultures and the ecosystems they live in (Cajete, 1994; Dudgeon & Berkes, 2003; Lacey, 1981; Prober et al., 2011). As an ecological knowledge, TEK strengthens this interdependence between people, their cultures, ecosystems and the land on which they all exist.

2.2.4 TEK as holistic knowledge

Third, TEK is holistic when focusing on human relationships with the environment (Berkes, 1993, 2008; Mazzocchi, 2008; McGregor, 2004a, 2009). This perspective emphasises the philosophical concept of holism which maintains that natural systems (physical, biological, chemical, social, economic, mental, linguistic, etc.) and their properties are intimately interconnected and should be viewed as a whole, not in parts (Dudgeon & Berkes, 2003; Oshry, 2008), and draws on the original works of Smut (1936) who argued that “parts of a whole are intimately interconnected in such a way that they are not able to exist independently” (p. ix). The Cartesian epistemology from which Western reductionist scientific knowledge is derived reinforces fragmentation of knowledge into parts and then piecing them together to understand them. This contradicts TEK which is a holistic knowledge of “accumulated experiences, wisdom and know-how unique to cultures, societies and communities of people living in an intimate relationship of balance and harmony” (Haverkort & Reijntjes, 2010, p. 19). TEK cannot be compartmentalised like scientific

knowledge as this will distort its meaning and disempower the users who have been using the holistic approach to understand knowledge.

Holism is also about “patterns of relationships, including the relationship between societies and their ecological circumstances” (Dudgeon & Berkes, 2003, p. 80). It embraces TEK as a type of knowledge that draws upon an understanding of both epistemological and political issues (ibid.) and gives users the freedom to decide the type of knowledge to utilise. TEK enables indigenous persons to be knowledgeable about everyday experiences of interactions of natural, physical and spiritual worlds and develop deeper understanding of relationships that exists within these components. For example, observation of natural and physical environments allow understanding of how these influence human interactions with their environment, leading to development of seasonal knowledge, such as those used by the Australian aboriginal people (Prober et. al. 2012; Johannes, 1993). This is further emphasised by the Andean peasants’ belief that “rivers, mountains, land, soil, rocks and animals are sentient and nurture human beings so humans have the responsibility to reciprocate this nurturing relationship” (Semali & Kincheloe, 1999, p. 42). Such exhibition of holistic relational beliefs enhances the value of reciprocal relationships, promotes respect for other components of the environment and has implications for sustainable natural resource management.

2.2.5 TEK as spiritual knowledge

Fourth, TEK is based on spiritual knowledge (Cajete, 1994; McGregor, 2004). TEK emphasises intimate relationships of indigenous people with the physical and spiritual entities in their environment. This relationship is essential for various reasons including acquisition of environmental knowledge (Tiu, 2007). Relationships are paramount as they emphasise interconnectedness. Plants, animals, spirits, physical objects (like rivers, sea, rocks, wind, and sun), heavenly bodies (sun, moon and the stars) and human beings are all equal as none of these components is above the other and cannot exist without the others. These perceptions acknowledge a dynamic relationship that already exists within the indigenous worldview.

The cohesiveness of human, natural and spiritual worlds influences knowledge production. This is depicted in the study of the Raramuri culture of Chihuahua in Mexico (Salmon, 2000) which describes a ritual where women dance in a circle and sing songs that “ask for the land to be nourished and that the land will nourish the people” (p. 1328). A similar practice exists within the Abelam culture of PNG where during the period of planting, growing, tending and harvesting ceremonial yams, the people follow very strict taboos to please the ancestral and related spirits so that yams can grow big and without fault (Scaglione, 1999). Following the harvest, a festive ceremony is held where yams are decorated in various ways and displayed. Such elaborate efforts emphasising the significance of local crops demonstrate strong connections between indigenous cultures, land and environment (physical and spiritual). Rituals, taboos and ceremonies signify the importance of other superior beings in the protection and nurturing of crops and the land in which they can grow and flourish. An exploration of such rituals can enhance understanding of relationships between indigenous people and the environments they live in. These examples also have implications for sustainable resource management.

2.2.6 TEK as culturally transmitted knowledge

Fifth, TEK is culturally transmitted over generations and is embedded in the spiritual, social and linguistic frameworks of a particular indigenous group who uses it. This set of information can assist with understanding how TEK is perceived, acquired and disseminated to achieve sustainable resource management. Other views of TEK describe it as a deeper knowledge about identity and culture (Semali & Kincheloe, 1999); being intuitive, moral and spiritual (Berkes, 1993); and being non-dualistic, dynamic, informal and sometimes secret or sacred (Haverkort & Reijntjes, 2010). TEK is universal as indigenous peoples all over the world have their own TEK and practice it (Berkes, 2008). TEK is about things that are known (*knowledge information*) and the ways of knowing (*knowledge process*). As knowledge information, TEK enables the users to know species names, life cycles, habitat types, names of stars and estimated distances. As knowledge process, TEK enables users to know different processes of doing things such as approaching elders, transmitting acquired information to users or conducting special rituals.

The interrelationships and interconnectedness of TEK using different forms of knowledge, whether it is passed on from one generation to another, gained from observation or acquired through spirit knowledge as a gift (Tiu, 2007), are all intended to empower the user to be able to survive. In other words, TEK is about survival in the world and deep revelations of one as an individual and a community. TEK is about life and living and acknowledging that every single entity in one's environment is special and has an important role to play. TEK is about existence.

Like all forms of traditional indigenous knowledge, TEK is found to be intellectually evocative and useful for a variety of purposes in many different contexts (Semali & Kincheloe, 1999). It has multidimensional uses and belongs to a community. TEK reflects the dynamic way in which the residents of an area have come to understand themselves in relationship to their environment or place (McGavin, 2016) and how they organise the knowledge of flora and fauna, cultural beliefs and history to enhance their lives, and ultimately manage their resources to ensure their survival.

TEK is environmental and spiritual knowledge based on ecological interactions. It is holistic as it embraces all aspects of the indigenous worldview and is culturally transmitted. These characteristics strategically position TEK as an approach in sustainable natural resource management. The following section discusses the current debates in TEK research and the implications for natural resource management.

2.2.7 Current debates in TEK

The term traditional ecological knowledge (TEK) emerged from almost three decades of research and debate as a recognised domain of knowledge (Berkes, 1993, 2008; Dudgeon & Berkes, 2003; Reid et al., 2002). Its widespread application occurred in the 1980s although the practice is as old as ancient hunter/gatherer cultures (Berkes, 2008).

The World Commission on Environment and Development (WCED) recognised

TEK and other indigenous knowledge forms as vital for achieving the goals of sustainable development, particularly for natural resource management in developing countries. Their report, *Our Common Future*, emphasised the need to reflect on “tribal and indigenous people’s lifestyles which can offer modern sciences many lessons in the management of resources in complex forest, mountain and dryland ecosystems” (WCED, 1987, p. 12). Practitioners and academics now have the opportunity to explore different avenues for integrating TEK concepts in formal practice. The significance of TEK in achieving sustainable resource management was reiterated by the Convention on Biological Diversity (CBD) which:

recognises the close and traditional dependence of many indigenous and local communities embodying traditional lifestyles on biological resources, and the desirability of sharing equitably benefits arising from the use of traditional knowledge, innovations and practices relevant to the conservation of biological diversity, and the sustainable use of its components. (United Nations, 1992)

Recognition of the role of TEK in resource management provided the framework for practitioners to integrate TEK in conservation and natural resource management (Huntington, 2000; Johannes, 1993; Lyver, 2002; Rist & Dahdouh-Guebas, 2006; Thomas, 2009). The debate in the application of TEK is around differences in the processes employed by indigenous communities and Western science in advocating these practices. TEK has its own principles and approaches to be observed. For example, TEK is holistic, environmental and spiritual knowledge based on ecological interactions embracing all aspects of indigenous worldviews. When using Western scientific methodologies to apply TEK concepts, the rules are different and expected outcomes are not always achieved (Cajete, 1994; McGregor, 2004a). The resulting unresolved conflicts over resource management give a poor impression amongst non-indigenous users.

Initial studies in TEK were in the field of ethnoecology, an approach that focuses on conceptions of ecological relationships held by a culture (Berkes, 2008). As a subset of ethnoscience or folk science, ethnoecology was interested in the way

knowledge systems are used to classify objects, activities and events within a culture's universe (Hardesty, 1977, p. 291). Much of the early research concerned itself with folk taxonomy and less on understanding ecological relationships and worldviews held by these cultures. An inevitable shortfall in this early research is the choice of scientific methodologies which did not embrace other cultural aspects. Dudgeon and Berkes (2003) assert that application of empirical observations and investigations into indigenous cultures allow social patterns of relationships within the culture under study to be explored. The choice of appropriate methodologies is therefore essential in understanding complexities of indigenous worldviews and interrelationships.

Other studies demonstrated the use of both approaches in interpreting cultural information on relationships and interactions within a particular context. For example, the integration of indigenous knowledge and ethnoscientific approaches in natural resource management amongst the Andean communities to successfully manage forest resources (Rist & Dahdouh-Guebas, 2006). Another study on the use of TEK during the bowhead whale census in Alaska provided crucial information on the whale behaviours that enabled scientists to correct their approaches in data collection (Huntington, 2000). Additional studies in natural resource management practices (e.g. Berkes, Folke, & Gadgil, 1995; Kawagley, Norris-Tull, & Norris-Tull, 1998; Lyver, 2002) emphasise significance of integrating TEK with Western scientific knowledge. While the process is desirable, the existing differences in these worldviews posit challenges. For example, oral dissemination of TEK (Tiu, 2007) has the possibility of being lost or modified in the process. The resulting setbacks in acquisition and dissemination of TEK require further investigation of its effects. Such a situation suggests recording of TEK in various ways to ensure its continuity. Similarly, Western reductionist methods of fragmenting knowledge is not applicable for TEK which is holistic. In reinforcing TEK, the application of new or mixed approaches needs to be favourable for both TEK and Western science. This creates further challenges on what may or may not be workable.

Given the situational challenges, existing commonalities can be considered when addressing differences in TEK and Western science. For example, considerations

need to be given to the local context in which TEK is used (Dudgeon & Berkes, 2003; Johannes, 1993; Prober et al., 2011; Salmon, 2000); to the local community to be involved as partners in resource management (Stephenson & Moller, 2009; Thomas, 2009); and, to locally appropriate tools and methodologies to be identified for implementing TEK (Abdullah & Stringer, 1999; Maurial, 1999; Tiu, 2007; Tiu & Eames, 2008; Warren, Slikkerveer, & Brokensha, 1995). TEK is a global phenomenon, yet the approaches employed to address resource management issues differ for different communities. Local consultation is essential in creating dialogue and eliminating issues of conflicting paradigms.

The methodological challenge is enhanced by the cognitively diverse knowledge domains in TEK such as forest, medicinal, agricultural and spiritual knowledge. Each of these domains requires specific approaches to address them but need further investigations to deliberate on them. I acknowledge this significant gap in TEK research but am not able to explore these in detail. Instead, I attempt to explore the general perceptions about these in relation to natural resource management and discuss this further in my findings chapter five.

2.2.2.1 TEK in Natural Resource Management

Recent studies in TEK and its use in resource and environmental management (see for example, McGregor, 2009) explore various aspects of indigenous livelihoods. These developed into various studies of TEK integration in conservation practices of indigenous and local peoples (Turner & Berkes, 2006); understanding the role of TEK in environmental assessment and management (Usher, 2000); and other land related issues (Dudgeon & Berkes, 2003).

Inclusion of indigenous perspectives is essential in achieving natural resource management (NRM) outcomes that are not only resilient to changing times but also impartial to the context and locality of where it is implemented. Sherry and Myers (2002) report the inclusion of local interests as “promoting effective conservation efforts and improving communication between indigenous and non-indigenous groups” (p. 346). Improved regional policies based on multilateral strategies such as the Millennium Ecosystem Assessment (2005), the Convention on Biological Diversity and the more recent global Strategic Plan for Biodiversity

2011–2020 and the Aichi Biodiversity Targets (Convention on Biological Diversity, 2010) emphasise inclusion of TEK and other forms of indigenous knowledge as significant to achieving biodiversity goals. The latter clearly states in its eighteenth target:

By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels. (CBD, 2010)

It is the obligations of countries and regions under the tenth Conference of the Parties (COP 10) held in Nagoya Japan in 2010 to ensure this and other targets are achieved. At the country or regional level, issues that may arise from such decisions include on whose terms resource management is to be implemented and who has power to make decisions on the management plans and strategies. Ens, Finlayson, Preuss, Jackson and Holcombe (2003) recognise these in highlighting the constant domination of processes by Western paradigms which are influenced by false perceptions that its philosophies and methodologies are superior. Indigenous values and preferred methods are often pushed aside in favour of the faster and dominant non-indigenous cultures (ibid), affecting indigenous communities and organisations. Sustainable resource management approaches therefore need to reconsider current practices to encourage collaborative partnerships through participatory planning processes and achieve global biodiversity plans and targets (CBD, 2010).

Other debates in the use of TEK concern lack of methodologies to achieve the natural resource management outcomes (Prober, O'Connor and Walsh, 2011). Resource management within indigenous perspectives is based on local or regional systems and has the elements of “customary authority, TEK and

communal management principles” (Sherry & Myers, 2002, p.347). These differ from non-indigenous perspectives which are guided by established legislation and policies of respective authorities, including state and federal governments. Kofinas (1998) adds that indigenous resource management approaches also comprise:

a knowledge base and set of mental constructs that organise and interpret information into useful knowledge; a system of rules, norms and customs concerning rights and responsibilities that are intended to govern the behaviours of all who partake of resources and their benefit; a set of practitioners with a distinctive worldview or culture that includes both this paradigm and certain normative values; and, an overall set of objectives that are embedded in the situations and ideology of the society. (p. 122)

The application of resource management practices within co-managed or traditionally managed areas needs to incorporate these elements into its management strategies and communicate or disseminate them in various forms. The choice of methodologies will vary depending on the location of the managed area and the agreed management strategies. For example, methodologies used in indigenous communities in older colonised countries like Canada and parts of North America may depend on the existing laws and agreements between Aboriginal Councils and the Government or State (e.g. Houde, 2007). These are often more rigid as they are guided by the legislation and policies. In other less colonised indigenous communities such as Papua New Guinea, site specific management strategies are developed and employed based on local practices (Johnson, 1997). This is often problematic in that there are inconsistencies in the application of the strategies for various reasons.

The implication for TEK in resource management is when used, it should be promoted and scrutinised on its own merit. For instance, based on the locality in which it is implemented, TEK can be assessed on whether it has any impact on the communities who use it and what works for them. It needs to also be applied to instances where it makes a difference in the quality of research, effectiveness of resource management and the involvement of resource users in decisions that

affect them (Huntington, 2000). Like scientific knowledge, TEK has its own indigenous methods (Smith, 1999) and approaches for application to specific problems (Haverkort & Reijntjes, 2010). TEK also has characteristics of rational knowledge, like science, and can be integrated with conventional (scientific) knowledge to enhance the chances for intercultural exchange and joint learning opportunities.

TEK in indigenous practices of natural resource management needs to involve ongoing dialogue and consultations based on customary authority and communal management principles (Sherry & Myers, 2002) and participatory approaches (Ens et.al., 2003) guided by indigenous systems of rules, norms and cultures (Kofinas, 1998). This may enable indigenous communities to recognise a process that want to include them in resource management and hence may encourage their participation. The following section examines how TEK has been used in natural resource management in PNG.

2.2.8 TEK in natural resource management in PNG

In an attempt to identify appropriate systems of resource management, it is worthwhile to consider the practices that enabled traditional communities to be sustainable in the use of their environment. Sustainable resource management practices used by these communities need to be understood from their perspectives as practices that are locally relevant. Current traditional resource management practices are common in marine or coastal communities in many parts of the Pacific (Macintyre & Foale, 2007; Ruddle, Hviding, & Johannes, 1992; Veitayak, 1997), including Papua New Guinea (PNG).

The natural resource management sector in PNG had taken a head start in the pre-independence period under the Australian Colonial administration, where the Fauna Protection and Control Act (1966) was first established to assist with resource management (Filer, 2011), and which was later revised in 1990. Under this Act, the protected areas system called Wildlife Management Areas were established in various parts of PNG in an attempt to use the Western ideologies of national parks and protected area systems. One of the challenges in this approach is the exclusion of the landowning communities from the protected areas

(Salafsky, 1999; Tutuana & Tiu, 2012) which was harmful for the local communities. This is because over 90 per cent of land is customary-owned and in such circumstances the people have a right to say how they want their land and resources to be used. As echoed by Johannes (1978), “understanding a conservation system means understanding not only the nature of what is being conserved, but also the viewpoint of the conserver” (p. 349). Any effort for natural resource management needs to take into consideration customs, norms and practices of the participating communities in order to have in place a mechanism that can be understood and implemented by all stakeholders.

In PNG, like other Pacific island countries, natural resource management practices that utilise TEK and other forms of traditional knowledge are common in marine and fisheries management. The Pacific island states are considered one of the “only places in the world with the greatest concentration of traditional community-based systems for managing coastal-marine fisheries resources that are still-functioning” (Ruddle, 1998, p. 105). Traditional marine resource management employs knowledge which the ancestors took centuries to work out and accumulate. These approaches use common TEK practices that guide the harvesting and management of resources and include:

- closing of fishing or crabbing areas.
- closed seasons or banning of fishing in spawning periods.
- allowing a portion of the catch to escape or deliberately not catching all readily available fish or turtles.
- ban on taking small individuals.
- holding excess catch in enclosures until needed.
- fishing in inland lagoons or for certain easily accessible species restricted to times of poor conditions.
- restrictions on taking seabirds and/or their eggs.
- restricting the number of fish traps in the area.
- ban on taking turtle eggs and turtles on beach.
- ban on frequenting favourite spots on turtle nesting beach.

(Johannes, 1978)

Other practices are also region or site specific. For example, Lihir islanders in Papua New Guinea have a practice of periodic or permanent prohibitions on fishing on an area of reef (Mok) installed at the end of the first feast of the funerary cycle (Hararum), when an elderly person first loses a tooth (Macintyre & Foale, 2007, p. 55). Both in Lihir and other parts of coastal PNG such as Karkar Island, temporary prohibitions on parts of reefs and the sea to allow populations of marine resources to recuperate has had favourable effects as numbers increase (Cinner, Marnane, McClanahan, & Almany, 2006; Macintyre & Foale, 2007).

While traditional marine resource management practices are widely recorded in PNG as described above, the same cannot be said about terrestrial traditional resource management practices, as few recorded cases are available indicating a gap in this area. Nevertheless, noted practices include taboo areas which are related to beliefs in spirits that prohibit people using or accessing certain aspects of the forest like the waterfall, mountain, lake or river (Kaiku & Kaiku, 2008; Tiu, 2007). Taboos are a significant traditional resource management practice, although the original intentions are not always explicitly intended for conservation or resource management; they do however, result in indirect efforts.

In a review of literature on the variety of taboos for the purpose of understanding their relevance in traditional resource management, Colding and Folke (2001) identified six categories of resource and habitat taboos which are summarised in Table 2.2. These taboos are practised collectively by the communities who establish them for the purpose intended. For example, segment taboos are applied when a cultural group bans the utilisation of particular species for specific time periods for human individuals of a particular age, gender, or social status. Similarly, temporal taboos are placed on certain resources for a short term period such as weeks or seasons. The significance of these taboos is the control measures for resource use when they are available or needed.

Table 2.2: Types of taboos and their resource management functions

Category	Function
Segment taboos	Regulate resource withdrawal
Temporal taboos	Regulate access to resources in time
Method taboos	Regulate methods of resource withdrawal
Life history taboos	Regulate withdrawal of vulnerable life history stages of
Specific-species taboos	species
Habitat taboos	Total protection to species in time and space
	Restrict access and use of resources in time and space

(Source: Colding & Folke, 2001)

The uses of TEK in natural resource management are varied and site specific. Indigenous communities develop their own practices depending on resource availability, geographical locations and interactions both with each other and their environment. Social obligations and practices are also influential in resource management practices. Significantly, TEK is a transformative knowledge which can be used to foster the empowerment of human populations to explore key issues of sustainable resource use and management and engage in shared production of knowledge and skills to address other environmental issues.

The emphasis of TEK on interrelationships and interconnectedness between people, culture and environment strongly links it to ideas of sustainability. Sustainability is about meeting the needs of present generation without compromising the opportunities for future generations to meet their own needs (WCED, 1987). The process of ensuring the ability of the future generation to meet their needs is not compromised is based on a robust and rich set of relationships that needs to consider the world holistically and recognise the importance of care and justice, both today and into the future.

2.2.9 Summary

Traditional ecological knowledge (TEK) refers to all aspects of indigenous knowledge and practices related to human interactions with the environment (both physical and spiritual) developed over time and passed through generations using various means. Given that TEK is environmental and spiritual knowledge based

on ecological interactions, and is holistic as it embraces all aspects of indigenous worldview and is culturally transmitted, it is now recognised as a strategy for sustainable natural resource management. Various key documents such as the Brundtland Commission report and the Convention on Biological diversity have given TEK prominence globally to be integrated with Western scientific methodologies to address issues of conservation and natural resource management.

TEK is a global phenomenon yet the approaches employed to address resource management issues differ for different communities. Local consultation is essential in creating dialogue and eliminating issues of conflicting paradigms. Inclusion of indigenous perspectives is essential in achieving natural resource management (NRM) outcomes that are not only resilient to changing times but also impartial to the context and locality of where they are implemented. Integration of TEK requires involvement of ongoing dialogue and consultations based on customary authority and communal management principles and participatory approaches guided by indigenous systems of rules, norms and cultures.

Current traditional resource management practices are common in marine or coastal communities in Papua New Guinea (PNG), but a gap exists in the terrestrial resource management practices by indigenous communities. The application of TEK in natural resource management is varied and site specific. Social obligations, resource availability, geographical locations and human and environmental interactions are some key factors that have enabled indigenous communities to develop their own practices according to their needs.

Collaborative efforts are required to foster the empowerment of human populations to explore key issues of sustainable resource use and management and engage in shared production of knowledge and skills to address other environmental issues.

The process of ensuring that the ability of the future generation to meet their needs is not compromised is based on a robust and rich set of relationships that needs to consider the world holistically and recognise the importance of care and

justice both today and into the future. The next section explores the idea of sustainability in relation to TEK.

2.3 Sustainability

Sustainability is a term that is frequently used with greater attention to problems presumably caused by human species. The term sustainability had its origin in the concept of sustainable development which was made popular by the publication of the World Commission on Environment and Development report, *Our Common Future*, also known as the Brundtland Report (WCED, 1987). This report emphasised the finite nature of planet Earth, as threatened by over-consumption of resources by some countries and under consumption by others, leading to inequality and poverty. According to world poverty statistics, 50 per cent of the world's population is living on less than \$2.50 a day with 1.1 billion of people having no access to adequate water (Statistic Brain, 2012). These figures emphasise the link between the environment and quality of life. The Millennium Ecosystem Assessment (2005) reinforced these concerns in their findings which reported "rapid depletion of Earth's natural stock caused by human action in the previous 50 years had caused about 60 per cent of a group of 24 ecosystem services to be degraded" (Millennium Ecosystem Assessment, 2005, p. 6). Such environmental strain is a risk on the ability of Earth's ecosystems to sustain future generations and can escalate human development concerns of poverty and social injustice for vulnerable communities.

Global challenges of ecological, social and economic issues have also increased the debates on sustainability. The widening gap between rich and poor in the dual society we live in, is enhanced by powerful corporations who control the global economy and manipulate production that determine levels of wellbeing. The ever increasing inequalities in economic and power distribution threaten the quality of life (see Barkin, 1998 for case study of Latin America). Sustainability is about people and survival as individuals and cultures (Barkin, 1998); thus preventative actions are necessary to address these. Traditional ecological knowledge (TEK) is identified as an instrumental or functional approach to minimise the effects of environmental degradation and resource depletion. Indigenous cultures in pre-colonial and post-colonial times have demonstrated the importance of sustainable

livelihoods using TEK through a sophisticated understanding of nature-society relationship that enabled them to be sustainable for many generations (Maragia, 2006). These sustainable livelihoods practised by indigenous societies can be used today to deter ecological and economic crises from being experienced globally. The next section provides a historical overview of sustainability and attempts to define it. It also explores the debate on sustainability research and the relationship with TEK.

2.3.1 Historical overview and definition

Sustainability is a multifaceted concept with many meanings derived from across various disciplines. From the ecological science where it has its origins, sustainability refers to the potential of an ecosystem to subsist over time without being altered (Jabareen, 2008, p. 181). From economics, sustainability is perceived as achieving sustainable economic growth at less or reduced environmental cost (Dresner, 2008), while in a social context, sustainability is the achievement of justice and equality for all (United Nations Development Programme, 2011). Sustainability describes the ability of human activities to continue into the future without threatening the existence of life and the environment. Rachel Carson in her book, *Silent Spring*, portrayed this in describing “lifelong interactions between living things and their surroundings without human invasion of the natural ecosystems” (Carson, 1963, p. 5). The human species, in its haste to advance lifestyles and expedite natural processes, interrupted these natural interactions through its activities such as increased use of DDT and other noxious chemicals by farmers for pest control in the 1960s. This affected human-nature interactions through enhanced biological magnification of toxins, killing not only the predator but also affecting the development processes of other animals, such as the fertility of pheasant birds (ibid.). I use the term sustainability throughout this thesis to refer to the ability to maintain and support life without altering the ecosystems.

Sustainability is often used synonymously with sustainable development (Jabareen, 2008; Seghezzo, 2009; Vos, 2007), a term which emerged from the World Conservation Strategy (IUCN, UNEP, & WWF, 1980) and later was given prominence by the publication of the Brundtland Report (WCED, 1987). In

contrast to the World Conservation Strategy, which encouraged use of conservation and development initiatives to promote ecological and social needs for society, this Report focused on people and economic sustainability. The Report also emphasised the “role of technological and economic tools in achieving sustainable economic development” (Tilbury, Stevenson, Fien, & Schreuder, 2002, p. 3), which may be seen as marginalising ecological sustainability through destruction of natural resources for economic growth. Some scholars though argue that “commitment to human and societal wellbeing is as important to the sustainability debate as ecological commitment to the planet” (Dunphy & Benveniste, 2000, p. 6). It is clear from the literature that sustainability requires an integrated approach and that decision making at all levels of society needs to recognise the significance of all three states of sustainability.

The 1992 Earth Summit in Rio de Janeiro was pivotal in reinforcing sustainability and sustainable development through two significant outcomes, Agenda 21 and the Rio Declaration on Environment and Development, which influenced many countries’ commitments to sustainability. Countries from around the globe produced development plans that included sustainability issues as a response. For instance, PNG developed the National Sustainable Development Strategy (1994) immediately in response to Rio 1992, which was then followed by the Medium Term Development Strategy (Mowbray & Duguman, 2009b). Ten years later in 2002, the World Summit on Sustainable Development held in Johannesburg resulted in the introduction of the Decade for Education for Sustainable Development, a United Nations initiative running from 2005-2014 (Conca & Dabelko, 2004). This initiative encouraged inclusion of sustainability topics at all levels of education, although country-specific actions differed as some were more advanced than others. For example, the New Zealand government produced *See Change: Learning and Education for sustainability* (Parliamentary Commissioner for the Environment, 2004) as a response, while countries like PNG had none in place. The Rio +20 Summit in Rio de Janeiro in June 2012, a follow-up to Johannesburg 2002, produced disappointing outcomes with key first world states failing to make commitments to sustainability, equitable development, and climate change (Vaughan, 2012). Such actions could jeopardise the enhancement

of sustainability concerns as lack of consensus on this crucial issue may have adverse effects on environment, natural resources and people.

The role of science in developing human understanding of “biological needs for food, water, air and freedom from diseases, parasites and harmful chemicals” (Morse, 2010, p. 6) is a key concern in the sustainability debate. Science is described as significant in “deriving minimum conditions for continuance of life in the biosphere and of humanity within society” (Craig, 2004, p. 11). Science, through ecology, provides a basis for understanding interconnectedness in the natural world where all organisms including humans interact at biophysical levels. Even “living organisms and their abiotic environment are inseparably interrelated and interact with each other” (Odum, 1971, p. 8). These interactions not only produce and support lives but also sustain and maintain the biosphere that we live in. An example of such interaction is demonstrated in the law of thermodynamics which allows us to understand the dependence of the biosphere on the sun’s energy to drive biogeophysical cycles and sustain life (Craig, 2004).

Another useful example is emphasised by the Club of Rome report, *Limits to Growth*, which predicted the impact of exponential growth of the human population on resource availability (Meadows, Meadows, Randers, & Behrens III, 1974). This influential report used computer modeling to examine the implications of unchecked economic and population growth in the context of finite resources, and predicted the likelihood of social and economic collapse if current trends remained unchanged. It also highlighted the potential for a state of global equilibrium, where “population and capital will be equally stable if the forces acting on them are in a carefully controlled balance” (Meadows et al., 1974, p. 171). The predictions in this report somewhat failed to materialise as advances in technology overcame some of the limitations to growth that were foreseen. However, it is clear that science and technology are inadequate to understand the complexities inherent in the notion of sustainability. The multifaceted nature of sustainability involving social, cultural, political and economic factors requires a broader participation, understanding and implementation.

The task of achieving economic, ecological and social sustainability requires a combined effort. Livelihoods can be economically sustained if different forms of capital are used to foster equitable distribution, access and utilisation of resources (Maragia, 2006). Similarly, sound management of environmental and natural capital to ensure present and future generations enjoy the same ecosystems can ensure achievement of ecological sustainability, while equal access, control and use of resources could ensure achievement of social sustainability (ibid). In achieving these different levels of sustainability, the wellbeing of people and cultures of the world can also be maintained. By valuing social justice, equality and human wellbeing, sustainability is aligned to the debates on traditional ecological knowledge (TEK) which also acknowledges cultural and moral values of society. The next section discusses the debates on sustainability and sustainable development.

2.3.1.1 Sustainability and sustainable development

The concept of sustainable development provides a global agenda for policy development in achieving ecological, economic and social sustainability. Sustainable development has been defined in the Brundtland Report as “development that meets the needs of the present without comprising the ability of the future generations to meet their own needs” (WCED, 1987, p. 43). Although this is a widely accepted definition of sustainable development, and to some extent sustainability, there are many debates on its interpretation as it differs in various contexts (Magis, 2010; Morse, 2010; Power, 2011; Rao, 2000; Seghezze, 2009; Vos, 2007). However, there are three fundamental concepts in the Brundtland Report definition that are commonly emphasised by all. These are the terms development, needs and future generations (intergenerational equity) and I explore each of them in the following discussions.

In the first instance, the World Bank (2004) defines development as “maximising people’s happiness” (p. 7) while Princeton (2012) refers to it as “a process that includes and goes beyond economic growth” (p. 1). Kurian and Bartlett (2011) delineate it as “the conscious and self-directed pursuit of desirable social change” (p. 2). The variance in the definitions indicates complexities in the terminology from different stakeholders’ perceptions. Kurian and Bartlett (2011) capture the

essence of a Human Development report (1990) which defines development as a means to “create an enabling environment in which people can enjoy long, healthy and creative lives” (UNDP, 2006, p. 263). Development can be perceived as either a process of growth and change, or a state of achieving a desired change in terms of growth and advancement. For instance, as a process, one can be empowered with freedom of choice to embrace changes experienced with an open mind. As a state of growth or achievement, a desired change is achieved such as construction of new classrooms for a primary school in PNG to increase participation rates. Development is a “multidimensional concept because any improvement of complex systems occurs in different parts or ways, at different speeds and driven by different forces” (Bellù, 2011, p. 2). What is evident is that it is generally about people and how they are able to take control of their lives to experience improvement or change.

In as far as human wellbeing is concerned, it is measured in terms of living a long and healthy life or longer life expectancy; being educated in terms of achieving adult literacy and enrolment at primary, secondary and tertiary level; and having a decent standard of living measured by purchasing power parity or PPP income (UNDP, 2006). For many indigenous communities of the world, a regular income is not forthcoming because many are subsistence farmers who live off the land. So material wealth should not be the only terms for measuring human welfare (Jackson, 2009) as there are other factors such as geographical location, culture and resource availability that may also influence this. While economic growth can achieve some measures of wellbeing, it should not be the only yardstick. From an ecological perspective, healthy ecosystems determine species wellbeing which also indicates a healthy gene pool. For example, forest resources offer natural habitats for other biological resources, including humans, and act as a genetic library (Rao, 2000). If these forests are healthy, the gene pool, humans and other species are also healthy. Healthy ecosystems influence environmental and social changes which in return influence economic growth and achieve social sustainability.

The term *needs* is defined by Thompson (1995) as wants or requirements while the Brundtland Report refers to it as things needed to achieve full growth potential

of poor nations like food, water, shelter, jobs and education (WCED, 1987). Various authors argue that all humans may have the same needs but their specific individual requirements are different (Seghezzo, 2009), depending on their own perceptions of the meaning and nature of life. Abraham Maslow's "hierarchy of needs" clearly categorises these different levels of needs from the most basic physiological (survival) needs to safety and security; belongingness and love, self-esteem, self-transcendence, to the highest level of self-actualisation (Koltko-Rivera, 2006). In categorising needs as defined by the Brundtland Report, economic needs would be closely aligned to Maslow's needs for safety and security, while environmental needs align to physiological needs. Social needs would relate to the remaining levels of Maslow's needs for belongingness and love; self-esteem, self-transcendence and self-actualisation. The correlation between need areas identified by Brundtland Report and Maslow's hierarchy of needs emphasise the importance of assessing needs of the present holistically so that the needs of future generations are not compromised.

This leads me to the question of whether Maslow's hierarchy of needs includes indigenous peoples' spiritual needs, as raised in section 2.2.1. As highlighted earlier, many indigenous communities live off the land and sea as subsistence farmers and have needs that may involve more than Maslow's needs list. Indigenous worldviews are centered on spirituality, which forms the holistic perceptions they hold. The existence of humans and other species is embraced within this spiritual realm and cannot exist without it. Whether it is the Christian God, ancestral spirits or other deities, indigenous people acknowledge the existence of spiritual beings which fulfill a certain spiritual need they hold. This need cannot be measured by the purchasing power parity or any form of material wealth.

Within the ecological perspective, other species also have specific needs for food, water, space, sunlight, and other biophysical factors for survival which is obtained from their natural environment. Yet these needs are ignored in the anthropocentric arguments offered by the Brundtland Report. Rao (2000) warns that "the anthropocentric approach will soon reach a critical stage so there must be room to accommodate a balance between the anthropocentric and ecocentric approaches"

(p. 70). The Brundtland definition needs to be redefined to incorporate ecocentric views. This leads me to the argument that meeting the needs of the present without compromising the ability of future generations to meet their own must also refer to the needs of other organisms. To achieve sustainable development, there needs to be a balance between anthropocentric and ecocentric approaches.

In the context of development, a measure of economic growth and development is derived from the Human Development Indicators (HDI) produced by the United Nations Development Programme. These indicators measure human wellbeing in terms of having a long and healthy life, being educated to a certain level and having a decent standard of living (UNDP, 2006). For instance, based on the HDI, the World Bank classified PNG as a lower middle income country with GNI per capita of US\$1480, life expectancy of 63 years, and average education of 4.3 years (World Bank, 2011). Although human needs can easily be categorised within these indicators, an individual's needs for happiness and fulfillment are not merely satisfied by material possessions. Excessive materialism often comes between people and their social needs, preventing them from achieving full satisfaction in life (Wilkinson & Pickett, 2009). There are human needs that cannot be satisfied by the accumulation of material wealth but needs to be met by other means. For example, within indigenous perspectives, spiritual values are recognised as important as they enable a person to develop a deeper relationship with their environment.

Another critique of excessive materialism is the issue of social equality and justice. The unequal distribution of resources within many societies prevents the needs of self-actualisation and self-esteem to be reached. Even in developed countries such as USA and New Zealand, the high level of socio-economic inequality leads not only to poor physical and mental health and other social problems, but also to everyone in society as a whole being worse off (Wilkinson & Pickett, 2009). Social sustainability is evident in a socially harmonious and inclusive society that allows the fulfillment of environmental, economic and social needs. It is also important to recognise that good development can be achieved particularly for indigenous people, not by relying only on Human Development Indicators to measure social sustainability, but also other intangible

aspects such as acknowledgement of cultural and spiritual values.

The third concept of *intergenerational equity* emphasises the issue of future needs and timing which is measured within generations (Kates, Parris, & Leiserowitz, 2005; Morse, 2010). The challenge for the present generation is to meet their needs without compromising the future generations' ability to meet theirs within this period. It may be that future generations' preferences may differ from those of the present generation, so there is a need for the present generation to leave behind sufficient resources so future generations are not constrained in their preferences (Rao, 2000). There are also the issues of carrying capacity and the Earth as a finite system with limitations that needs to be considered. This demands actions by governments to incorporate sustainability objectives in their national plans to ensure the overall goal of sustainability is achieved. The Millennium Development Goals (MDGs) (United Nations, 2012) followed by the Sustainable Development Goals (2016-2030) established by the United Nations, for example, provides a strategic framework on which governments around the world can develop relevant policies and strategies to direct sustainable development. While many countries including PNG have developed their immediate development goals in response, their effectiveness is yet to be established and is beyond the scope of this study.

The Brundtland Report was a landmark that pioneered the debate on sustainable development. It makes a strong argument to recognise social justice and basic needs as essential for economic growth. The report also acknowledges key roles of the present and future generations in achieving sustainable development. It is my view that capitalist economic growth should not be the sole focus of sustainable development. A more revised approach towards green growth which considers holistic human needs, social equality and justice *and* environmental sustainability would be an ideal model. Within this perspective, sustainable development can be defined as development that meets the holistic needs of the present without compromising those of the future generations (WCED, 1987) while sustainability is the state of achieving sustainable development.

2.3.2 Sustainability and its implications for TEK

Sustainability is related to the quality of life in a population or community where a healthy, productive and meaningful life is provided for its citizens, a notion that is consistent with the literature on TEK (Berkes, 1993; Hart, 2010; United Nations, 1992; World Commission on Environment and Development, 1987). The term sustainability was founded on the Brundtland definition of sustainable development which is described by Bellù (2011) as “development that considers the long term perspectives of the socio-economic system; to ensure that improvements occurring in the short term are not detrimental to the future status or development potential of the system and are sustainable on environmental, social and economic grounds” (p. 3). Sustainable development was defined by Tilbury et.al. (2002) as a “process of change that possesses values and principles” (p. 4) consisting of equity, interdependence and responsible actions. These principles are aimed at achieving human wellbeing, key elements of which are described as having basic material needs for a good life, freedom and choice, good social relations, personal security, and good health (Millennium Ecosystem Assessment, 2005)

Firstly, “equity is a measure of the relative similarity among individuals or groups to have the opportunity to enjoy socio-political rights, material resources, technologies, health, education, and other elements of human well-being” (Daily & Ehrlich, 1996, p. 992). Human wellbeing in the context of TEK is about people helping, supporting and respecting each other (Hart, 2010). These elements may differ slightly from some indigenous perspectives where specific things like secured land use rights are deemed significant for their wellbeing. The approaches used to identify these elements vary for each situation, however fairness of processes and outcomes of decision making (Munasinghe, 1999) are the key focus. Fairness is crucial in this sense because already benefits of growth are unequally distributed globally. For example, a fifth of the world’s population earns just two percent of global income as compared to the richest 20 percent who earn 74 percent (Jackson, 2009). Huge disparities such as having a fifth of the world’s population earning just two percent of the global income are unacceptable as they have spill-over effects on society such as resource overuse, land degradation and deforestation.

Social equity has recently received a lot of attention and has been linked to sustainability due to widespread unfair distributions of income and social benefits. Many efforts have been made to achieve social equity but culminating results indicate lack of success due to an “unending agenda of poverty; increasing inequality in many countries; and the considerable stress Earth’s ecosystems are undergoing” (Clark, 2012, p. 1). The issues of poverty, inequality and environmental degradation need to be addressed holistically due to disparities. Even advanced economies have their own share of inequality and Jackson (2009) noted this was higher than it was 20 years ago. According to Munasinghe (1999), “poverty alleviation; improved income distribution and intragenerational (or spatial) equity are key aspects of economic policies seeking to increase overall human welfare” (p. 17), although in isolation they are ineffective. A combined effort by concerned stakeholders can ensure inequality mounting from environmental degradation is addressed. Keck (1995) describes an example about the growth of the Acre Rubber Tappers' Movement in Brazil from a traditional extractivist population concerned with land use rights to a broader movement for social justice and global environmental struggle. This growth was the outcome of the group’s ability to recognise their limits and align with strategic partners to support them in their fight for justice. This is supported by the argument that if disadvantaged groups are empowered through grass-roots participation in decision-making, there will be a greater chance of strengthening the fight for equity (Munasinghe, 1999). The implication is that issues of social equity are not isolated and need to be considered in the broader sense in consultation, although some local or regional differences may exist between third world and the richer nations.

Secondly, the principle of interdependence exists across time and space, connecting the past, present and future and emphasises the connections between society and environment. This knowledge has enabled early inhabitants of our planet to recognise the limit of the environment to provide what it can to society. Earth’s limit is its carrying capacity which is dependent on the amount of resources available in the ecosystem, the population or community size, and the amount of resources each individual within the community is consuming (Sustainable-environment, 2012). Humankind has the responsibility to take only

what is needed from the environment and interestingly, this principle already exists within indigenous societies of the world through their TEK (Berkes, 1999; McGregor, 2004). It is for this reason that an understanding of TEK is essential for promoting sustainability principles.

Globalisation has seen that nations and peoples of the world are interdependent through economic, environmental and social interactions. Economic interdependence also exists in the production and marketing of goods and services which are made easier through computerisation, telecommunication and cheap transportation (Paehkle, 2012). Greider (1997) noted a sharp increase in global bonds financing and international bank loans in 1980 as a result of these interactions. It is worth noting that economic interactions are dependent on the environment for natural resources. This is illustrated by the Millennium Ecosystem Assessment (2005) which reported the production and manufacture of industrial wood products in the early 1990s as contributing \$400 billion to the global economy (Matthews, Payne, Rohweder, & Murray, 2000), while the world's fisheries contributed \$55 billion in export value in 2000 (FAO, 2000).

Environmental interdependence has been an existing phenomenon since the beginning of time when humankind and other organisms had a direct dependency on the environment for basic needs. While this has changed due to the changing needs of the modern world, there are still some indigenous communities and other species that are reliant on the environment. For indigenous people, this reliance is evident in many of their daily practices today (see also Stephenson & Moller, 2009; Turner & Berkes, 2006), although some modifications are made in their methodologies to combine western and traditional ecological knowledge where appropriate. The same cannot be said about other species as they are the most vulnerable to environmental changes that are happening today. For example, the decreasing population of North American songbirds due to loss of their habitat in the tropical rainforest of Latin America (Paehlke, 2012) reminds us of the vulnerability of many animal species. One key factor is that many non-human species cannot be contained in fragments or corridors of habitats as they prefer wider foraging areas. With increasing habitat loss and other environmental problems, all organisms including humans need to recognise that their survival

depends on recognising their interdependence on other species and on healthy ecosystems.

Increasing demands for natural resources has resulted in increased environmental problems which are widespread and complex as many parties are involved. The extraction of natural resources, for instance, has adverse effects on the environment and society resulting in injustice, poverty and inequality. Social interdependence has become significantly crucial although it comes in many forms. Paehlke (2012) noted three common aspects of social interdependence as increasing global cultural integration mostly influenced by the American culture, employment opportunities, and civil society organisations.

Thirdly, the principle of responsible actions emphasises the importance of how we as global citizens view the environmental dilemmas and their effects, and take actions that are sustainable for the present and future generations. Taking responsible actions was a characteristic of traditional systems through TEK whereby resource consumption was at its minimal and concerns for future use was constantly on the communities' minds (Berkes, 1999; Houde, 2007; Usher, 2000). One of the problems of global citizenship today is the high consumption of energy and other material goods for comfortable living (Sustainable-environment, 2012), which in return produces detrimental effects such as air and water pollution. By being part of the global society, we are obliged to develop solutions to address these issues and become responsible citizens. Some of the key aspects of this include promoting social and economic justice; consensus-building; cultural harmony and tolerance; the willingness to contribute for the common good; acquiring a better understanding of the environment; and, translating knowledge into responsible environmental action and the empowerment of others (ibid). The recognition that we live in an interdependent world where the Earth's ecosystems interact with society and economy enables us to acknowledge the global responsibilities we have as well.

Sustainability is about integrating the environment, society and economy and being responsible for our actions to achieve equity and promote recognition of interdependence. Within this perspective, the economy, and in turn society exists

within the wider context of the environment. This is illustrated by the strong sustainability model in Figure 2.1. The strong sustainability model recognises that “economic systems always exist within a social context and many important aspects of society do not involve economic activity” (PCE, 2004, p. 15). The strong sustainability model focuses on the environment and supports the notion that all economic activities are constrained by the ecological systems within which they exist. Within this paradigm, there are restrictions on human societies to ensure the biosphere does not exceed its capacity to support life. The strong sustainability model is favourable because it is more likely to deliver on the goal of sustainability.

The use of the strong sustainability model clearly emphasises the inextricable link between all components of sustainability including its existence and application through the use of TEK. Economic sustainability is a subset of society which in return is completely dependent on the environment (TKI, 2012). The environment contains the natural resources which supply raw materials for development. By protecting and caring for the environment, the resources will not be depleted.

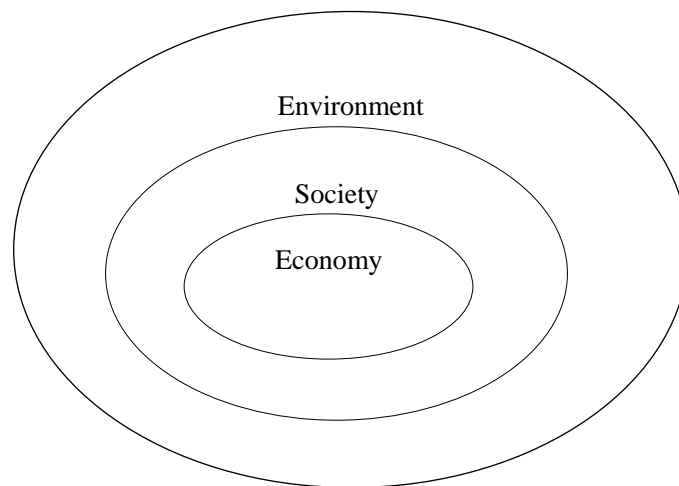


Figure 2.1 Strong sustainability model

Source: Parliamentary Commissioner for the Environment, 2004

The three key principles of sustainability described above (equity, interdependence and responsible actions) are consistent with the ideologies of TEK as described in section 2.2.1. TEK recognises the interdependence that exists

in the world and attempts to approach this holistically. It emphasises equality among all components of the environment and encourages responsible actions to be taken to ensure continual supply of resources for all organisms. The next section discusses the issues on education and its implications for sustainability.

2.4 Education for all

Education is seen as an essential constituent of any society; promoting equity, interdependence and responsible actions. Globally today, education is not confined to schools or formal education institutions, it extends beyond the classroom and involves non-formal means. Whatever learning that occurs outside of the formal system can be as liberating as learning within that system. It is not necessarily what is learnt that matters, but the reasons why learning occurs and who benefits from it that makes a difference. Baker, Lynch, Cantillon and Walsh (2004) asserted that primary education was established for the purpose of social control, not necessarily liberation and enlightenment (p. 40). Other authors (Baker et al., 2004; M. Cole, 2008; Freire, 1976; Wilson, 1975) describe education as essential for improving awareness and participation of the underprivileged to exercise their rights as global citizens.

Education matters to everyone irrespective of class, gender and race. It “develops capabilities and reinforces a sense of wellbeing and self-esteem; has powerful formative influence on personal and social development; and, enhances the chances of attaining other rights” (Baker et.al., 2004, p. 142). Through education, issues of oppression, social injustice and inequality were addressed by early educators through various pedagogical approaches. For example, Freire (1994) described the ‘pedagogy of the oppressed’ as an approach he used to address the growing oppression in Brazil through education. Drawing from other philosophers such as Dewey and Piaget (ibid), Freire focused on the importance of positive child-centered reinforcement in learning and liberation in education. These pedagogies were used to create on-going dialogue between educators, governments, the oppressed and advocates in an attempt to emphasise education as a right for all people despite their class and origin. Freire’s views were captured by UNESCO’s Education for All goals which emphasise “education as a fundamental human right and essential for the exercise of all other human rights.

It promotes individual freedom and empowerment and yields important development benefits” (UNESCO, 2012, p. 1). This is supported by Article 26 of the Universal Declaration of Human Rights (1948) which states:

Everyone has the right to education. It shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory...and shall be directed to the full development of the human personality and to the strengthening of respect for human rights and fundamental freedoms. It shall promote understanding, tolerance and friendship among all nations, racial or religious groups and shall further the activities of the United Nations for the maintenance of peace. (Cole, 2006, p. 1)

Education is an influential tool for those who are economically and socially underprivileged or have been oppressed on the grounds of race or ethnicity, gender, class, sexuality or other forms of structural discrimination. Similarly, education is also an enlightening tool for indigenous peoples as education provides them the opportunity to improve their social and economic conditions. For indigenous and Third World nations, education also serves the purpose of material and cultural survival. Not only have these groups of people been exposed to devastating impacts from the consequences of colonisation and western ideologies of development and growth; but they have also been separated from the land, which is the source of their livelihoods, and forced to fit into societies that are alien to them (Sullivan, 1999). Over many generations, these people have practised a custodial concept of land and other resources and define themselves in relation to the habitat from which they draw their strength and resources for livelihoods (ibid). Separation from their source of livelihoods has oppressed many, leaving them helpless in their plight, uncertain of their future. To such oppressed, education is not only indispensable, but also serves an emancipatory function when they are allowed to exercise it. Such circumstances require education to be geared towards achieving self-education and emancipation using culturally relevant pedagogies. This can be achieved through enhancing their capacity for intellectual inquiry through guided discovery and sustained attention through experiential learning (Freire, 1994). As emphasised by United Nations

(2010), education beats poverty, promotes gender equality, and contributes to improved maternal health and reduced child mortality. It helps combat HIV, malaria and other preventable diseases, encourages environmental sustainability and helps global development (ibid).

Education for indigenous peoples need not only embrace Western ideologies, but be drawn from their holistic indigenous knowledge, particularly their local TEK. The principles that promote equity, interdependence and responsible actions embedded in TEK are significant in this regard and need to be identified to guide indigenous education. While rights to education, according to UN Declaration of Human Rights (1948), encourages full development of human personality (Sullivan, 1999), they do not specify formal education as the only source to achieve this status. In other words, any form of education, either formal or non-formal, is accepted as means to achieve rights to education for all global citizens. The next sections examine these forms of education and how they occur in PNG.

2.4.1 Formal Education

Formal education enables indigenous communities to participate in the global economy, achieve good health and improved standard of living, yet, there are aspects of indigenous livelihoods that it does not influence, such as the knowledge of how to live sustainably. Formal education often disorients indigenous learners (Semali & Kincheloe, 1999; UNESCO, 2010), who have difficulty grasping abstract knowledge and academic ways of learning which Western reductionist perspectives promote. It alienates them from their practical everyday indigenous knowledge and ways of learning and leaves them feeling inadequate. The Western education differs from indigenous education in that it uses the process of “learning through instruction and reading and internalising abstract information for application later in real world context (Bates, Chiba, Kube, & Nakashima, 2009, p. 6). Indigenous education on the other hand, involves the process of learning through observation and doing by interacting over long periods of time with knowledgeable elders and the natural environment (ibid). These differences highlight the significance of the debate on what indigenous people want as compared to what can be acquired from Western perceptions of education.

In one example, Matthews (2010) reported the case of inconsistencies in the Indigenous and Western cultures in Australia that is often viewed as destroying indigenous education and patronising to the Indigenous ways of life. The debate on indigenous versus western perceptions is never ending but what can be drawn from these debates is the argument that education for all can be achieved if due consideration is given to the ways indigenous people view education and how they want to benefit from this process. It is therefore my view that non-formal, informal and community education all play significant roles in addressing these gaps by allowing education of indigenous people to occur using the approaches and context that are familiar to them (see section 2.4.5 for discussion on indigenous education). The next sub section provides an overview of the formal education system in Papua New Guinea.

2.4.2 Formal Education System in Papua New Guinea

Formal education is a term used to refer to a structured education system provided by the state for its citizens. It is a hierarchically-structured system of education which is chronologically graded from primary schooling through to the university, and includes specialised full time professional and technical programmes and institutions (Smith, 1996). In most countries, formal education is state-supported and operated but private systems are often allowed or certified to provide comparable education.

The history of formal education in Papua New Guinea (PNG) is relatively short. Modern schools were introduced in the late 1900s by missionaries for the purpose of reading the Bible (Kaleva, 1998). It was not until the early 1960s that the first state schools were established by the colonial administrators, which continued until the 1970s when the current national education system was established (National Department of Education, 2004). One of the critiques of pre-colonial education was the perception that it was set up to prepare clerical workers to assist colonial administrators. These perceptions changed slowly post-independence as many more Papua New Guineans became educated and took up other professional and trade jobs.

Over the last decade, the National Education system experienced a major curriculum and structural reform which set the pathways for education in PNG for the next ten years and beyond. These pathways are summarised in Figure 2.2 and include pre-school, elementary, primary, secondary and technical/vocational education. Within this system, there are three years of elementary, six years of primary and four years of secondary education with three exit points at Grades 8, 10 and 12. National enrolment figures for 2008 indicated that over 1.2 million children and youth were enrolled in schools in PNG in that period. Of these, 34.5 per cent were enrolled in elementary schools while 57.8 per cent in primary and 7.7 per cent in secondary schools respectively (NDOE, 2008). This was an increase from the year 2000 when the total student enrolment was recorded at about one million. The National Department of Education projects that by 2014, the school age population will be about 2.3 million which is almost twice the number in 2008 (NDOE, 2004).

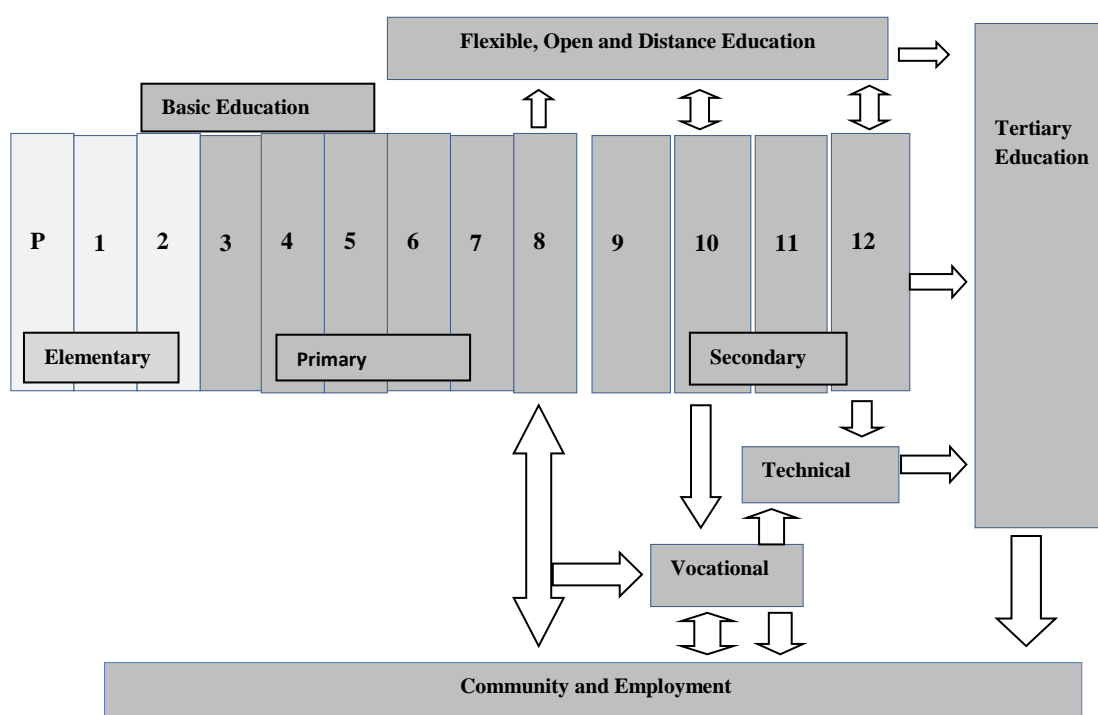


Figure 2.2 Overview of PNG Education Structure

At each exit stage, a national examination is used to determine students' progress through either the academic or vocational pathways. It is worth noting that this system has its own flaws. For example, Kaleva (1998) noted shortages of Grade 6, 7 and 8 teachers in primary schools and lack of qualified teachers for Grades 11

and 12 in secondary schools as a problem. While I acknowledge the existence of these flaws, it is not my intention to discuss them in detail as it would require thorough investigation.

Within the current system, which underwent some changes for elementary, primary and secondary education in 2015, the subjects offered are varied but consist of the ones shown in Table 3. The elementary level is significant because it is at this stage that formal education of the child begins to take shape. The emphasis at this level is linking formal learning to what the child receives at home or in the community; which encourages use of local vernacular as a medium of communication and focusing on four subjects particularly Culture and Community, English, Language and Mathematics. Initially there were only three subjects (Culture and Community, Cultural Maths¹ and Language) but with the changes in 2015 in the curriculum, there was an additional subject (English). The critics of the previous system (Heistand, 2009) question the use of local vernacular in early education and single it out as contributing to poor reading and writing skills in English in the later years. Thus the changes that now includes English as a subject. The continued use of local vernacular in the elementary curriculum is significant as it fulfills the purpose of the sixth goal of UNESCO's Education for All Goals which aims to "improve all aspects of the quality of education and ensuring excellence of all so that recognised and measurable learning outcomes are achieved by all, especially in literacy, numeracy and essential life skills" (UNESCO, 2012, p. 1). The use of local vernacular helps to achieve the learning outcomes as prescribed by the syllabus by using a familiar language then slowly introducing a new language, which is English.

The primary level has two categories, lower and upper. The lower Primary links the elementary and primary levels so it continues to offer the English bridging programs in Grade 3. The subjects change slightly in Upper Primary to expose the learner to a more specialized learning environment which prepares them for the next stage. The secondary level is also categorised into lower and upper levels. At the lower level, generalised subjects in science and social sciences are taught but

¹ Cultural Maths was used to describe the kind of Maths taught to elementary children which uses the local vernacular with a lot of focus on the cultural uses of Maths.

these become more defined at the higher level where specific disciplines (such as biology, chemistry, physics and geography) are now taught. At this level, the students are also encouraged to choose their own pathways in academic or vocational subjects. In the academic pathway, students have a choice of the arts or sciences which prepare them to enter university or other post-secondary learning institutions. The vocational pathway encourages students to choose subjects in the vocational trade that prepares them for direct employment or further skills training in vocational and technical schools.

Table 2.3 Summary of subjects offered in formal education in PNG

Level	Grade	Subjects
Elementary	Prep – 2	Language, Mathematics, English, Culture and Community
Lower Primary	3-5	Language, Mathematics, Environmental Studies, Community Living, Art, Physical Education
Upper Primary	6-8	Language, Mathematics, Science, Social Science, Personal Development, Arts. Making A Living,
Lower Secondary	9-10	English, Mathematics, Science, Social Science, Personal development, Arts, Business studies, Design Technology, Agriculture
Upper Secondary	11-12	Accounting, Applied English, Natural Resource Management, Applied Science, Biology, Business Studies, Chemistry, Computer Studies, Design Technology, Economics, General Mathematics, Geography, Geology, History, ICT, Language & Literature, Legal Studies, Music, Personal Development, Physical Education, Physics, Theatre Arts, Tourism, Visual Arts

The primary level has two categories, lower and upper where the lower links the elementary and primary levels. The subjects change slightly in Upper Primary to expose the learner to a more specialised learning environment which prepares them for the next stage. The secondary level is also categorised into lower and upper levels. At the lower level, generalised subjects in science and social sciences are taught but these become more defined at the higher level where specific disciplines (such as biology, chemistry, physics and geography) are now taught. At this level, the students are also encouraged to choose their own

pathways in academic or vocational subjects. In the academic pathway, students have a choice of the arts or sciences which prepare them to enter university or other post-secondary learning institutions. The vocational pathway encourages students to choose subjects in the vocational trade that prepares them for direct employment or further skills training in vocational and technical schools.

One of the shortfalls of formal education in PNG, and the Melanesia region in general, is its inability to close the growing gap between the increasing number of school leavers and the availability of jobs to be filled up. For example, in 1993, PNG had a total of 50,000 school leavers; but only 2000 jobs were available (Cole, 1996). Similarly, for the projected 3,065,000 working age population in PNG in 2011, about 2,019,000 were expected to be economically active but only 332,000 would have a wage employment (ibid). These projections are similar for other Melanesian countries of Fiji, Solomon Islands and Vanuatu indicating high number of school leavers without adequate wage employment, and increasing the need for people to live off the land. Another issue related to this is the case of a low-skilled labour force. Formal education alone would not be able to up-skill the whole population because of many factors including lack of financial and other resources. The governments in this region need to seek alternative measures to improve the situation and increase not only the skills, but also basic knowledge and livelihoods of the population to achieve UNESCO's education for all goals and the UN declaration of human rights. It is in such situations that the need for alternative education becomes crucial and needs to be incorporated into government policies.

One of the key aspects of formal education that is often overlooked is that the majority of PNG's population is rural, that is about 87 per cent, who depend on a subsistence economy. One of the problems that is often associated with this is low literacy levels. For example, a study by Rogers et.al (2010) in the Eastern Highlands Province of PNG highlighted more than 70 per cent of those surveyed "do not have any experiences of formal education" (p. 8). The government of PNG has recognised the shortfalls of formal education as well as being aware of the need of these 87 percent heavily rural-based populations to be involved in the

informal sector and thus has in place a National Literacy Policy (2000). The overview of this policy states:

Literacy is not just reading and writing. It is about learning, thinking, critiquing and expanding vision; it is about encouraging a desire for life-long learning in all Papua New Guineans and equipping them with the skills to fulfil that desire. (Asia-Pacific Cultural Centre for UNESCO, 2003)

While this policy encourages a desire for life-long learning through skills acquisition, it does not clearly outline how these can be achieved. Its central focus is on achieving literacy skills in reading and writing. This is unlike the neighbouring Melanesian country of Solomon Islands, which already has a clearly defined non-formal education policy outlining its purpose and objectives (Cole, 1996). By comparison, PNG has a bigger population of 7.3 million with greater economic and social needs, requiring clear policy directives to enable it to achieve its hopes and dreams. It is often the rural illiterate population that is highly susceptible to external pressures of developers to extract timber, minerals and other resources.

2.4.3 Non-formal education in PNG

Structured education is “no longer bound by place or time or how, when and where it occurs” (Coombs & Ahmed, 1974, p. 8). Education that focused on recurrent and lifelong learning became known as non-formal education (NFE) and gained recognition through education policy between the late 1960s and early 1970s (Smith, 2001). NFE refers to education other than the formal school or tertiary system. Coombs and Ahmed (1974) also define it as “any organised educational act outside the established formal system whether operating separately or as part of a broader program that is intended to serve an identifiable clientele and objectives” (p.15), while Dip (1988) also added that it involves “less teacher-student contact while taking place outside a formal institution” (p. 301). Both definitions highlight organised activities outside of a formal context as a key characteristic and Fordham (1993) also adds other features such as NFE “has relevance to the needs of disadvantaged groups, concerns specific categories of

persons with clearly defined purposes and flexibility in organisation and methods” (p. 2).

NFE is not compulsory, does not necessarily lead to formal certification and is not often supported by the State, although it does achieve some purposes of the government’s policies such as adult literacy and youth development programmes (Smith, 2001). NFE can take many forms including out of class activities for children, adult literacy programmes, accelerated learning programmes or entrepreneurial skills development. In the context of this study, I use NFE to refer to any type of learning or education that occurs outside of formal classroom learning such as informal community meetings.

The type of NFE programs in PNG, like other Melanesian countries, include village-based literacy programs for adults and children, agriculture and health programs, provincial and community libraries, and some distance and flexible learning opportunities through various Universities. Cole (1996, p. 17) lists four categories of NFE that were also used in PNG and other Melanesian countries including:

- general or basic education such as literacy, numeracy, an elementary understanding of science and one’s environment;
- family improvement education such as those designed to impart knowledge, skills, and attitudes useful for improving the quality of family life, health, nutrition, home making, child care, home repairs and family planning;
- community improvement education such as those designed to strengthen local and national institutions and processes through instructions in such matters as national and local government, cooperatives and community projects; and,
- occupational education consists of those programs designed to develop particular knowledge and skills associated with various economic activities and are useful in making a living.

It is also worth noting that in PNG, there is no clear distinction as to when formal education ends and non-formal education begins so a mixed approach appears to be more appropriate. In the light of this thesis, TEK and its relationship with sustainability can be emphasised through all the above four categories. TEK is about one's knowledge of the environment (Berkes, 1993, 1999; Berkes et al., 1995) and the specific knowledge, skills and attitudes one has learnt to use to improve one's livelihoods. Sustainability is about being aware of one's responsibilities to design tasks and activities using skills and knowledge acquired to strengthen relationships, improve dialogue, live healthy meaningful lives and improve living standards (Boyden, 1994; Jabareen, 2008; Magis, 2010; Power, 2011). Non-formal education provides the opportunity to harness the relationship between TEK and sustainability through indigenous and sustainability education. These require models of education that could promote and facilitate flexible lifelong learning systems that integrate all aspects of formal, non-formal and informal education approaches that meet national and regional needs goals of sustainability.

2.4.4 Informal Education

Informal education diversifies in some way from formal and non-formal education yet it maintains some connections to both. Dip (1988) describes informal education as having “no organised and systematic approaches such as a written curricula, aimed at both students and the general public with no control over performed activities and imposes no obligations” (p. 304). Coombs and Ahmed (1974) defined it as “a lifelong process by which every person acquires and accumulates knowledge, skills, attitudes and insights from daily experiences and exposure from unorganised and unsystematic educational experiences” (p.8). Eshach (2007) adds that informal education is “learning that occurs spontaneously such as those within family or neighbourhood circles” (p. 173). Thus a general definition of informal education would be education that involves unstructured systems which embraces daily learning experiences and exposure at any time. This general perspective of informal education connects it to indigenous education practices (see section 2.4.6) through which TEK about sustainability was often delivered throughout generations. An example of informal learning occurring within an indigenous cultural context was described by Margaret Mead's

anthropological observations of children in Manus Island in PNG learning paddling skills (Scribner & Cole, 1973). In contemporary PNG, informal learning such as this is an ongoing process which has a role in reinforcing sustainability values and practices drawn from TEK.

2.4.5 Community Education

Community education is one aspect of education that encompasses formal, non-formal and informal approaches and is also used as an approach by organisations to promote community or social development efforts within their communities intending to improve sustainable livelihoods. According to Tilbury and Wortman (2008), community education “falls outside of formal institutionalised programs and encompasses a broad range of target audiences, topics, and approaches” (p. 84). Community education is also about “encouraging and engaging people in the learning of topics of their interests” (Tett, 2010) and “providing opportunities to collaborate in addressing local issues and problems” (White, 2014, p. 1). An interesting perspective of this highlighted by Connolly (2010) was that it is “a caring process, with a big emphasis on relationship and interpersonal connection” (p. 133). Some of the core ideas reflected in these definitions are that community education is a form of non-formal education which utilises both formal and informal approaches targeted at improving community understanding and wellbeing, encourages collaborative strategies for communities to develop their own approaches to resolve issues, and emphasises relationships and connections. The use of the term community in this context refers to both “the physical location where a group of people reside as well as those who share the same interest” (Connolly, 2010, p. 134). While I concur with Connolly’s use of the term community as people with shared interest, I also include it to refer to a group of people with shared inheritance of cultural, natural, social and spiritual environments.

The historical foundations of community education were associated with 19th century movements such as the social reforms forced by economic and industrial growth and the philanthropic organisations such as the churches (Tett, 2010). The former was interested in strengthening its networks through educational activities while the latter targeted those who were unfortunate and needed access to some

form of educational support to achieve physical, social and spiritual wellbeing (ibid). The expansion of this form of educational access and support grew throughout Europe and to other parts of the world where programmes became more structured for involving youths and adults. The core principles of community education were associated with justice, equality and inclusiveness through empowerment (AONTA, 2014) and targeted the eradication of oppression and discrimination through capacity building for personal and communal social development (Connolly, 2010). In endeavouring to bring learning to people in their local areas, community education also responded to the social needs of people helping each other in ensuring they access the support provided.

Drawing on the definitional view of community education, its theoretical assumptions are aligned with the social agendas of liberation, problem solving and self-determination (Connolly, 2010). These also have connections to the work of Paulo Freire, John Dewey and Edward Lindeman on informal and community education (Smith, 1996a). These assumptions also enable community education to develop a critical perspective to its approaches and programs. For example, in the United Kingdom, two objectives of national adult education through voluntary community education programme are to ensure learners are rooted in their community projects and that skilled staff use holistic approaches when working with learners (AONTA, 2014). These objectives provide both the staff and learners the opportunity to connect, develop an understanding of the learners' needs and use appropriate approaches that could be beneficial to both. Another example from PNG shows a conservation organisation who uses community education not just to deliver biodiversity conservation messages but also to promote universal basic education for the rural communities it works with (Tiu & Betabete, 2011). The flexibility of community education to enhance individual or organisational objectives is underpinned by the existence of core ideas of community education which are:

- employs various educational approaches,
- focuses on the community,
- encourages and engages learners,

- reinforces relationships and connections,
- enables learners to achieve a sense of liberation, and
- enhancing problem solving and self-determination skills.

These core ideas of community education emphasise community connections and relationships between humans and their natural environments. They also encourage application of locally relevant methodologies which reinforces local education approaches and practices such as those from indigenous education, as discussed in the next sub-section.

2.4.6 Indigenous education

Indigenous education (IE) focuses on informal teaching and learning of indigenous knowledge and practices. During the pre-formal education era, indigenous education occurred through different phases in the life of an individual. At each stage, the learner was taken through different development processes that prepared each person for life. For example, Cajete (1994) describes eight stages in the American Indian education process that every learner has to go through to learn the philosophies of life. The learners develop a sense of tradition and respect for humans through interacting with family and community, other organisms and the ecosystems they live in. They also learn different ways to empower themselves to be effective members of the community and develop an innate spirituality that connects them and other organisms. This process of education enables learners to develop a sense of place; relationships, dependence and deep learning prepares individuals holistically to cope with the harshness of their lifestyle. A notable factor in this discussion is how the learner was entrusted to learn about family, tribal and community responsibilities before their own. This strengthens the communal and kinship relationships and in the context of PNG, protection of inheritance such as land and sea rights for foraging, fishing, gardening and hunting.

One of the problems of formal education curriculum in relation to IE is that it clashes with some of its ideologies. This has resulted in the devaluing of indigenous and traditional ecological knowledge and the isolation of humans from nature, breaking up holisticity (Maurial, 1999). Holism is the central focus of IE

and indigenous knowledge and if broken or removed, IE will have no value. Tomlins-Jahnke (2008) described a similar scenario in the development of cultural standards in indigenous education in Canada and New Zealand due to cultural and epistemological disconnectedness between the nation-state education system and indigenous communities (p. 1). The differences identified raise concerns about methodologies and recognition of the need to embrace different types of education in order to achieve the goals of education for all across the lines of class, race, ethnicity and gender, amongst others.

Indigenous Education (IE) is very informal in nature as it is about survival and how one embraces different components of the environment to one's advantage. IE is education about life, the natural and physical worlds. Its ultimate goal is to be fully knowledgeable about one's innate spirituality (Cajete, 1994) and develop one's emotional and spiritual capacity. IE is the medium through which traditional ecological knowledge (TEK) is transmitted from one generation to the next. The informal nature of IE enables the acquisition, interpretation and dissemination of TEK to occur at any location at any time (Tiu & Eames, 2008; Tiu, 2007). One of the key characteristics of IE that embraces TEK is its holism, which enables the teaching and learning of TEK to be comprehensive and involve diverse areas of knowledge (Simonella, 1997).

Another characteristic of IE that relates to TEK is it involves nature as a teaching tool and teaches through the real situation, which favours direct experiences and learning by doing (Tiu, 2007; Tiu & Eames, 2008). TEK is accumulated knowledge, beliefs and practices about relationships between humans, other living things and their environment passed on through generations by various means. The processes of accumulating and disseminating TEK involve real experiences, learning by doing and using nature as a teaching model. The implication for this is that IE is pivotal in the acquisition and dissemination of TEK. Efforts to integrate TEK into formal curriculum or education system need to take into consideration its nature and the approaches it uses.

One of the key links between TEK and sustainability is the relationship that exists between humans, other living things and the environment. TEK as a holistic type

of knowledge acknowledges the existence of other components of the environment and the relationship humans have with all of these. Humans also have the responsibility to use the resources around them wisely so that they can continue to sustain life. Another characteristic of TEK that links it to sustainability is that it can be used as a platform to transform teaching and learning (Semali & Kincheloe, 1999), particularly if integrated with traditional Western curriculum. This enables TEK to be used to foster empowerment of human populations to explore key issues of sustainability and engage in shared production of knowledge and skills to address environmental issues. Education as a transformative process (Huckle & Sterling, 1996) enables both TEK and sustainability to be effected through education for sustainability.

2.4.7 Sustainability education and TEK

Sustainability education, education for sustainability and environmental education for sustainability are some alternative terms used to refer to education that is concerned with promoting sustainable approaches and methodologies. For the purpose of this thesis, I use sustainability education to refer to this. In an attempt to understand the choice of the term sustainability education, we need to look at each of these two terms. Sustainability refers to the need “for reconciliation between economic development and environmental conservation; to place any understanding of environmental concerns within a socio economic and political context; and to combine environment and development concerns” (Tilbury, 2006, p.197). Education is seen as having a significant role in bringing about changes in sustainable lifestyles and achieving the goals of sustainability. Sustainability education is therefore a form of environmental education (EE) that uses sustainable teaching and learning approaches and methodologies to promote economic, environmental and social sustainability. Sustainability education differs from other forms of EE because of its focus on environment and development that encourages:

developing closer links among environmental quality, human rights
and peace; food security, poverty, sustainable tourism, urban quality,
women and gender issues, fair trade, green consumerism, public
health and waste management, climate change, deforestation, land

degradation, desertification, depletion of natural resources and loss of biodiversity.

(Tilbury, Stevenson, Fien, & Schreuder, 2002, p. 9)

These issues highlight an important argument in the sustainability debate that environmental quality can be achieved if human quality is improved first. Environmental degradation at one level may be linked to poverty, unequal resource distribution and unsustainable subsistence lifestyles because many Third World countries are highly dependent on the environment for immediate resources. However, the tendency to blame poor people for destroying the environment because of their subsistence lifestyles is questionable. Corporate and/or state driven development are often the main driving forces behind these environmental destructions as underpinned by most extractive industries. Thus the environmentalism of the poor need to be recognised as they are the most dependent on the environment for survival as argued by Guha and Martinez-Alier (1997) and are likely to be among those fighting to stop environmental degradation by the rich.

It is also worth noting that transforming people's attitudes and practices will require a combined effort from all sectors of the society using a variety of approaches and resources. Education is critical for promoting sustainability and improving the capacity of humans to address environment and development issues (UNCED, 1992). Education is also described as a key policy tool for bringing about transformation (Huckle & Sterling, 1996) in order to improve people's attitudes and practices. This can be achieved through development of structured interventions and policies, and sustainability education is recognised as just the tool for promoting these as it is seen as "an imperative for quality of life and the survival of future generations" (Littledyke, Taylor, & Eames, 2009, p.4). Note also that implementation of sustainability education is not restricted to the formal education system as non-formal education also has a significant role in ensuring the continuity of sustainability education outside the formal sector.

The previous discussions on TEK and sustainability (see sections 2.2 and 2.3) demonstrate that many indigenous societies already practice some form of

sustainability education through indigenous education and natural resource management practices. Thus developing structured interventions and programs could enhance these existing practices. For example, in a community conservation capacity building project in the Eastern Highlands of PNG, participants from the rural communities involved demonstrated prior knowledge that resources are limited (Tiu, 2011). This knowledge was drawn from their own understanding of resource use and management derived from daily practices. The structured education intervention provided to these communities basically enhanced their perceptions and appreciation of the significance of their environment and how this contributes to the wellbeing of society and the world they live in. This example emphasises the argument that education should no longer be restricted to an academic focus but should include a wider participatory approach to connect all sectors of the community (Tilbury, et.al. 2002). The transformative (Huckle & Sterling, 1996) and holistic (Tilbury et. al., 2002) nature of sustainability education enables it to be disseminated using a multidisciplinary approach throughout all sectors of society.

In PNG, sustainability education is recognised as crucial for various reasons, including scientific and educational purposes. Being located in a biological hotspot (Conservation International, 2012), the increasing endangerment of species and habitats are a concern for biologists and conservationists. These threats to biodiversity are not only caused by extractive industries; but also the increase in human population and unsustainable harvesting practices. This is also underpinned by the Global Biodiversity Strategy (World Resources Institute, IUCN, UNEP, FAO, & UNESCO, 1992) which identified the unsustainably high rate of human population growth and natural resource consumption; the steadily narrowing spectrum of traded products from agriculture, forestry, and fisheries; economic systems and policies that fail to value the environment and its resources; inequity in the ownership, management and flow of benefits from both the use and conservation of biological resources; deficiencies in knowledge and its application; and legal and institutional systems that promote unsustainable exploitation as fundamental causes of biodiversity loss.

Sustainability education is crucial in this context to educate people on the consequences of these activities and help provide alternative measures to sustainably utilise and manage their resources. For example, annually during the local cultural festival in the Eastern Highlands Province of PNG, local biologists conduct wildlife cultural artefacts surveys to monitor the use of wildlife for cultural purposes (PNG Institute of Biological Research, 2012). During these surveys, people are advised about the preservation methods for their wildlife furs, feathers and plumes so that they can continue to re-use these annually instead of hunting new ones. This initiative by the local scientific institute recognises the significance of biodiversity in the local culture and attempts to educate the public on sustainable practices so that both the biodiversity and culture will be protected and sustained in the long term.

In education, the formal system in PNG covers some aspects of sustainability which are scattered across the curriculum documents from elementary to upper secondary (see Table 2.3 for list of subjects and grades). The National Curriculum Statement clearly emphasises PNG's need to have a curriculum that not only "builds on traditional knowledge, values and attitudes in order to support the development of relevant knowledge, skills and attitudes" but also "promotes and encourages the sustainable use of resources" (NDOE, 2003, p. 3). The emphasis on traditional knowledge and sustainability in the formal curriculum signifies its importance as perceived by the Government of PNG through the National Department of Education for the benefit of the present and future generations. Similarly, efforts supporting sustainability in the non-formal education sector are generally implemented by the non-government organisations (NGO) that have vested interests in sustainability. For example, all of the fifteen registered NGO members of the PNG Eco-forestry forum have some aspects of environmental and sustainability education factored in their community projects (PNG Ecoforestry Forum, 2012) that are implemented throughout PNG. It is worth noting that unlike formal education, the non-formal education approach does not have a set curriculum to be followed. NGOs that are promoting sustainability education through NFE develop their own activities that are not necessarily consistent with each other, but are geared towards meeting project goals and purposes to achieve sustainability.

The above discussions exhibit a few gaps that this study intends to address. Firstly, there is a need to have consistency in the kind of content disseminated in education for sustainability either through formal or non-formal education. This could be centered on the issues of environment and development as described by Tilbury et.al. (2002) and include issues of human rights, peace and equality, food security, poverty, public health, environmental degradation, depletion of natural resources and biodiversity loss. Secondly, the approaches to be used need to guide people to reflect on their actions and take action (Huckle, 1996), embrace alternative epistemologies and community-based approaches (Fien, 1995), and utilise any other traditional approaches that are deemed culturally appropriate (Cajete, 1994; Smith, 1999). In these circumstances, the need to develop policy guidelines is crucial to guide implementation of education for sustainability as well as achieving the goals of universal basic education, human rights to education, the Global Biodiversity Strategy and the Brundtland Report.

2.5 Chapter summary

This chapter explored the literature on the nature and historical context of traditional ecological knowledge (TEK), sustainability and education. The review of the literature indicated that traditional ecological knowledge (TEK) refers to all aspects of indigenous environmental knowledge, interactions and practices. TEK is holistic, spiritual in nature and is culturally transmitted. TEK reinforces sustainability principles that are significant for natural resource management.

TEK is recognised by reports and conventions such as *Our Common Future* and the Convention on Biological Diversity as a strategy for sustainable natural resource management. TEK is also recorded as widely used in Papua New Guinea in traditional marine natural resource management efforts in comparison to terrestrial management, implicating a gap in this area.

Sustainability principles of equity, interdependence and responsible actions are consistent with the TEK ideologies of a holistic, interconnected world that emphasises equitable access and continual supply of communal resources for all organisms. Sustainability is the state of achieving a desired change and ensuring the needs of present and future generations are met. To promote sustainable

resource management, TEK can be used to ensure spiritual and other needs of indigenous communities are met.

Education promotes equity, interdependence and responsible actions and develops capabilities, reinforces a sense of wellbeing and self-esteem in citizens. Formal and non-formal education can help all global citizens achieve their rights to education. Both formal and non-formal education are in place in PNG with the formal being well established in terms of curriculum and structure. Non formal education is actively used by nongovernment organisations to deliver sustainability and other forms of education. The gap in this chain of actions is the emphasis on TEK and the need for sustainability education to reinforce TEK values.

Indigenous and sustainability education embrace cultural norms and practices, and contribute to improving sustainable livelihoods towards economic, environmental and social wellbeing. Indigenous and sustainability education are both holistic and transformative in nature and easily embrace the cultural context in which non-formal education applies. This could be strengthened further through policy as discussed in the next chapter.

Chapter Three

Political and Policy Context of PNG

3.1 Chapter Overview

Sustainable resource management has become a significant global issue as environmental threats such as pollution, overpopulation and land degradation increase. The already existing problems of poverty, inequality and injustice in many developing countries are exacerbated by these environmental problems, requiring political and bureaucratic actions to address the situation. Sustainable policies and strategies are required by governments to ensure the alleviation of such oppressive conditions of existence (WCED, 1987). The reality, however, is that few governments have well developed strategies and policies in place, or the ability to effectively implement the existing ones. Indeed, it is important to recognise that policy making is a political process that needs to involve society at large – the polis – and not merely the economic and political elites (Stone, 2012). This also emphasises Stone's argument that policy is a struggle over ideas (ibid) whereby competing ideas are debated on to identify those that could be brought together to make a policy. As a fundamental political process (ibid), a policy needs to be scrutinised, debated and modified to address the problem it was intended to address. In Papua New Guinea (PNG), many policies and strategies, ostensibly developed to help people fail to include community perspectives, resulting in ineffective policies.

As a country, PNG is at crossroads in political governance, as much of what is in place was adopted from colonial administrators, particularly the British systems of governance through Australia. There is a clear need to understand the traditional context of decision-making and leadership which greatly influences the political governance of PNG today (Geddes, 2010a; Loveday, 1975; Oates, 2012; Prideaux, 2008; Sepoe, 2006). When PNG adopted the Westminster system of governance at Independence in 1975 (Loveday, 1975; Oates, 2012), the cultural values of leadership and governance within the Melanesian context were overlooked. These practices encourage consensual decision-making processes and

ensure that anyone who became a leader had the special characteristics that enabled that person to fulfill his or her responsibilities (Prideaux, 2008).

Political governance is guided in significant ways by public policies which provide general directions for decision-makers. There is a broad consensus among critical policy scholars that involvement of stakeholders from the initial stages of decision-making is significant for policy implementation (Hill, 2009; Stone, 2002). In the PNG context, however, there is a lack of community consultation on types of policies made, their roles and purposes (May, 2009; Oates, 2012). The absence of such consultation poses a significant barrier to integrating TEK and sustainability education as appropriate.

This chapter discusses the political and policy context of PNG in the light of TEK and sustainability and explores ways in which both traditional and modern decision-making and leadership styles have influenced current practices. Section 3.2 discusses the political context of PNG and how the past practices influence current decision-making processes. Section 3.3 discusses the policy context of PNG to provide an insight into the factors influencing policy-making in PNG. It highlights traditional decision-making processes and the government structure as two factors affecting the policy process. Section 3.4 provides a brief overview of the theories in policy-making, which leads to section 3.5 which outlines the theoretical underpinnings for this study. Section 3.6 provides a summary of the chapter.

3.2 Political context of PNG

Papua New Guinea adopted the Westminster system of governance from the time of British colonisation in the late 1800s and early 1900s. It is worth noting that there was no dominant governance or leadership style prior to colonisation which PNG could adopt. One reason for this is that PNG did not exist as a country institutionally. It was, and is still, a collection of societies (Loveday, 1975) that are “culturally heterogeneous and historically autonomous clan or tribal-based political entities” (Sepoe, 2006, p. 399). This, enhanced by language diversity, poses a challenge for political stability in governance and leadership today.

A common feature in this collection of societies was the existence of a social organisation (Geddes, 2010a, 2010b, 2009; Oates, 2012), which served two key purposes. First, it focused on addressing community needs by developing “intricate kinship structures and diverse rules governing land tenure and inheritance with the extended family as the central feature” (Woolford, 1976, p.1). Second, it encouraged a style of leadership that was based on local interests, promoting regionally individualistic and yet communalistic forms of leadership (Brison, 1992; Loveday, 1975). That is, the style of leadership differed between different regions. This social organisation was developed within the framework of a system of reciprocal obligation commonly known as ‘wantok (same language) system’. The significant factor within this reciprocal system is the value of sharing. As asserted by Tivinarlik and Wanat (2006):

Indigenous Papua New Guineans were concerned with and consistently pursued the basic needs of life, food and shelter. They attended to the interests of their own small communities with each village life centered on the values of sharing, which entailed interactions in which persons participating communicated relationships that were of one kind and did not engender indebtedness in either of the participants. (p.4)

The value of sharing is fundamental in the traditional discourse of governance and leadership in PNG. It centres on the overall welfare of the community and promotes communal ownership in which personal wealth was held in trust for the family, the clan, and the village, instead of oneself (Narakobi, 1983). The wantok system is described as a friendly welfare and life assurance system (Swatridge, 1985) which ensures those within a kinship group such as the sick, elderly clan members or the widow and orphans are supported. It recognises people who speak a common language or dialect, live in the same place and share the same values. Migration into towns for educational and job opportunities have also extended these practices to embrace a wider network of people forming their own kinship groups where they live and work. The change of context from a small village community to large networks in towns and cities has its own disadvantages however. For example, political appointment of wantoks (people from the same

tribal groups) into top positions in the bureaucracy instead of very senior and highly qualified public servants is one disadvantage of this system (Kulwaum, 2012). Similar cases can be noted in other systems of government such as education as well as in private sector appointments.

A major flaw in the wantok system is the cultural/tribal obligation that one has to uphold one's tribal interests before national interests, thereby resulting in the appointment of often unqualified and inexperienced tribespeople instead of more able candidates (Kulwaum, 2012; Prideaux, 2008). This clashes with the Western forms of management and governance that PNG adopted at Independence in 1975, where employment or recruitment was meant to be on the basis of merit. Poor management and misappropriation of resources often result from wantok-based choices.

Decision-making processes within the traditional social organisation framework were based on consultation of all parties in order to reach a consensus. Traditional leadership followed the 'Bigman' style (Oates, 2012; Prideaux, 2008; Tivinarlik & Wanat, 2006) where the leader was not only practical but led by an unwritten code of ethics, based on honour, integrity and respect. In many parts of PNG, this status was earned through merit as well as by being an elderly representative of a clan or sub-clan (Prideaux, 2008; Brison, 1992). In other parts of PNG, like the highlands, wealth was used as a measure of leadership abilities (Barnett, 1979). In the Islands and other regions in PNG where in which women had land rights (i.e. matrilineal societies), the men were leaders but the decision-making roles were shared between both men and women (Tivinarlik & Wanat, 2006). An interesting feature of traditional decision-making processes was the clear delineation of gender roles and responsibilities (Oates, 2012; Tiu, 2007). The men had the role of hunting, building houses and defending the family or clan against other clans or tribes, while the women were involved in domestic duties including raising pigs and gardens. While each gender had their own prescribed roles, decision-making was a shared responsibility since women's opinions were as important as the men's. It was the women who determined the quality and quantity of food and pigs the men presented to their rivals or contributed in a traditional ceremony. Oates (2012) argued that the traditional "Melanesian culture favoured an

egalitarian approach since everyone was a collective land owner and lived in the same village” (p. 2). The reality of this today, however, is that there is very little consideration for this egalitarian approach with the traditional values and norms of decision-making and leadership being overlooked (ibid).

The framework of traditional social organisation in Papua New Guinea which promotes communalism clashes with the Western ideologies of leadership that promotes some aspects of individualism (Oates, 2012). The communal culture encourages a harmonious attitude and promotes the value of sharing. It challenges leaders to perform beyond expectation to gain recognition and respect as being reliable, trustworthy and honest. It encourages a consensual decision-making process where every person has the right to express their views. This is significant in this thesis because where people’s collective views were considered, they tend to take ownership of the decisions, and policies in particular tend to be effective when considered in this way. In addition, in some societies, this approach was also used to choose tribal leaders if the community felt the need to change any existing ones. This concept of collectivist communal views has been distorted with leaders now driven by the vision of increased power and wealth that comes with political roles. Prideaux (2008) maintained that young people, who would traditionally not be considered mature for leadership roles, are now entering politics in the hope of acquiring the fame and fortune that goes with the status. This creates problems in the already deteriorating state of political leadership and governance.

At Independence in 1975, PNG adopted the Westminster system of governance, which was a foreign concept. The government at that time overlooked several aspects associated with the traditional manner in which Melanesian people conducted debates and made important decisions inclusively. For instance, traditionally, decisions were made after everyone had a say; women’s views were sought and discussions and decisions were not dominated by any one person (Oates, 2012). The current political and governance system does not maintain this process. Instead it promotes party politics (Geddes, 2010a; Sepoe, 2006), encouraging one party to dominate the decision-making and leadership processes.

This is in direct contradiction to the consensual Melanesian decision-making process and is detrimental to the wellbeing of the people and indirectly the nation.

The social organisations in which traditional political systems of collective or 'Bigman' leadership exist, encourage communalism as opposed to individualism and are based on the principle of sharing and communal ownership of wealth and property (Oates, 2012; Prideaux, 2008; Tivinarlik & Wanat, 2006). The practice of 'wantok' or reciprocal system is also encouraged through these organisations, which practice fair consultation among members of society to reach consensual decisions. These views are greatly threatened by the imported ideologies that promote individualism and lack consensual processes (Prideaux, 2008).

In the context of natural resource management, the current political approach does not favour the views of the rural majority. The decisions made promote the interest of the reigning minority political power (Sepoe, 2006) and overlook the interests of the majority. This creates dissatisfaction and unrest among the majority of citizens who feel their voices are not heard. The increasing environmental threats, particularly from extractive industries, enhance the consequences of inequality in the decision-making process, with the brunt of the effects primarily affecting the poorest and most vulnerable. Other issues such as the impact of climate change on the environment and people, and overpopulation continue to increase due to the lack of in-depth consultation with all stakeholders, as was common in the traditional Melanesian practices. Due consideration is needed to review the decision-making processes that embrace the Melanesian ideologies and at the same time promote democracy.

The argument for this thesis is the need to recognise the traditional context in the light of changing contemporary society and develop policies and strategies to embrace the useful ideologies, practices and values that promote equity, interdependence and responsible actions. Given the political context of PNG, this study has followed the traditional protocols of consultation with stakeholders in identifying common sustainability principles embedded in TEK, and used this to inform policy recommendations for sustainability education. The next section discusses the current policy context in PNG.

3.3 Policy context in PNG

Public policies are concerned with decisions made by Governments which influence people's professional or personal lives; and provide the framework under which governmental organisations work to resolve social, economic and political issues in a society (Foster, 2013). Policies shape the course of action to guide institutions towards accepted strategies and objectives based on respected principles. They identify key activities and provide a general strategy to decision-makers on how to handle issues as they arise, by providing limits and alternatives that can be used to guide the decision-making process (Stensgaard, 2007). Policies are fundamental for consistency and efficiency in decision-making, create confidence, increase accountability and reduce biases (Isaac, 2013). As an independent state, Papua New Guinea has in place public policies for different sectors of government to influence and guide its citizens. With more than 90 per cent indigenous peoples, PNG has different cultural and traditional aspects of governance and leadership (see section 3.2) that influence policy-making and implementation. This has generated mixed results, of which some have adverse effects on leadership and management styles. This is described by Prideaux (2008) in the following:

Formal modern organisational arrangements, appointed leaders and managers, and duty statements introduced an extreme form of the bureaucratic system. As a result, almost all government decisions are made by senior managers without consultation with employees; knowledge sharing is restricted; and the value of individual employees is often not recognised. As a consequence, a leadership crisis has resulted in bankruptcy, political instability, poor service delivery, bribery, and mal-practice, such as misappropriation of public funds and wantokism, in both the public and private sectors. (p.33)

The notion that a Western or modern leadership and management style reinforces bureaucratic systems is true to some extent, although it has some negative impacts for nations whose leadership styles differ from this, particularly in terms of their perceptions. For instance, leadership and decision-making process in the Melanesian context is consensual in nature, not individualistic (Prideaux, 2008).

This creates problems for policy-making and implementation because decisions are made by senior management (ibid) without due consideration for all public servants down the line. This leads to differences of opinions and lack of in-depth understanding of the roles and purposes of the policies resulting in ineffective implementation and practice.

Since early post-independence, there has been little attempt to study the processes of policy-making and implementation across a range of sectors and functions in Papua New Guinea. But recent studies in public sector policy-making and implementation (May, 2009), revealed significant variation between different government sectors. For example, Thomason and Kase (2009) reported a slow but steady decline in health services available to rural people, despite PNG having sound health policy and well-articulated health plan. Several factors attributed to this situation but a key factor is the “impact of successive decentralisation reforms on the organisation and management of health services:” (p. 117). Similarly, Filer and Imbun (2009) described a slightly different scenario in the mineral development policy, where the Government of PNG (GoPNG) has made progress despite difficult challenges in comparison to other developing countries. The differences in the measure of policy implementation in the public sector demonstrates a “recurring gap between the diagnosis of weaknesses in the policy process, prescription of remedial action, and effective action to implement changes” (May, 2009, p.2). This is further enhanced by poor policy design and implementation and lack of political support from decision-makers.

The tendency to opt for system changes rather than to address identifiable problems within the existing system when desired policy outputs are not forthcoming is common in the PNG bureaucracy (May, 2009). This is enhanced by the inconsistencies in policy-making and implementation processes, which are also underpinned by several weak factors. First, there is a decline in the analytical and research capacity of bureaucrats to formulate and legislate policies without proper analysis of their feasibility, likely impact, or the extent of support for or against them (May, 2009; McKillop, Bourke, & Kambori, 2009; Mowbray & Duguman, 2009). This creates misunderstanding during implementation when stakeholders are not informed on the purpose and benefits of new public policies.

For example, the environmental policy on a ban of non-biodegradable plastic bags introduced in PNG in 2009 to address the increasing problem of littering and waste disposal created a mixed reaction where some supermarkets took measures to address the issue whereas others were not prepared (The National, 2009). This policy helped to minimise uncontrolled littering of urban cities in PNG and encouraged shoppers to use strings bags (bilums) and baskets, which are culturally appropriate, to carry their shopping. National and sub-national governments have the responsibility to ensure the public is informed through awareness and education efforts. With limited access to newspapers and television because of the isolation of many communities from the main towns, alternative means of communication such as radio notices can be used to ensure the information reaches everyone. Another added dimension to this problem is the migration of senior bureaucrats to the private sector that creates gaps in the public sector which cannot be filled easily. Less senior bureaucrats do not have the experience or skills to ensure proper procedures for public policy-making are adhered to, such as knowing what the desired objectives and their targets are, determining pathways to reach the identified objectives, and designing specific programmes or measures to implement and assess the identified interventions (Torjman, 2005).

A second factor is the poor level of coordination between government departments and agencies at the national, provincial and local level governments. Policy decisions made at national level are not well implemented and monitored at sub-national levels often because provinces have their own priorities (Thomason & Kase, 2009) or necessary financial and technical support is not easily accessible. For example, one province may have health as a priority while another has education as its priority. This means in each of these provinces the top priority sectors get the highest budgetary and other resource allocation, leading to inconsistencies in other sectors. Clearly, this is an issue of power regarding who is mandated to make the decisions. Government sectors at the national level are at the top end of the political hierarchy and often have the power to dictate what aspects of policies may or may not be administered. The problem with such an approach is the lack of consultation with implementing officers and other stakeholders resulting in poor implementation and practice. Cooperation in policy making requires forming strategic alliances that can reinforce or challenge power

distribution (Stone, 2002), therefore coordinated efforts from all levels of the same government sector, such as education officers from the provincial and national offices, are necessary to secure financial and technical support to implement policy changes.

A third factor is a frequent lack of commitment to policy directives and institutional mechanisms designed to ensure efficient and equitable service delivery and accountability, from the most senior levels down to local officials (May, 2009). This may not only be associated with a rising level of corruption in both the public and private sectors but also the aspects of decentralisation of powers at national and sub-national levels. For instance, McKillop, Bourke and Kambori (2009) reported a continuous breakdown of communication and funding arrangements between the national and sub-national offices that hindered implementation of agricultural policy directives. Disgruntled public servants at sub-national levels complain about the inability of those at the national level to be in touch with the reality of situation on the ground. Such situations can be minimised if policy directives are viewed by all as clearly applicable at all levels and that all implementing officers are equipped with the appropriate skills and knowledge to administer these policies. An additional constraint is the lack of capacity as a nation to absorb advice and assistance from external sources without losing a sense of ownership of policy initiatives (May, 2009). Policy initiatives driven by various bureaucratic sectors need to be recognised as significant for national development. Gerston (2004) argues that it is critical to “determine policy issues that need to be resolved; identify the actors who present, interpret and respond to those issues; and, the levels of government that are best equipped to make policy” (p. 8). The bureaucrats and the sectors responsible for these initiatives need to take ownership of the policies and ensure that they are understood and implemented in every aspect as intended. In addition, resources needed to effect change need to be provided, and proposed changes, as envisaged by the policy change should be adequately communicated to all personnel down the line of command.

The issue of leadership and governance at the time a new public policy is introduced is another crucial factor in policy making and implementation in PNG.

What comes out of the government is as important as what goes in, because government activities and commitments are crucial to the meaning of public policy (Gerston, 2004). A change in governments also affects policies that have been put in place by the previous government as it creates political instability and disrupts implementation of government plans and policies. This is emphasised by Sepoe (2006):

Endemic corruption, a general lack of government accountability to the people, the weak capacity of the State to deliver basic services, law and order, and a host of other governance issues endanger the effective functioning of institutions and the processes of democracy.
(p. 400)

Public policies result from the interaction of powerful forces that lead to power being distributed equally or in a fragmented manner, affecting decision and policy making processes. In PNG, there is an assumption that power is distributed equally because “decisions are made by the representative government in which a unified executive is responsive to popular will” (Hill, 2009, p.26). This is contrary to the ongoing political instability in the governance and leadership status of the country (Sepoe, 2006) which demonstrates power struggles. One example of this was the demand for removal of the Outcome Based Education approach used by the elementary, primary and secondary school systems in PNG (Unage, 2012) as soon as the new government was formed after the national elections in 2012.

New policy development in any sector needs to be justified by empirical research on its significance and purpose for the benefit of the stakeholders. The actors and the public institutions that will be affected by the policy change need to be consulted and the process supported with adequate resources for development and implementation.

3.4 Critical and Interpretive Approaches to Public Policy

Integration of TEK into policy could reinforce sustainability values embedded in TEK to be emphasised for the benefit of the present and future generations. This is where the role of public policies is crucial as they are “action driven and aimed

at acting on collective problems” (Wagenaar, 2011, p. 12). The collective problem central to this thesis is the role of key public policies, and whether they reinforce the nature and significance of TEK in sustainable natural resource management, in the context of Papua New Guinea. These key policies are important in ensuring that local people, whose livelihoods depend on natural resources as highlighted in chapter two, are not deprived of their rights to access these resources (Convention on Biological Diversity, 2010; Millennium Ecosystem Assessment, 2005; Sherry & Myers, 2002), and at the same time they be given due consideration by the State and its development partners in any resource development initiatives.

Inclusion of public policies reinforcing TEK in natural resource management and education strategies would acknowledge the notion that policies are “struggles over ideas” (Stone, 1997, p. 11) and values are central to this struggle as each society has its own social needs, values and ideals. Societies differ in their needs and struggles which influence their choices of what is significant to them, thus highlighting the argument that “for policies to be effective, governments need to take into consideration the needs, feelings, constraints and opportunities of the people their policies will affect” (Bühns & Bartlett, 1993, p 2). The recognition of the significance of policy and society underpins the notion that the society is a political community where policies and considerations for policy development occur (Stone, 1997, 2012).

For policies to make a change in society and be successful, they need to be unpacked to understand how and why they exist in the first place (Bacchi, 2000). The existence of policies implies that there must be a problem and that the problem the policy is directed at has already been identified. Bacchi (ibid) also adds that problems that policies are directed at are shaped by our assumptions and values, thus, all policies are value laden and not just some neutral tool. This approach to unpacking policies is relevant to this thesis as TEK is heavily laden by values, and an understanding of these values, would enable policy makers to develop sustainable natural resource policies that would be embraced by society, the State and resource developers.

Public policy development is often determined by a range of ever-changing public issues which are categorised as *substantive* or *symbolic*. Issues that are substantive “have major impact on the society, such as environmental protection and civil rights legislation”, while those that are symbolic “focus on uncontroversial issues with quick fixes to get them off the public agenda more quickly” (Gerston, 2004, p. 9). Substantive issues are usually quite difficult to resolve and may take longer, so policies pertaining to these need to be developed with longer time frames with due consideration for all stakeholders involved. An area of focus in the light of this thesis is the issue of environmental policy, particularly in terms of resource use and management and the role of TEK in achieving these. The development of environmental policies need to consider several factors including;

...anticipatory (preventive) issues; changing human ways and approaches towards environmental issues; institutional reform to enhance environmental policy performance; and, more integrated or comprehensive environmental policy development. (Bührs & Bartlett, 1993, p. 3)

Today’s environmental problems are influenced by the use of new activities and technologies (Dryzek, Goodin, Tucker, & Reber, 2009; Dryzek, 1997, 2005; Kurian, Munshi, & Bartlett, 2014) with often irreversible consequences. Policies to address such issues cannot be made based on previous experiences because they are hardly static. Some of the problems are a one-time phenomenon, and once resolved, will not reappear, while others are open-ended and will re-emerge some time later (Gerston, 2004). While the concept of anticipatory policy-making intends to address the issue of re-emergence and prevent controversial problems from over-ruling the decision-making process, it also implies a more realistic expectation of what can and cannot be resolved by policy development.

An issue that emerges from environmental literature is the need for humans to change our ways in order to resolve environmental predicaments which are manifestations of more fundamental environmental, social and cultural problems (Bührs & Bartlett, 1993, p. 6). These cannot be overcome by technical means alone and require a radical transformation of societal values with respect to

cultural, political, social and economic perceptions (ibid). Many environmentalists also argue that efforts to resolve environmental problems are doomed to fail if this does not happen. The values of political and bureaucratic systems need to also be realigned with ecological rationality to ensure green policies and principles are supported (Bartlett, 2005; Paehkle & Torgerson, 2005) both at national and sub-national levels. All policies have values at the centre but they may not always acknowledge it. This is the same with environmental policy and sustainable development, which have the values of sustainability at heart. Although the notion “of environmental policies is a recent phenomenon and did not exist as a concept in politics and policy making in any country until the 1960s” (Dryzek, 1997, p. 4) today, nearly all countries have some form of environmental legislation and established government departments responsible for environmental issues. Critical and interpretive approaches to policy analysis, which look centrally at the ideas and values that underpin policies, are particularly relevant in this study of environmental policy which has sustainability at heart.

The issue of institutional reform can be regarded as a potential method of enhancing policy performance in the long term (Bühns & Bartlett, 1993), although the consequences are unpredictable (March & Olsen, 1983). The significance of institutional reform is through changes in rules, practices and policies, and the way people think and act may change as they engage in the process of transformation (ibid). This whole process of changing institutional rules and procedures may draw people’s attention on specific areas that have been overlooked previously and influence a value change that would have otherwise not been possible. In the context of Papua New Guinea, institutional reform may be necessary due to the historical set-up of the bureaucratic system borrowed from the outgoing colonial administration (Geddes, 2010a) which did not necessarily reflect the views and perceptions of the people. As an independent state, PNG can make its own decision to apply appropriate measures to address environmental and other developmental problems and institutional reform maybe a useful approach. However, it is notable that many factors can also contribute to the usefulness of such a process. For example, availability of funds and technical support or the ability of a bureaucratic agent to implement the process is also significant for its success.

Consideration of the environment comprises cultural, ecological, economic and social dimensions that are intricate. The complexities and interrelatedness of these dimensions are inherent in many environmental problems and need to be clearly identified. One of the inadequacies of environmental policy development is the inability to demonstrate the complexities and interrelatedness of all dimensions of the environment with a holistic view on how these systems function, a lack of which has led to displacement of environmental problems. Bührs & Bartlett (1993) recommend the inclusion of comprehensive environmental policy to capture the holistic view of the environment and promote some measure of control. The growing recognition of comprehensive environmental policies will help to capture the effects of human impact (such as water pollution) on the environmental systems (such as marine or forest ecosystems) and promote measures to portray these in policy formulation. On the other hand, the concept of integrated or comprehensive environmental policy can be difficult to achieve in terms of its theoretical, political and practical status. The nature of environmental policies is somewhat “ad hoc, fragmented and compartmentalised” (Bührs, 2009) yet it provides a significant scope for developing comprehensive policies if well-coordinated. Effective environmental policies can be made if a high level of integration or comprehension is achieved (Bührs & Bartlett, 1993).

In the context of PNG, the process of integrating effective environmental policies enables the integration of comprehensive cultural and social environmental values reinforced by TEK, and promotes sustainability principles at the initial policy development stage. This is where the idea of deliberative democracy becomes useful as it emphasises the need for active engagement of people in the whole process of decision making and governance (Dryzek, 2000; Gutmann & Thompson, 2004). Deliberative democracy reinforces the notion that “all decisions made by citizens and their representatives including laws impose on one another needs to be justified” (Gutmann & Thompson, 2004, p. 3). This approach emphasises rights of individuals to know about the reasons for a decision that is made. In addition, Sass and Dryzek (2014) add that deliberative democracy embraces the existence of deliberation in different cultures of the world and acknowledges that these cultures have different ways of demonstrating these. This

is similar to the traditional decision making processes involving consultation and deliberation.

3.5 Theoretical Perspectives for this study

Theoretical perspectives that inform this study are derived from the literature on traditional ecological knowledge (TEK), sustainability, education for sustainability and the public policy-making processes. It is clear from the literature that all is not well on planet Earth as the human drive for material comforts coupled with improved technology leads to over-exploitation of minerals and fossilised energy sources such as coal and crude oil (Barkin, 1998; Millennium Ecosystem Assessment, 2005). Jackson (2009) argues that the finite nature of Earth already creates constraints on resource availability which is again problematic for many parts of the world, particularly developing nations who are still trying to find their niche in the global economy. Large scale mineral and timber extraction to meet these global economic demands is becoming problematic for many developing countries. For Papua New Guinea (PNG), this trend of resource exploitation to the detriment of the natural environment is threatening, because over 80 per cent of its population is rural (Rogers, Bleakley, Ola, & CARE Integrated Community Development Project, 2010) and highly dependent on the natural environment for basic resources such as food and building materials.

Resource depletion not only affects the environment, it disturbs people's social and cultural livelihoods which have evolved over time to be dependent on this environment. Barkin (1998) and Dresner (2002) assert that ecological, social, and economic sustainability can be achieved if equality and justice (equity); human interactions with the natural ecosystems (interdependence) and strategies for sustainable development (responsible actions for sustainability) are improved for every citizen on Earth. This is a challenging task that requires cooperation from all the governments of the world.

The literature on sustainable development describes the contribution of traditional and indigenous ecological knowledge to natural resource management practices (CBD, 2010; WCED, 1987), in the light of Earth's deteriorating conditions, as

significant. WCED (1987) describes vulnerable and indigenous communities of the world as “repositories of vast accumulation of traditional knowledge and experience that links humanity with its ancient origins and that their disappearance is a loss for the society at large” (p. 114). This supports the argument that a great deal can be learnt from TEK to sustainably manage complex ecosystems. TEK is not only about physical and spiritual indigenous knowledge and practices, nor the interrelationships of human and environment (Cajete, 1994; McGregor, 2004). It is also the survival knowledge of a particular group of people (Berkes, 2008) who use it to access and manage resources in their environment. TEK encourages communal ownership of assets such as land and sea among kinship groups (Macintyre & Foale, 2007; Narakobi, 1983), promotes equal distribution of resources, and maintains cultural identity (Semali & Kincheloe, 1999). The oral transmission of TEK over generations through various means emphasises the value of maintaining social identity and relationships. The concepts of belongingness, ownership and relationships embedded in the practice of TEK encompass the values of equity and interdependence (Daily & Ehrlich, 1996; Munasinghe, 1999; Millennium Ecosystem Assessment, 2005), which are significant for social, economic and ecological sustainability.

The implication for TEK in governance and leadership is the emphasis on consensual decision-making processes (Brison, 1992; Oates, 2012; Prideaux, 2008), which encourages equal participation for collective decisions and actions. Dresner (2008) asserts that sustainability is about making informed decisions, taking responsible actions and distributing resources equally to ensure planet Earth continues to sustain life. TEK emphasises the values of sharing of resources, promoting equality and taking responsible actions which links it to sustainability.

The literature describes the role of TEK as a functional approach to addressing the gaps in natural resource management (Berkes, 1993; Dudgeon & Berkes, 2003; Turner & Berkes, 2006; Usher, 2000). The increasing threats on indigenous and vulnerable communities of the world, caused by the upsurge of resource extraction, are not only detrimental to the environment but also their livelihoods and social organisations. The skills and knowledge in sustainable resource use and management practised by these communities can be learnt and integrated into

natural resource management practices before they are completely lost. As argued by Berkes et. al. (1995), deforestation and environmental degradation is threatening the loss of useful TEK which is capable of providing new insights and models for biodiversity and sustainable management. Indigenous worldviews on practices of environmental values are based on TEK (Berkes, 1993; Dudgeon & Berkes, 2003; McGregor, 2004, 2009; World Commission on Environment and Development, 1987) and promote communal ownership of land and resources. Within these worldviews, both the physical and spiritual interrelationships are significant for enhancing cultural identity (Semali & Kincheloe, 1999) of the people who practice and use this form of knowledge. These practices are continued over many generations through indigenous education which encourages holistic informal teaching and learning processes (Maurial, 1999; Semali & Kincheloe, 1999). These perceptions differ to those of the western worldviews which are based on scientific knowledge (Odum, 1971; Rao, 2000), promote natural resource management practices (Berkes, 1999; Usher, 2000) and conservation of cultural and natural heritage areas as identified by scientific research. Western worldviews are also supported by the scientific evidence of physical interrelationships in a given environment and are guided by teaching and learning through formal education.

The social values and practices in indigenous worldviews are guided by consensual decision-making processes which encourage equal distribution of resources and social interactions that promote communal equity (Brison, 1992; Prideaux, 2008; Swatridge, 1985; Tivinarlik & Wanat, 2006). In a political community (Stone, 2002), the decision-making and governance processes occur within a social context and are informed by the values, ideologies and worldviews of the communities (Ens, Finlayson, Preuss, Jackson, & Holcombe, 2012; Kofinas, 1998; Sherry & Myers, 2002). These shape their meaning and understanding and influence their practices. Within indigenous perspectives, social values and practices promote knowledge and understanding of equality, justice, and spirituality which are built on cultural norms and practices. Western worldviews and practices differ in some ways to indigenous perspective as they are guided by a bureaucratic system of governance and decision-making (Geddes, 2009; Oates, 2012) that encourage social interactions and equality to some extent,

yet they promote personal interests. While society is a political community (Stone, 2002), it is not only informed by values and ideologies but also various institutions such as federal and state governments, educational institutions and other organised bodies (Rossi, 1957) which shape meanings, understandings and practices of the users. Like indigenous worldviews, western perspectives of social values promote equality and justice with the anticipated outcome of some transformation by way of lifestyle of the citizens.

In as far as economic values and practices are concerned, indigenous worldviews and practices differ from Western worldviews. Traditionally, all resources obtained or produced are for personal use, sharing with relatives, exchanges with traditional partners or for ceremonial purposes. In other words, they promote social and cultural purposes. For example, in certain parts of PNG, yams as ceremonial crops are often exchanged with traditional partners (Scaglione, 1999) which then makes it obligatory for the recipient to reciprocate the action in the next season. The practice in contemporary PNG today has an added monetary aspect whereby excess produce is now sold for cash. This is in line with the western worldviews of resources having monetary values. The implication for TEK with this shift from production of crops for personal consumption to selling for cash is that the practices and values of TEK get used less with the potential for them to be lost.

This review of the theoretical positions in the literature has highlighted the relationship between TEK and sustainability as:

- comprising normative values such as equity, interdependence, responsible actions for sustainability and traditional ecological knowledge (TEK);
- existing in both the marine and terrestrial ecosystems;
- involving key actors such as National and sub-national governments, NGOs (environmental groups), industry and community; and
- reinforcing decision making processes involving consensual leadership and governance, and community consultation and participation.

This signifies the possibility of a model for sustainability that could reinforce incorporation and implementation of TEK values in PNG.

3.6 Chapter Summary

This chapter discussed the literature on political and policy context in Papua New Guinea and the way traditional and modern decision making and leadership styles have influenced policies. This review noted three political contexts in PNG as summarised below:

- There was no dominant leadership or governance system prior to colonisation. PNG was not a country but a collection of societies that was guided by a social framework of reciprocal obligations or *wantok system*, a system that has its own flaws in the current governance and organisational systems.
- PNG adopted the Westminster system of governance at independence in 1975. This form of governance overlooked some aspects of the Melanesian decision-making processes and perspectives that encouraged consultative decision making processes.
- The current policy approach to natural resources lacks consent from the rural majority and promotes the interest of minority political powers.

The bureaucratic system adopted and introduced during independence in 1975 influences policy development within the current governance systems in PNG. Well-developed public policies are in place to direct implementation of government programmes and plans, however, the actual implementation of these policies is often problematic. To achieve a high level of integration, environmental policies may need to be comprehensive to capture impacts of human effects on environmental systems.

Public policies are crucial for sustainable natural resource management in PNG. The majority of the population whose livelihoods are dependent on these resources means the inclusion of these policies in both natural resource management and education is important. With the increase of environmental

problems associated with introduced technology, key policies encouraging use of TEK principles offer a sustainable way forward.

Theoretical perspectives from the literature on TEK, sustainability, education for sustainability and public policy indicated that:

- All is not well on planet Earth as increased human activities and improved technologies increase the chances of environmental deterioration.
- Resource exploitation in PNG threatens human livelihoods and needs to be addressed through integration of key policies that emphasise TEK and sustainability values.
- Inclusion of TEK and sustainability in policy would reinforce the normative values of equity, interdependence and responsible actions; and reinforce a consensual decision making process, community consultation and participation.

This study sought to explore the perceptions of indigenous Papua New Guineans regarding the relationship between TEK and sustainability, and whether TEK has a place in sustainable resource management through education and policy. The next chapter discusses the research design and methodology for how this exploration was carried out.

Chapter Four

Methodology

4.1 Chapter Overview

Knowledge formation draws on people's perceptions and conceptualisation of the natural and physical world and is often based on their beliefs and ideals that form their worldviews (Ichikawa & Steup, 2013; Steele, 2014). Traditional ecological knowledge (TEK) is one such form of knowledge that stemmed from indigenous worldviews and has been found to be a useful strategy for sustainable natural resource management (Berkes, 1999), as highlighted in Chapter 2. Understanding the nature and usefulness of TEK in this context would require an investigation of the underlying rationale, principles and practices. There is a need to gather systematic data and information about the way TEK is understood, applied and sustained. This chapter discusses the research methodology used for this study and how it guided the development of theory underpinning the data collection and analysis processes, in accordance with the literature on TEK and natural resource management. Section 4.2 re-presents the research questions. Section 4.3 discusses the methodology including the research paradigms, approaches and methods used in educational research. Section 4.4 continues to discuss the research design, including sample description. Section 4.5 discusses data collection, while section 4.6 discusses the qualitative data analysis techniques used. Section 4.7 addresses the issue of trustworthiness of the data, research ethics and ethical concerns. Section 4.8 is the chapter summary.

4.2 Research Questions

Research questions express a particular problem or phenomenon the research sets out to investigate in question form and provides direction and focus on the area of enquiry (Boudah, 2011). These can consist of overarching questions and subsidiary questions which "guide one's literature search, research design, data collection and analysis methods, and write up of the data" (Bryman, 2012, p. 11). Boudah (2011) also noted that research questions need to be clearly expressed to capture the intended problem being explored and reflect the possible interventions and targeted participants of the study.

The objective of this research is to develop recommendations for a policy framework for sustainability that is founded on TEK and could inform education practices for natural resource management in Papua New Guinea. It is also about offering insights into the principles and practices of TEK, and the links between TEK and sustainability. The research questions for this study are as follows:

1. What are Papua New Guineans' perceptions of the relationship between traditional ecological knowledge and sustainability?
2. What are Papua New Guineans' perceptions of the role that education and policy can play in the use of TEK in sustainable resource management?
3. To what extent do existing policies related to sustainable resource management include an emphasis on TEK in PNG?

4.3 Methodology

This study is about the social world because it is about people and their interactions within a social context. The study of the social world embraces human experiences and endeavours, as opposed to the study of objects, and is interested in understanding the subjective world of human experiences where their actions become the focus of investigation (Bryman, 2004; Cohen, Manion, & Morrison, 2000). Within this subjective nominalist view, people's construction of their worldviews are influenced by their beliefs and ideologies, and TEK is a socially constructed knowledge associated with people's interactions both with the physical and human environment (McGregor, 2004), thus placing the interest of this study within subjective nominalist views. People's interactions with physical environments enable construction of knowledge, such as observations of the flowering of *Piper andacum* plants which determine the abundance of spotted cuscus (*Spilococus phalanger*) (Tiu, 2007). The interactions with other people, places and organisms allow this knowledge (TEK) to be practiced and maintained for the benefit of the present and future generations. Moreover, the process of knowledge formation differs according to each social context. For instance, in the Western context, the process of scientific knowledge formation is often questioned, further investigated and deliberated on before being accepted. Code (1987) describes how a would-be knower has the responsibility to focus on an assumed knowledge and modify it to create a better understanding. Through the

process of refuting the claimed knowledge and justifying its relevance to society, the would-be knower yields new perspective to this claimed knowledge. The process of knowledge construction according to Code's description is not applicable within an indigenous context because the epistemology in indigenous knowledge formation is closely linked to their worldviews (Ladson-Billings, 2000, p. 258), which often do not question the process in which knowledge is acquired and constructed. In the traditional PNG context, knowledge formation follows less scrutiny than the process described by Code (1987). The would-be indigenous knower accepts the knowledge as it is told, shared or experienced. Often, how one views the world is influenced by what knowledge one possesses, and what knowledge one is capable of possessing is influenced by one's worldview ((Ladson-Billings, 2000). Thus, in the search for truth – even a partial truth - to understand the natural phenomena surrounding humankind and the quest for knowledge, the choice of methodological approach becomes crucial.

Methodology differs from methods in that it “is the philosophical stance or worldview that underlies and informs a style of research” (Sapsford, 2006, p. 175), determines the research design (Cohen, Manion, & Morrison, 2011) and guides research inquiry (Guba & Lincoln, 1989). Founded on ontological and epistemological underpinnings, methodology attempts to justify how we know and can explain what we know (Crotty, 1998), such as understanding about the environment and its related natural phenomena. Methodology provides the choice and use of appropriate methods which are enhanced by one's experiences and ability to reason and research these phenomena (Cohen et. al, 2011)

Experiences are based on common sense and random events, whereas reasoning follows a set of deductive, inductive and a combination of both techniques, that not only search for understanding but also enable formation of theory and practice. In search for understanding, qualitative research aims to identify both partial and contingent truth and employ a combined inductive-deductive model. This follows controlled systems with self-correcting mechanisms that utilise experience and reasoning approaches to foster understanding. Understanding the composition of the world one lives in, the nature and reality of being and what one values as knowledge is necessary in this search for truth (Cohen et al., 2011). The

following sub sections discuss the paradigms underpinning educational research and the methodological choices for this study.

4.3.1 Research Paradigms

A paradigm is a belief system or framework developed from shared understandings of knowledge that guide research and practice (Rossman & Rallis, 2003; Williams, 2011). Paradigms are grounded in epistemological, ontological and methodological suppositions (Vine, 2009) that foster social and natural assumptions about acceptable evidence, the nature of human actions, and common characteristics based on social structures and procedures (Rossman & Rallis, 2003). Paradigm choices influence the type of research undertaken using particular theoretical frameworks and methodology. For instance, epistemology concerns itself with “providing a philosophical grounding for deciding what kinds of knowledge are possible and how we can ensure that they are both adequate and legitimate” (Crotty, 1998, p.8). Epistemology is also concerned with the “assumptions and views about how research should be conducted” (Bryman, 2012, p. 6), such as decisions on the type of methods used. Ontology on the other hand, is the “study of being” (Crotty, 1998, p. 10) and attempts to understand the question of ‘what is’. Ontological assumptions are therefore concerned with “what reality is” (Bryman, 2012, p. 6), forcing researchers to take a stance on their perceptions of the social and natural worlds and the way they function. Every paradigm has its own set of epistemological and ontological assumptions resulting in their own methodology and methods (Scotland, 2012) to inform research. Methodology is a strategy or plan of action to find knowledge (Crotty, 1998) and describes approaches and paradigms associated with research (Cohen et. al., 2011). Several paradigms have been described in social and educational research that become useful or not depending on the nature and type of research to be carried out. Three major paradigms in educational research that are discussed next are positivism, interpretivism and critical theory.

4.3.2 Positivism

Positivism as a paradigm describes an “epistemological position advocating for application of natural science methods to the study of social reality” (Bryman, 2012, p. 28). The philosophical position of positivism portrays “sense experiences

as producing genuine knowledge which could be advanced by means of observations and experiments” (Cohen et al., 2011, p. 7). Within the positivism paradigm, objects are viewed as having their own meaning which are independent of any human awareness or intervention (Crotty, 1998). In other words, positivism assumes a realist ontology that “there are real world objects apart from the human knower or objective reality” (Cohen & Crabtree, 2006c, p. 1). The epistemological stance of positivism is representational and assumes that “people can know this reality and use symbols to accurately describe and explain this objective reality” (ibid). Positivism observes phenomena and places emphasis on clear objectives that are “measureable, predictable and controllable towards constructing laws and rules of behaviours and causality” (Cohen et al., 2011, p. 31).

4.3.3 Interpretivism

Interpretivism as a theoretical perspective helps us “understand and explain human and social reality” (Crotty, 1998, p. 66) or “understand and interpret the world in terms of its actors” (Cohen et al., 2011; p.31). Interpretivism is about making meaning of the social world through employing strategies that respect differences between people, their institutions and objects of natural sciences (Bryman, 2012). Within this paradigm, subjective meanings of social actions (Cohen et al., 2011) and interpretations of the social world are found to be culturally derived and historically situated (Crotty, 1998). The difference between interpretivism and positivism is that the former focuses on people and their institutions, and the need for understanding (ibid), while the latter focuses on the objects of natural sciences and explanations of the reality. While interpretive and positivist paradigms are concerned with understanding phenomena, both view these through different lenses.

Interpretivism takes a relativist ontology in assuming that “reality as we know it is constructed intersubjectively through the meanings and understandings developed socially and experientially” (Cohen & Crabtree, 2006b, p.1). Thus, interpretivism has a subjective epistemology with the view that what we are and what we know cannot be separated from each other (Cohen et al., 2011). The culture, social environment and relationships one develops over time have an influence on the

researcher's values and perceptions of the objects of investigation and how these interactions are interpreted. Naturalistic methods such as interviews, surveys and text analysis (Cohen & Crabtree, 2006b) are favoured by interpretivism.

4.3.4 Critical Theory

Critical theory is a social paradigm that has both political and epistemological intentions to uncover effects of political structures and their power relations (Griffiths, 2009). It is based on Marx's critical philosophical views of social reality for change and derived from the Frankfurt School (Crotty, 1998). Ontologically, critical theory assumes that "reality is understandable and created and shaped by social, political, cultural and economic forces" (Cohen & Crabtree, 2006, p. 1). Epistemologically, critical theory assumes that humans cannot be separated from reality and embrace people's subjective views. Critical theory also employs an interpretivist approach to "determine what was wrong with society and identify ways to help transform society for the better" (Finlayson, 2005, p. 4). In addition, critical theory explores community beliefs and practices to uncover structures and systems associated with unequal power relationships that have held agents in coercive situations. Thus society is transformed from being disempowered to having their inequalities redressed to promote freedom and an equitable democratic society for all (Cohen et al., 2011).

Critical theory is also "a coherent body of thought" (Crotty, 1998, p. 130) seeking to understand how human society and the natural world co-function. Within this sphere of interconnectedness, knowledge is constructed in different ways and influenced by differing socio-cultural, political and decision making processes (Geuss, 1981; Crotty, 1998). Critical theory used in this perspective provides a distinctive aim, cognitive structure and mode of confirmation for researchers to better understand society. These core features enable society to reflect, developing reflective beliefs about itself, and account for its own origin to form its reality. The notion of better understanding oneself to be freed from coercive situations draws on Habermas' early work on conceptualising reality, which seeks to find answers from the cognitive areas of "prediction and control, understanding and interpretation, and emancipation and freedom" (Cohen et al., 2011, p. 32). The conceptualisation of reality serves different interests (Habermas, 1972). Each

registered interest is “socially constructed and constitutes knowledge which influences what counts as the objects and types of knowledge” (Cohen et al. 2011, p. 27). These interests have ideological functions that are technical, practical or emancipatory in nature. They also draw on the notion that “worthwhile knowledge is determined by the social and positional power of that knowledge” (ibid). What Habermas describes as technical interest characterises the positivist methods with “emphasis on laws, rules, prediction and control of behaviour” (ibid) while practical interest is associated with the hermeneutic interpretive methodologies. The third interest, emancipatory, is “concerned with actions that are informed by reflection with the aim to emancipate” (Kincheloe, 1991, p. 177). According to Habermas (1974), “emancipatory interest aims to expose the operation of power and bring about social justice so individuals could achieve social freedom” (p. 194-195). Habermas (1972) suggests that this could be achieved through “describing and interpreting existing situations, analysing the situation to understand its causes and purposes, ways to alter the situation and evaluating the achievement of the situation in practice” (p. 230). These suggestions reinforce the intentions of this study in attempting to establish the situations within which local communities’ TEK is treated in natural resource policies and legislations.

Emancipation and freedom was argued by Freire as possible to be achieved by those in coercive situations, if they recognise their state of oppression and reflect on ways to liberate themselves (Freire, 1996). The state of liberation is influenced by unequal power relations as the oppressed lack power to confidently take a stance against the oppressor, a theory associated with Freire’s pedagogy of the oppressed. Emancipation requires empowerment and the oppressed need to be enlightened and empowered to experience liberation.

Critical theory, as a reflective theory, allows agents to undergo self-reflection to identify and address coercive situations (Geuss, 1981). The reflective process enables agents to realise their disadvantaged status and experiences forced upon them by various sources and situations. This state of self-reflection enables agents to deal with root causes of their oppressed states, forcing coercion to dissolve and lose its hold on them. This “dissolves any self-generated objectivity and illusion agents may hold, making them more aware of their own origin” (Geuss, 1981, p.

61). Agents achieve a sense of enlightenment that emancipates society through social transition from an initially unclear state to a final state of clarity where they experience equality and fair distribution (Griffiths, 2009). Critical theory helps members towards self-knowledge and makes explicit their beliefs when directed at a particular group of human agents. It also gives them knowledge of changes resulting from applying standards of rationality to the whole body of their beliefs (Geuss, 1981).

The difference between critical theory and positivism exists in their focus. Critical theory focuses on people's subjective views to understand social reality through self-reflection and enlightenment that results in emancipation and transformation of society. These aspects of critical theory are crucial in this study as demonstrated both through my personal and professional experiences as an indigenous Papua New Guinean. Unlike other cases of marginality, my personal experiences have been filled with debates on the marginalisation of TEK (Foale, 2013) and other traditional practices and beliefs, whereby any knowledge associated with these beliefs and practices was considered inferior to those of the Western origins. This was a perception developed during colonialism and was also magnified by Christian missionaries who often described these knowledges and practices as heathen or ungodly (Tivinarlik & Wanat, 2006). The marginalisation of TEK and other indigenous knowledge and practices by colonial administrators and missionaries evoked fear among practitioners of TEK. This oppressive perspective continued to exist in the post-independence era as I experienced among many rural communities involved in natural resource management. It is during such encounters that I recognised the need to empower people in these communities to reflect on their TEK, acknowledge the significance it holds in their communities and ensuring its continuity, a view that aligns this study with Habermas' suggestions (Habermas, 1972). The need for transformation of community views and perspectives through empowerment that leads to emancipation was one reason for my decision to employ a critical interpretive paradigm in my methodology.

4.3.5 Methodology for this Research

Methodology enhances understanding of the process of scientific inquiry (Cohen et.al., 2011), shapes methods or approaches used and influences the results achieved (Boland, 2014). This research employed critical theory to understand participants' subjective views about TEK in natural resource management for sustainability through self-reflection. Some elements of interpretivism were also applied in analysing natural resource policy documents as discussed in section 4.5.3 and Chapter 8. Critical theory and interpretivist paradigms are both concerned with participants' subjective views and employ interpretive approaches to improve actions that reinforce the notion that "knowledge is a social and historical product" (Miles & Huberman, 1994, p. 4). The focus of this study, TEK, is knowledge that is produced both historically and socially through the interactions of individuals within a society to understand themselves, their culture and interactions with both human and non-human environments. Positivism promotes scientific methods as the only way to discover the truth about the natural world (Cohen et al., 2011; Crotty, 1998). This includes a tendency to prioritise quantitative data analysis techniques, which is of less relevance to my study. Positivism also perceives objects as producing their own meaning which are independent of human influence; a view that runs counter to the epistemological and ontological assumptions of this study. Thus it was not used in this study.

While the focus of this study is to bring about change, this process itself would take time to be realised. Ensuring this is achieved would require the support of approaches and methods that empower and enlighten the agents. The critical paradigm enables agents to undergo a self-reflective process to identify social, cultural, economic and political shortcomings of their society that are brought about by various factors, including oppressive natural resource management practices and policies introduced by the State and resource developers. For example, Banks (2002) reported how the local people within and around the Porgera mine in PNG were concerned about "issues of marginality, involvement in decision making, and control (or lack of it) over resources" (p. 51). These concerns formed the issues associated with the environmental impact of Porgera mine which were overlooked by the State. As the institution of power, the State's

dominant policies often take precedence over those of the community and marginalising of traditional resource owners often occurs.

In engaging a critical interpretivist approach, this research takes on the assumption that participants' ontological and epistemological views about the reality of their natural world are subjective and shaped by their social, cultural, economic and political context (Crotty, 1998; Finlayson, 2005). Interpreting and understanding these views could provide some insights into the participants' perceptions of TEK and sustainable natural resource management and the ways these could interact. Incorporating interpretivism in analysing natural resource policy documents was based on the assumption that the meaning of the social world can be made through respecting differences between people and institutions (Bryman, 2012) and employing strategies that could bring about change through informing policy for sustainability. Combining elements of both critical and interpretivist paradigms in this research assume a process that facilitates self-reflection and empowerment for emancipation. This creates an avenue for understanding and interpreting participants' perceptions of challenges, limitations and management strategies for sustainable natural resource management using TEK.

4.4 Research design

Research design provides a holistic strategy outlining how a research study will be implemented in a coherent and logical manner to address the research problems (De Vaus, 2001; Trochim, 2006) through collection and analysis of data. The design of this study was guided by the literature on TEK in natural resource management and followed the indigenous processes of PNG where face to face informal discussions were culturally appropriate. Thus, the use of interviews and workshops were useful approaches that encouraged participation of all invited stakeholders. The study also incorporated elements of critical theory which provided an avenue to explore societal beliefs about structure, institutions and the state of society. The cognitive nature of critical theory (Geuss, 1981) also enabled agents to reflect on personal and societal beliefs and values and give accounts of their perceptions. This process provided opportunities for reflection on current policies which are driven by beliefs and values, and reflect the struggle over ideas

and values in societies (Stone, 2012). Critical theory also provided the framework for agents to reflect on policy issues and correct their understanding through various means for the purpose of enlightenment and emancipation. This study used inductive reasoning to identify common themes, or issues emerging from the analysis. Some aspects of deductive reasoning particularly, key concepts derived from the literature, were also used to identify common themes, or issues based on the literature. These themes are used to understand the relationship between sustainability and TEK to inform policy. The study also employed elements of interpretivism to interpret policy documents and understand the subjective views of the participants.

This study was conducted in two phases. Phase one was carried out between April to July 2013 in parts of the Eastern Highlands, Manus, Morobe, Simbu, and the National Capital District Provinces of Papua New Guinea. It involved interviews with various stakeholders from the natural resource sector including community members, educators, conservation practitioners, policy makers and resource developers. Phase two involved the staging of two workshops in the National Capital District and Eastern Highlands Provinces in March and April 2014 respectively. A summary of the preliminary findings and draft sustainability policy recommendations developed from phase one were presented to the participants of the workshops (see Appendix D1). An open discussion was held in response to the presentation to obtain participants' feedback. This was audio recorded and transcribed later. A post workshop feedback form was then completed by the participants (see Appendix D2).

4.4.1 Description of the sample

The sample for this study was purposefully selected from the wider population (Bryman, 2004; Cohen et al., 2000). There were 24 participants of which 16 were male and 8 were female. This included a rural community focus group comprising 2 males and 1 female. A summary of this is shown in Table 4.1. Stakeholders' representatives included policy makers in national and local state agencies such as the Departments of Environment and Conservation, Forestry, and Office of Climate Change and Sustainability, and Department of Education. Other representatives were conservation practitioners from civil society organisations,

including non-government organisations involved in conservation, educators, community members including women and corporate representatives. The choice for these participants was due to their direct involvement in the implementation of natural resources and education policies and plans. Community organisations and individuals selected for this study have also had some involvement in implementing sustainability and TEK.

Table 4.1. Description of participants

Type of participants	Number	Data collection method
Policy makers	6	Interview/Workshop
Conservation Practitioners	5	Interview/Workshop
Corporate	3	Interview
Educators	5	Interview/Workshop
Community	5	Interview/Workshop/Focus group

The focus group was chosen from one rural village in PNG. The variables used in the selection of this focus group included the rural location of the village, suggesting that the people have less influence from external groups; their dependence on TEK on a daily basis and the location of the village within a nationally-recognised protected area. These variables are in accordance with Bryman's suggestion that "focus groups typically emphasise a specific theme or topic that is explored in depth" (Bryman, 2012, p. 501). In this case, the themes were TEK, sustainability and natural resource management, concepts that are quite familiar amongst members of the focus group.

With one or two representatives from each of these groups and an allowance for snowball sampling, 24 participants were interviewed. The proposed sample size aimed to overcome potential issues of attrition which could arise during the study. According to Cohen et al (2007), "sample size, representatives and parameters of the sample, access to sample and the sampling strategy" (p. 100) are significant and have to be planned earlier in the research planning stage. Careful selection of the sample involved a letter of invitation to participate being sent to various

stakeholders listed in Table 4.1 (See Appendix A). Those who accepted the invitation participated in the study. The variables to guide this sample selection included experience in policy development and reinforcement, policy implementation, practitioners and users of natural resource management, sustainability and TEK. These variables were important based on the researcher's experience as they provided the basis for this study. Participants with natural resource or education policy experience would be in a better position to recognise policy gaps, while those who are practitioners would note the gaps in the implementation of natural resource and education policies. Communities would also recognise the gaps in the local concerns for sustainability of their natural resources and the use of their TEK.

4.4.2 Data Collection Methods

Methods are approaches used in gathering data (Cohen, Manion, & Morrison, 2007) in various forms such as questionnaires, interviews, surveys or observations. Qualitative methods are characterised by the “emphasis on words” (Bryman, 2012, p. 36) to describe a phenomenon while quantitative methods “emphasise collection of numerical data” (ibid, p. 160). Qualitative research in education enables the researcher to gain an understanding of the topic being investigated. It explores the reasons for doing something and the factors influencing the action or situation. Data collection in qualitative research is a process that enables researchers to gain information on the perceptions of local actors, their interactions with others and the surroundings. This study is interested in the “unstructured data, the role of subjectivity, a small number of naturally occurring cases in detail, and use of verbal rather than statistical forms of analysis” (Hammersley, 2013, p. 7). Thus the choice of methods that primarily produce qualitative data suited the purpose of this study which was to explore participants' perceptions about TEK and its role in sustainable natural resource management. Quantitative data methods were not chosen for this study as statistical data was not the focus. The qualitative data methods used for this study included semi structured interviews, workshops and document analysis. Each of these are discussed below.

4.4.2.1 Semi-structured Interviews

Interviews used in research show human subjects as having the ability to generate knowledge through conversations (Cohen et al., 2007). This production of knowledge was described by Kvale (1996) as the result of “an interchange of views between two or more people on a topic of mutual interest which was socially situated” (p. 14). Cohen, Manion and Morrison (2007) added that interviews “enable participants to discuss interpretations of their world and perceptions of their situations” (p. 349), a choice that underpins the purpose of my study which is interested in indigenous Papua New Guineans’ perceptions of TEK and sustainability. The human embeddedness in interviews strengthens the social nature of interviews as a qualitative research method. Interviews also provide the researcher with opportunities to record “non-verbal data” (ibid) which could be observed during the interchange. This social nature of interviews enables qualitative researchers to employ structured, semi-structured or unstructured interviews as a research method.

The choice of semi-structured interviews as the primary method for data collection for this study was based on the view that interviews encourage production of knowledge (Cohen et al., 2007; Kvale, 1996) in a social environment, and captures participants’ interpretations and perceptions (Cohen et al., 2007). Semi-structured interviews are “conducted with a fairly open framework which allows focused, conversational, two-way communication” (Keller & Conradin, 2016, p. 1) and comprise open-ended questions. In addition, semi-structured interviews use an interview guide approach to “increase the comprehensiveness of the data and makes data collection somewhat systematic for each respondent” (Patton, 1980, p. 206) and enable interviewers and respondents to engage in informal interviews (Cohen & Crabtree, 2006b) that gives the researcher the flexibility to start the interview process in any order and not strictly in the order of the interview guide. This sets semi-structured interviews apart from structured interviews which adhere to a strict line of questioning or unstructured interviews associated with unprepared questions. In the PNG context, the use of semi structured interviews encouraged less formal discussions. This approach was well suited to the participants in this study (Mead, 2001) who responded well to the informal sessions.

Prior to conducting the interviews, the interview questions were trialed with six participants not involved in the study. These people were representative of the groups of stakeholders who were going to be interviewed. The trialing of the questions indicated no subsequent changes to the questions as these non-interview participants did not experience any difficulty in understanding the questions and responding to them. In addition, all interviews were conducted in both English and Pidgin and allowed flexibility as participants were freely able to express their views using either of the languages which they felt comfortable with.

Research in culturally sensitive areas, like those among indigenous communities, need to follow culturally acceptable processes (Smith, 1999). The semi-structured interview sessions in the communities, particularly with villagers, including the focus group, took this into consideration and involved aspects of storytelling as part of the interview process. Storytelling in this context was a culturally appropriate approach (Mead, 2001; Smith, 1999) as through this process one is given the opportunity to position oneself in the research and be able to contribute to the co-creation of knowledge (Lowan-Trudeau, 2012). Storytelling allowed participants to respond to the interview questions in a relaxed manner with the freedom to express their views as they saw fit. The way this worked involved firstly, encouraging the community participants to tell their story about themselves and their environment, how their ancestors used their environment and whether these had changed in the present day. During this session, the researcher was allowed to ask the interview questions through probing as it indicated that the researcher was attentive and interested in the stories being told. This encouraged the participants to expand on their stories to respond to the interview questions.

Two main interview techniques were employed in this study. There were twenty-one individual face to face interviews and one focus group interview consisting of three members. For individual interviews, the dates, location and times for each session were decided upon in consultation with the interviewees after they accepted and signed the research consent form. For the focus group, permission

was sought from the Wildlife Management Area Committee² as their community was located within a gazetted protected area in PNG. This committee also requested the researcher to conduct an in-service professional development for elementary and primary school teachers in their community in return for conducting the focus group interview there. This was not surprising as reciprocity is a common practice in many parts of PNG and the researcher did anticipate conducting teacher in-services if requested. In consultation with the Wildlife Management Committee, an interview date was set and conducted on site in the protected area. Each face to face interview was about one hour in duration.

In the second instance, a corporate participant chose to provide written answers to the interview questions as part of their company regulations and then requested to do a follow up discussion of these responses. In addition, another company representative requested the list of interview questions to be emailed to them for screening which the researcher did but received no responses back from the company. Only two out of the three corporate representatives agreed to do face to face interviews, which were conducted like the other stakeholder groups. These highlighted challenges involving resource developers, particularly in the gas and mining sector who have very strict policies regarding providing information about their company, as there have been cases associated with “environmental impact of their waste management strategies” (Banks, 2002, p. 39). The resource developers appeared to be concerned about protecting their company interest, thus they were quite selective about how they responded.

Face to face interviews enable the researcher to carry out synchronous communication with the interviewees at a particular time and place (Opdenakker, 2006). The advantage of this process is that the researcher gains additional information about interviewees from their voice intonations, gestures and facial expressions (ibid). This enhances the researcher’s knowledge of the interviewees, knowledge that may not be obtained from other techniques. For example, voice intonations highlight emphasis placed on certain concepts or issues of significance

² Wildlife Management Area (WMA) is a protected area in Papua New Guinea gazetted under the Fauna Protection (and Control) Act 1980. The Management Committee is the body that enforces the WMA laws and also ensures the wellbeing of the WMA.

that enables the researcher to gain insights into the interviewee's thoughts and views. A focus group was employed to explore in-depth the views of a specific group of participants on a specific theme (Bryman, 1996; Cohen et. al., 2007). The focus group in this study were members of a community that is known to practice their TEK daily for resource use and management (Sinclair, Tuke, & Opiang, 2010) as they are located within a gazetted protected area. The location is rural and isolated and sits within three bordering provinces. The focus group comprised clan elders, youth, adult men and women. The interview began with the researcher asking the group to talk about themselves and their interactions with the environment and how they were able to survive over generations. This prompted the elders to tell their story and allowed the researcher to weave the prepared interview questions into the story. This session was audio taped with permission and lasted sixty minutes. All data was transcribed, analysed and reported in Chapters 5 and 6.

4.4.2.2 Stakeholder Consultation Workshop

Stakeholder consultation is a significant research process involving different groups of people whose views are vital for data generation and verification. Stakeholder participation can enhance decision making (Reed, 2008) by providing the opportunity for those in the study to express their views. A representative from each of the participating agencies described in section 4.4.1 was invited to participate in the consultation workshops, however only fifteen of the adult stakeholders were able to attend. The details of those who participated are described in Table 4.2.

Table 4.2 Description of workshop participants

Type of participants	Male	Female	Total
Policy makers	1	1	2
Conservation Practitioners	4	2	6
Corporate	1	0	1
Educators	2	2	4
Community	1	1	2
Total:			15

The process of reporting back to the indigenous stakeholders, aspects of one's findings is consistent with Smith's (1999) argument that "researchers' reporting back findings to indigenous communities must assume the principles of reciprocity and feedback" (p. 15). Lowan-Trudeau (2012) describes reciprocity as "recognising that the participants are select group of individuals representing a greater community and it is important to honour and recognise that community" (p. 124). The principle of reciprocity binds the researcher to reciprocate the favour given to the community, which in this case, is responses provided in the face to face focus group interview. In the PNG context, it is culturally acceptable for the person who was given something to reciprocate this. As such, it is anticipated that the researcher will report back the research findings to participating agencies and communities. Such a principle of reciprocity in giving feedback to participants is part of reflective traditions including feminist and indigenous research practice (Smith, 1999) and the sharing of knowledge (Lowan-Trudeau, 2012). For indigenous communities, such actions also enhance relationship building which often develops into a lifelong friendship.

Two stakeholder consultation workshops were conducted in phase two of this study in March and April 2014. One was staged in the National Capital District where most of the policymakers and some of the other stakeholders were located. The second was held in Eastern Highlands Province where most of the other stakeholders were located. Both the summary of the preliminary findings and the draft recommendations for a sustainability policy framework were presented in these workshops (See Appendix D1 for the presentation). The workshops took on average one hour and 20 minutes, including the presentation taking 40 minutes, while the discussions and the completion of the feedback forms taking another 40 minutes. After the researcher's presentation, opportunities were given to all participants to provide oral feedback on the preliminary findings, as this was also culturally appropriate. Each participant was given time to comment on the findings presented and give their personal views on the topic. These were all audio-taped with the participants' permission. A follow-up workshop feedback form was also provided to each participant, which were completed in 20 minutes and returned to the researcher at the end of the workshop (See Appendix D2). All

data generated from the workshop discussions were then transcribed, analysed and are reported in Chapter 7.

4.4.2.3 Document Analysis

The data collection method of document analysis enables “documents and records related to a particular study to be examined” (Heffernan, 2015, p.1) or a “systematic procedure to review and evaluate both printed and electronic material” (Bowen, 2009, p.27). The process of examining a document allows the researcher to gain a deeper understanding of the content. This creates a space for “eliciting meaning through interpretation of data and production of empirical knowledge” (ibid). Document analysis was employed in this study to enable the researcher to explore policy documents and records on natural resources management and education to review and evaluate relevant clauses and statements associated with TEK and sustainability.

As this study was interested in analysing policy documents, it used the critical discourse analysis approach to examine five different policy documents related to natural resource management in Papua New Guinea, including the National Curriculum Statements, Environmental Act (2000), National Forest Policy (1991), Protected Areas Policy (2014) and Mining Policy Draft (2012). Each of these policy documents was examined using two criteria as suggested by van Vinjik (1985). Firstly, the document was analysed for any mention of the relationship between TEK, sustainability and policy. Secondly, the context of the document was examined to understand the writers’ perspectives and reasons for writing the policy documents. Each policy document was evaluated, interpreted and analysed respectively, with the findings discussed in Chapter 8.

4.5 Qualitative Data Analysis

In qualitative research, data analysis occurs after data is collected and involves “organising, accounting for and explaining the data to make sense of it by noting patterns, themes, categories and regularities” (Cohen et.al., 2011, p. 537). Miles and Huberman (1994) describe qualitative analysis as a process of “data reduction, data display and conclusion drawing or verification” (p. 10) which forms the Data Analysis Interactive Model. The model shows that once data is

collected, it goes through a cyclic process of reduction, display and conclusion where data coded at the reduction stage allows new ideas to emerge, which are then displayed for further deliberation.

This study used simple qualitative data analysis techniques, particularly the Data Analysis Interactive Model suggested by Miles and Huberman (*ibid*), to collect, organise and account for the data from the interviews. At the data reduction stage, a thematic approach was used to categorise data into common themes to allow for further analysis. Braun and Clarke (2006) described thematic approach as “providing a flexible and useful research tool that can generate rich and detail, yet complex account of data” (p. 78). This characteristic made a thematic approach a useful tool for this study because the interview questions required exploration of the relationship between specific concepts such as TEK, sustainability, education and policy. These concepts provided some ideas for key themes that the researcher was able to look for in the data. Participants’ responses to the questions also provided an opportunity to both explore their understanding of the concepts and identify any emerging ideas or themes. These were clustered together to form the analytical framework used in interpreting the data. This process highlighted the use of inductive reasoning with some aspects of deductive reasoning. A Codebook approach (La Pelle, 2004) was used to further simplify the data and format the interview data into tabular formats using Microsoft Word documents. A theme codebook was created by “noting themes that seem to occur that have some significance to the study” (*ibid*, p. 88). Each utterance in the constructed text was then allocated a numerical code which was later used for sorting of text data (See Appendix E). Since all interviews were recorded, it made the process easier for the researcher in terms of listening to the recorded responses, and interpreting the information. In addition, most of the interviews were conducted in English, except for some contributions from community participants which were conducted in Pidgin and later translated to English during transcribing. This is because some of these community participants do not speak English, so Pidgin was the better option for them.

Transcribing and analysing of data occurred in two stages. The first stage involved interview data from phase one of the field work. The second stage

involved data gathered from oral discussions and written workshop evaluation feedback collected in phase two. Once the interview data from phase one of the field work was transcribed using Microsoft Word, meaningful codes were allocated to each transcript to make sense of the utterances (see Appendix E). Codes were allocated based on the analysis of participants' responses to the research questions. Common terms or key ideas emerging from these responses were identified and coded and sub coded. These codes were later used to determine the theme.

After the coding process, an excerpt of the coded data went through a peer review process, involving another researcher who applied separate codes. Peer review or examination of data is an internal validity process (Lecompte & Preissle, 1993) often used in qualitative research for validation purposes. The other researcher's codes were compared for validation with the codes analysed by the researcher from this study, which were found to be similar in context. The coded data was then collated and further refined to identify similar themes and patterns. Physical grouping together of recognisable themes enabled the researcher to link the themes with core ideas from the research questions and the literature. The coded data from phase one was later analysed to produce the preliminary findings, a summary of which was presented at the phase two workshops (See Appendix D). The processes applied in phase one data analysis were repeated for phase two data. All the findings for phase one data are presented in Chapters 5 and 6 while those from phase two are presented in Chapter 7.

4.6 Trustworthiness

Validity and reliability of any research is vital for those intending to implement the outcomes of the research or replicate some aspects of the study. In qualitative research, the use of the term trustworthiness has become more common than validity, as validity is a term used in association with quantitative factors, such as measurement validity (see also LeCompte & Goertz, 1982; Kirk & Miller, 1986). Lincoln and Guba (1985) proposed the term trustworthiness in qualitative research with key aspects that are parallel to those of quantitative research. Trustworthiness "allows researchers to describe the virtues of qualitative terms outside of the parameters that are typically applied in quantitative research" (Given & Saumure,

2008, p. 1) and include terms such as “credibility, transferability, dependability and confirmability” (Bryman, 2012, p. 49). These aspects of qualitative research enable trustworthiness to evaluate the robustness of the findings and the research’s ability to be applied elsewhere to confirm that the research was carried out in good faith. In quantitative research, “validity must be faithful to the premises of positivism and positivist principles” (Cohen et al., 2011, p. 180). This is achievable when “assumptions underpinning the statistics, construct and content of the measures, and careful sampling are used to avoid range of threats to internal and external validity” (ibid). It is the focus of quantitative research on the aspect of measurement validity that separates it from qualitative research and leads to the use of the term trustworthiness over the rigidity of the term validity for qualitative studies. Thus trustworthiness of this qualitative study was viewed in terms of its credibility, transferability, dependability and confirmability.

The credibility of this study was addressed through the use of triangulation and member checks. Triangulation in qualitative research implies the use of more than one method of data sources. In this study, several methods of data sources were used, particularly semi-structured interviews, consultation workshop feedback, and document analysis. Member checks were also carried out after transcribing data from the interviews when transcripts were sent to interview participants to review. Nearly all participants indicated acceptance of the transcripts with no correction except one participant from the resource developer category who made a slight amendment to their transcript.

The issue of transferability is addressed through the thick descriptions provided both in the methodology (this chapter) and the findings of this study (Chapters 5, 6 and 7). These thick descriptions give the reader and the user of research the opportunity to determine its usability (Cohen et al., 2007), so that they can decide if aspects of this study can be used in their study. On the other hand, the issue of dependability was addressed through member checks or respondent validation where participants’ transcripts were returned to them via email to verify the content. Expert views from the supervisory team were also sought on the interview questions used in Phase one of the field work and the workshop feedback questions used at the end of the workshops in Phase two prior to the

actual field work. Peer review continued throughout the data analysis process where another researcher in the area of environmental and sustainability education was provided the excerpts of interview transcripts to reflect on the data and code them according to their own interpretation. These codings were found to be consistent with my own.

Confirmability was addressed through various methodological processes followed during the research process. For instance, this study sought ethical approval from the University of Waikato (see Appendix A) after which participants were invited to participate only if they gave informed consent. Appropriate permissions were also sought for release of participants if they were employed (see Appendices B and B1). Data from phase one was analysed and the preliminary findings presented in stakeholder workshops for feedback (See Appendix D1). Thus processes that were followed as evident from various appendices attached support the confirmability of the study.

4.7 Research Ethics

Historical roots of social science research ethics originate from concerns about the abuse of research subjects in the medical research in Nazi Germany during Second World War and took measures to address these (Wiles, 2013). Central to these concerns were the issues of consent and risk avoidance, concerns which are still applicable to social science research ethics today. Research ethics refer to “the analysis of ethical issues that are raised when people are involved as participants in research” (Walton, 2015, p. 1). The broad purposes of research ethics include “protecting human participants, ensuring favourable research is conducted for the benefit of all those involved, and examining specific research activities and projects for ethical soundness” (ibid). Ensuring these expectations are met in this study require specific processes to be followed or taken into consideration, some of which are discussed below.

4.7.1 Ethical concerns

Some areas of ethical concerns include “harm caused to participants, getting informed consent from participants, privacy and deception” (Bryman, 2012, p. 135) and “access and acceptance in the research setting, confidentiality, and

personal code of practice” (Cohen, Manion & Morrison, 2011, p. 75). While these concerns are common, they can also differ in varying situations. As Wiles (2013) points out, “research is situated and contextual where specific issues that arise are often unique to the context of each individual research project conducted” (p. 2). Ensuring such situations are minimised before research projects begin is one reason why ethical clearance is required from an ethics committee. This committee ensures researchers conduct research that does not harm their reputation and that of their institutions and research participants (Bryman, 2012). Ethical considerations for this study followed the ethical guidelines outlined above through acquiring approval from the Faculty of Science and Engineering Human Research Ethics sub-committee of the University of Waikato (see Appendix A). Participants’ permissions were obtained to conduct interviews and audio-tape record interviews when the informed consent letter was sent to them. At the start of the interviews, the research process was explained to them. Participants were also informed of their rights to decline to participate or withdraw their responses both on the informed consent letter and at the start of the interview.

Ethical considerations are also crucial when involving indigenous or tribal communities in research. These communities have cultural ethics that need to be considered. For example, in granting permission to enter their community and conduct focus group interviews, the rural community in this study expected the researcher to reciprocate their participation through providing professional development training for elementary and primary teachers in their local schools. This is consistent with “the protocols of respect and practices of reciprocity” (Smith, 1999, p. 136) and are ethical practices in indigenous research. A researcher studying indigenous communities has to be prepared to give back to the community in order to take from them, for instance, they have to be prepared to share the knowledge from the research (Lowan-Trudeau, 2012). An indigenous researcher has the challenge of nurturing such relationships which are culturally ethical and can gradually develop into the giving of consent to conduct research (Smith, 1999).

4.7.2 Informed Consent and confidentiality

Getting consent from participants involved in the research project is crucial (Bryman, 2012; Cohen et al., 2011) as they (participants) need to be informed about the full process of the research. For this study, potential participants and their supervisors (those formally employed) were invited to participate through a consent letter (see Appendix B and B1). Those who gave permission to participate were then contacted individually and an interview date and time was set for them. Assurance of confidentiality was another area of concern (Cohen et al., 2011) to boost participants' confidence in the researcher and the genuineness of the research process. Confidentiality was assured early in the study when participants and/or their immediate supervisors were informed through the consent letter about the full process of the research i.e. the findings will be kept confidential and no names will be mentioned, that these findings will be presented as a report in the researcher's PhD thesis and in conference presentations and journal publications. In addition, participants were also advised that data collected will also be stored in a safe place for the duration of the study before it will be destroyed, thus maintaining participant confidentiality. A similar process was also undertaken for the interview participants in re-inviting them to participate in the workshops when use of the findings and the maintenance of confidentiality were explained to them. Those who responded to the email and agreed to participate were then advised on the date and time of the workshop.

Obtaining informed consent and permission from the community focus group involved a longer process. The consent letter was firstly sent to one of the researcher's colleagues in Goroka who then delivered the message request to the community leader. The leader then called a meeting to seek the views of the Wildlife Management Area Committee before responding back with permission to conduct the focus group interview. Staging of meetings is an ethical process of negotiating community entry, as discussed by Smith (1999), and should be anticipated by indigenous researchers or others when researching indigenous communities.

Other stakeholders such as conservation practitioners were approached through the researcher's experience. That is, conservation organisations were firstly

identified and then a staff member was approached with the invitation to participate depending on their field experiences. Those who responded back with permission were then involved. Similarly, educators were identified through their community education experiences and when approached, those who gave permission to participate were involved. On the other hand, natural resource policy makers were identified through the PNG Eco-forestry forum, a network of environmental and conservation organisations. The researcher approached members of the forum and enquired for assistance in identifying officers responsible for natural resource policies, such as forest and environment. Some of the members of this forum were quick to connect the researcher to specific line managers who were approached through email. They then identified their staff members and granted permission for them to participate.

The final group, resource developers, were difficult to access as they had their own company protocols to abide by. For example, as a company policy, employees of some oil and gas companies are not permitted to give information about the company. When officers responsible for community relations and environment were contacted, their responses were not favourable. However, some non-gas and oil companies gave permission to participate in the study, so three participants from this stakeholder group were able to take part.

During the field research, no harm was faced by the researcher or the participants, other than the time involved in participating.

4.8 Chapter summary

This chapter focussed on the research design, methodology and issues of trustworthiness in this study. Various aspects of these discussions are summarised below.

In the search for understanding, knowledge formation in the indigenous context does not always follow the processes of being questioned, investigated further or deliberated on before being accepted. This challenges the need to understand the natural phenomena surrounding the context of such societies in their quest for knowledge to select an appropriate methodology.

The social nature of this study enhanced by the need for transformation of community perspectives through empowerment enabled a critical interpretivist approach to be employed. Critical aspects of this approach support a self-reflective process on personal and societal beliefs and values that enables stakeholders to contribute to policy changes.

Stakeholders selected to participate were representative of those involved in natural resource management such as community members, educators, conservation practitioners, policy makers and resource developers. The selection process was based on participant experience in policy development and reinforcement, policy implementation, practitioners of natural resource management and users of natural resources.

Data collection methods used included semi-structured interviews, consultation workshop feedback and document analysis. Semi-structured interviews and consultation workshop presentations were culturally appropriate and enabled participants to be relaxed and freely express their views and opinions. Document analysis provided an understanding of the context of the policy documents and enabled an exploration of the relationship between TEK, sustainability and policy. Critical discourse analysis was used to evaluate each policy document.

A Data Analysis Interactive Model was used to organise and account for data which was further categorised into themes using a Thematic Approach. A Codebook approach provided tabular formats to further analyse data to allocate numerical coding for each utterances.

Approaches to trustworthiness included obtaining expert views from the supervisory team, piloting interview questions, thorough examination of data, conducting member checks and peer reviews, and triangulation of data.

Ethical considerations for the research were crucial with maintenance of confidentiality for the participants throughout the study. Permissions were obtained to conduct interviews, audio-tape record interviews, and discussions and explanations of the research processes. Participants were also informed of their

rights to decline to participate or withdraw their responses. Considerations were also given to cultural ethics and protocols involving indigenous communities.

The next chapter discusses the first part of the findings of phase one data

Chapter Five

Traditional Ecological Knowledge and Sustainability

5.1 Chapter Overview

The recognition of the value and role of traditional ecological knowledge (TEK) in contemporary management of natural resources globally has increased over the past few decades. TEK is derived from the wisdom of the past and embedded in the practices of the present, which could provide alternative solutions to the deteriorating conditions of Planet Earth. The practices of TEK by indigenous and tribal peoples over many generations have ensured the availability of resources accessible today and is one reason for the increased support for TEK from global conventions and reports such as the Brundtland Commission's Report *Our Common Future* (World Commission on Environment and Development, 1987), the Convention on Biological Diversity (United Nations, 1992) and the Declaration on Indigenous People's Rights (United Nations, 2008). The use of TEK in this context refers to all aspects of indigenous knowledge and practices related to human interactions with the environment (both physical and spiritual) developed over time and disseminated through generations using various means.

This chapter discusses the findings of the study on indigenous perceptions of the relationship between traditional ecological knowledge (TEK) and sustainability in the context of natural resource management in Papua New Guinea. It addresses questions about the way stakeholders perceive the relationship between TEK and sustainability, and the ways in which this relationship is strengthened. These questions were administered through the interviews (See Appendices C and C1) to targeted stakeholders who participated in this study, particularly community members, conservation practitioners, educator, policy makers and resource developers. The data was collected in the first phase of the field work in 2013. By combining simple qualitative data analysis techniques as described by Miles and Huberman (1994) and La Pelle (2004), the data collected was categorised into key themes and sub-themes which were analysed and presented in the findings chapters as quoted text with an attribution based on the role of the participant and a number showing the utterances.

The findings indicated that the participants had an understanding of their TEK and recognise its relationship with sustainability in terms of the core values they share. These are discussed under the headings: Perceptions of traditional ecological knowledge (TEK) and Sustainability, and Sustainable Living and TEK. Section 5.2 discusses participants' perceptions of traditional ecological knowledge (TEK), types of TEK and its uses in resource management. Section 5.3 discusses participants' perceptions of sustainability and sustainable living through actions for sustainability, its application in contemporary natural resource management and social responsibilities for sustainable futures. Section 5.4 provides a summary of the chapter.

5.2 Perceptions of Traditional Ecological Knowledge (TEK)

To understand perceptions of traditional ecological knowledge and practices held by indigenous Papua New Guineans, participants were asked to explain their understanding of traditional knowledge of the natural world. The findings indicated that participants' views on traditional ecological knowledge (TEK) portrayed it as comprising different knowledge types that reinforce local cultures and practices; vital for reinforcing local connections between people and their environment, and applicable in natural resource management practices. These perceptions are discussed in the following subsections.

5.2.1 Knowledge about life and living

Responses regarding the question of TEK and how it was defined indicated varied views depending on individual interpretation of the question. A common response expressed by participants was that TEK was a holistic knowledge about life as it enabled the user to acknowledge the interconnectedness of all environmental components, both physical and spiritual, and the need to ensure its continuity. As a holistic knowledge, TEK was perceived as a *system of knowledge*, as expressed by a conservation practitioner:

TEK is about a system of understanding or knowledge that people have built throughout history. It was acquired out of experience or actually doing something in an experimental

way through trial and error (PRT2, 33).

This response portrays TEK as a historical and experiential knowledge which was improved as users combined it with other knowledge types. As part of a system, TEK was also viewed as comprising knowledge about people's way of life, their interactions with the environment and how they utilise resources, as described by another practitioner:

TEK is about people knowing themselves, their environment and culture in relationship to their daily interactions based on what they know, practice and acquire from one generation to the next (PRT3, 67).

By possessing TEK, a person could inherit the knowledge about different uses of living organisms such as knowledge about the uses of different woody plants and other non-wood forest products by Kayapo Indians of Brazil (Dubois, 2016). The amount of TEK one possessed was also determined by one's desire to acquire definite knowledge about different aspects of their environment. The types of knowledge one acquires or develops may vary depending on one's needs but three common areas of TEK identified in the findings are ancestral environmental knowledge, knowledge about place, and knowledge about continuity. These are discussed in the following sub-sections.

5.2.1.1 Ancestral Environmental Knowledge

Understanding one's ancestral origins, the way nature works and the co-existence of different organisms and levels of interactions they share were knowledge and practices developed over time and passed on for generations. This type of knowledge was fundamental for understanding environmental functions and accessing resources, as described by a policymaker:

Traditional knowledge of the natural world means the kind of understanding, explanations, practices and skills that the forefathers had or used over thousands of years, such as ways of understanding the environment they were in and the

explanations they had for their surroundings (POL5, 167).

This was also echoed by an educator:

Traditional knowledge of the natural world is the knowledge of our ancestors that was practised in the past. They used this to help them cope with life by utilising whatever resources were available to them from the land or water. It was also the knowledge and skills they had about the things within their environment (ED4,176).

As environmental knowledge acquired from their ancestors and improved over time, TEK enabled the local people to be knowledgeable about the interactions of organisms in their environment such as the behaviour of megapodes (Sinclair et al., 2010) or the effect of cutting down primary forests on bird species that live exclusively in this type of habitat (Thomas, 2010). These examples suggest specific knowledge local people possess and practise that has been drawn from TEK acquired over generations to meet present day needs.

TEK was also viewed as ancestral knowledge about resource availability and origins of life, including clan existence, which was often illustrated in various forms. For example, as one conservation practitioner expressed:

In my work, all clans and tribes tend to identify with an animal, plant or a mountain. For instance, according to the myths and legends of one mountain clan, they think of themselves as related to the raggiana bird of paradise so they don't hunt, shoot or kill it. This increases the bird's chances of survival. Similarly, in another tribe in the lowlands, people don't hunt or harvest monitor lizards and cassowaries because they identify with these animals. This allows them to be protected (PRT3, 71).

This unique clan identity was associated with the kind of knowledge each clan possessed about their relationship with the animals, plants and the land or seascapes. TEK as ancestral knowledge also emphasised inheritance and kinship

identity and was also consistent with other findings on indigenous family knowledge (Tiu, 2007). By being in possession of this knowledge, local people developed a sense of identity which positioned them in their respective space.

Another area in which TEK as ancestral environmental knowledge was seen to be at work was through the knowledge of resource inheritance. This could be seen in the process of land acquisition, where both inheritances from biological parent to offspring or an elder to another clan member were practised to ensure limited resources were maintained within a particular clan. As described by a community participant:

Apart from immediate family inheritance (father to son), another way in which land is also inherited is based on the principle of supporting and caring in times of need. For example, if my father died and someone from my clan came to my aid in killing a pig during the funeral feast, later when I share the possessions of my father, I can allocate a portion of land to this person. This practice is very alive today and land inherited in this manner is not disputed in any way or taken back by the biological sons (COM4, 34).

In a country with an increasing population, land is becoming a limited resource so inheritance of this and other resources associated with it is significant for today's society. TEK as ancestral environmental knowledge reinforces the value of kinship identity through inheritance of land and resources which were also consistent with other findings on indigenous family knowledge (Tiu, 2007). Being in possession of this knowledge reinforces a sense of identity in local people and positions them in their own space to exercise their rights of inheritance.

TEK as ancestral environmental knowledge is essential for understanding interactions of humans with the environment and its components such as plants and animals. It is also vital for reinforcing family knowledge about clan origins and identity, and inheritance of resources such as land. This type of knowledge also sets the foundation for developing a deeper understanding of one's place, as discussed in the following subsection.

5.2.1.2 Knowledge about Place and Responsibility

TEK was also perceived as knowledge about people's place in the environment and the relationships they have developed with other components of that same environment. This was demonstrated in their role as caretakers or guardians of their ancestral lands as described by a community participant, "each clan in my area had a leader whose opinion was sought before resources were harvested from a particular site" (COM3, 96). This responsibility of guardian was seriously implemented throughout an individual's lifetime. In this example, the leader was the guardian of the clan land and had the role of protecting the resources by giving or refusing permission for people to harvest. This approach could also be viewed as an unintentional resource management strategy and reinforces the authority of the caretaker or guardian. This view is similar to other indigenous worldviews such as the New Zealand Māori concept of *Kaitiakitanga* or guardianship (Miller, 2014). The concept of guardianship may be misconceived to mean total protection without any use of resources. However, Miller (2014) added that guardianship also refers to ensuring the sustainability of resources for the long term. That is, to utilise the environment and its resources in a meaningful way without harming the Earth and the life forms it supports.

As knowledge about place, TEK was also seen to enable its users to recognise and interpret natural signs to determine weather conditions, harvesting and planting times. This knowledge was both reconstructed by the people who used it and acquired from the past users. As one educator explained:

Traditional knowledge of the natural world is about what a particular people in an area know about that area, what to do or not to do, the restrictions and taboos of certain areas we have in our villages and so on. TEK belongs to the people; they have the know-how and are the master technicians in that area (ED5, 236).

TEK was portrayed as people's deeper knowledge and understanding about significant resources, traditional knowledge that guided their uses, and ways to manipulate these resources to their best advantage. The detailed information

indigenous people possessed about specific resources reinforced their values, as described by a conservation practitioner:

People have within their traditional knowledge systems accumulated knowledge about a particular resource of importance to them. They even know the seasonality of species and the breeding systems, if it's an animal. In fact, they tend to have more knowledge about this particular species than if they don't have a particular use for them. So if something is of a very high importance to the people traditionally, they tend to over classify it or see more details in it to separate it from other species (PRT2, 41).

Species knowledge as described above was accumulated over time and was seen to be confined to a specific geographical area. This type of knowledge was used to separate culturally significant species from those that were not. Such species were also aligned to a cultural practice that maintained its continuity. For example, karuka nuts³ (*Pandanus jiulianettii*) are exchanged by mountain people in the higher altitude areas of central PNG highlands for pandanus marita⁴ (*Pandanus conoideus*) with valley people in the lower altitude (Brown, 1970). Both these resources were important food sources as they are rich in nutrients. By exchanging with another kinship group, the local people had placed cultural values of relationship building through reciprocity on these resources. While there are no monetary values placed on these resources, the measure of this exchange was often based on the number of bags of nuts to the fruits exchanged. For example, for every one marita fruit presented, there would be an estimated one to two bags of karuka nuts reciprocated. The strength and longevity of these kinship bonds were reinforced by the generous additions one made to the actual amount of these resources exchanged. Furthermore, a kinship group was obliged to reciprocate this gesture when the common resources in their area were in season. This process of reciprocity reinforced stronger lifelong bonds between the kinsfolk involved and ensured seasonal resources were accessed by all.

³ Karuka nuts (*Pandanus jiulianettii*) cultivated in high altitude areas in Papua New Guinea. The fruit is a round composite fruit about 15 - 20 cm across. It is made up of about 1000 nuts.

⁴ *Pandanus marita* (*Pandanus conoideus*) is a tropical pandan species endemic to the island of New Guinea. Its red and sometimes yellow fruit produces a thick source when cooked, mashed with water and strained. The vitamin A rich sauce produced is used to flavour food.

TEK as knowledge about place reinforces the values of guardianship and strengthening relationships through reciprocity. It also enables TEK users to develop a deeper understanding of their environment and certain species that are of cultural importance. TEK as knowledge about place could also be viewed as a traditional resource management strategy that enhances local people's understanding of survival and the need for resources to continue to exist. This knowledge about resource continuity is discussed further in the next subsection.

5.2.1.3 Knowledge about continuity

The use of TEK continued throughout the history of indigenous Papua New Guineans as it got passed on from one generation to the next. The ability of TEK to be disseminated in this way was associated with its active, applicable and living nature, as expressed by a community educator:

Whether people know about the terminology is one thing but in practice, they have already been doing it [practicing TEK]. It's like a wealth of knowledge, a warehouse, so in order for them to keep these intact to be used to access resources later, they have to practise it. So, traditional ecological knowledge is already a part of their system. It's a kind of knowledge that people are living; it's a living knowledge, it's not just stored and locked away (ED3, 128).

TEK was a knowledge that people used as they sought resources to meet their daily needs. For instance, it provided the knowledge about where to locate and harvest seasonal foods such as wild fowl eggs and okari nuts (*Terminalia kaernbachii*). The use of TEK in such ways also ensured these practices continued for a long time and in the process, encouraged sustainable harvest and access to resources. Being an active knowledge, TEK was also viewed as keeping subsistence living alive through enabling local people to possess certain knowledge and skills for survival. This dependence can still be seen in the subsistence lifestyles of over 80 per cent of Papua New Guinea's rural population today. TEK strengthens the connection of humans to other organisms in the environment when these knowledge and skills are utilised to access resources.

As a living, evolving knowledge, TEK was seen to meet the changing needs of people who used it, particularly in terms of improving and utilising available resources to meet current demands without harming the environment. For example, a community participant explained this use of TEK when producing traditional medicines:

In the past people could take leaves, roots, vines or fruits as cure for certain ailments. Today people are still able to collect these bush resources to produce potions to treat diseases without harming their environment. They are able to do this because they know what ingredients to use. The ability to identify the specific plants was knowledge acquired from the spirits but today it could be done through observing and learning to identify specific plant parts used to cure particular diseases (COM3, 108).

The production of medicinal potions based on an understanding of TEK about specific plants and plant parts was a demonstration of a living knowledge that was applied in today's society. With the ability to evolve, its practices were modified to suit the needs of its users. For instance, those wanting to know how to make potions could learn it by observing the type of plants used; they no longer got an actual revelation of knowledge from spirits or their designates. This could be viewed as permission to acquire knowledge without the proper training and authority to exercise the power, as would be the norm, and is due to an increasing need for community health and wellbeing. In this example, the values of caring and sharing prevail over the need to maintain control of a particular knowledge type. The principles of TEK used in producing traditional medicines were not changed; instead, they were applied to respond to the need for human wellbeing. Emphasis on the evolving nature of TEK could also be seen in a study on the use of intercropping and crop rotation amongst the Peruvian Amazon tribe of Yanesha to improve cassava cultivars without losing biodiversity (Missouri Botanical Garden, 2012). These examples reinforce the view that TEK can continue to be alive and relevant if it is practically applied in everyday uses without compromising the principles which have governed its use over generations.

Another factor that continuity of TEK as a living, active and applicable knowledge depended on was the regularity with which it was used. TEK had a greater chance of being recognised as essential for survival when it was frequently used. This was particularly so where communal resource harvesting was involved, where individuals practiced TEK together, as described in this example by the community focus group:

Traditional knowledge of the natural world is knowledge of the forests, rivers, streams and wild animals which was practised when people hunted together as a team (COM2, 49).

Resource gathering in groups in the past allowed for TEK to be applied more frequently and enabled kinsfolk to practice its uses. The decline in these practices today had raised concerns about the continuity of this knowledge as expressed by one community participant, “today’s life is more individualistic in nature and this really contradicts our cultural ways” (COM4, 132a). This tendency towards meeting individual needs before communal needs conflicts with the principle of collectivist societies where concerns for communal wellbeing are a priority. This was a main concern for the community focus group because of the nature of their communities and heavy dependence on kin members to harvest resources. The declining collective practices also reduce the chances of every member to exercise their TEK practices as an obligation to their kinsfolk. This was acknowledged by other participant groups who associated these with introduced ideas and practices. For example, one sustainability educator stated, “today’s generation has become ignorant about proper ways of managing and using their resources because of greed and introduced Western ideas of cash economy” (ED1, 13). The promotion of individualistic importance over communal wellbeing was seen to be a threat to collectivist societies as it could lead to social and environmental unrest.

In sum, TEK was viewed as knowledge about life which comprised other systems of knowledge that were drawn from ancestral knowledge. These types of knowledge reinforced the practice of resource inheritance and kinship identity; emphasised people’s role as guardians of the environment; enhanced people’s understanding of the ecological and cultural significance of specific resources;

and ensured continuity of TEK throughout history. The application of TEK was found to be determined by a community's need and easily threatened by introduced ideas that promoted individualism. Such threats are a concern for remote communities who have a dependent relationship with other kinsfolk and the natural environment.

The next sub-section discusses TEK as knowledge about people's relationship with the environment and the ways this is used to reinforce connections between all other environmental components.

5.2.2 Lifelong Connections and Relationships

Indigenous people's perceptions of TEK are informed by their worldviews (McGregor, 2004a) and are often demonstrated through daily interactions with the environment. These worldviews perceive every component of the environment as connected through a relationship which needs to be regularly maintained and nurtured. The maintenance or nurturing processes are reinforced through the enactment of various cultural ceremonies, spiritual knowledge and practices. For example, as recognition of their spiritual belief that the tree kangaroo originated from the spirit of their dead relative, a group of Gimi people in Papua New Guinea do not hunt this marsupial (see Tiu, 2007). This strengthens their relationship with these arboreal mammals, thus preventing the people from hunting the animals for food or fur. Such examples illustrate the complex relationship humans have developed with other organisms in their environment and practices they adhere to that ensure its health and integrity.

A demonstration of the participants' understanding of TEK as knowledge about local connections was also evident in the way people maximised available resources due to their limited nature. This could be seen in this description from a community participant:

Our environment consists mostly of blady grass (*Imperata cylindrica*) and soft cane grass because we live in the valley. We hunt ground birds among these grasses where we would follow their tracks until we locate their nests and mark the site. Later we would return and

catch the bird by trapping it carefully with our hands. This was done by blocking the main entrance of their nests to prevent them escaping and feeling the bird with our hands (COM4, 118).

In this example, the nature of the described environment indicated a regular limitation on available game for hunting. This meant that the local people needed to develop an understanding of the wildlife to know what would be available at a certain time. It was the TEK they had that enabled them to recognise these connections and reinforced their ability to access this resource as and when needed.

The findings also indicated that regular users of TEK such as rural community participants were found to have a greater knowledge of their environment and the role each of its components played in reinforcing interdependence of humans and other species than those in urban areas. The knowledge about when and where resources were plentiful and what type of resources could be used for certain purposes was one way regular TEK users demonstrated greater understanding of their natural world. For example, one community participant demonstrated such wealth of knowledge, as expressed in the following:

You do not just harvest any trees to get timber. Every part of the house has special timbers which are obtained from very specific trees. For instance, the posts were from one species, the frames were made from other species; the walls were from another and so on (COM3, 106).

The understanding of tree species and their uses was a crucial knowledge used by TEK users to selectively harvest specific timber resources for their need. Such knowledge, including the ability to physically differentiate between tree species, was possessed by people who have had a long history of interacting with their environment. Another community participant also added that people often demonstrated an understanding of their connections with nature through observing and responding to natural signs and signals. For example, as explained by a community participant:

There is a season for everything and people are aware of these. For example, they know when the bush greens are ready for harvest. Or, they know that the flowering season of a particular plant indicates the abundance of certain birds or mammals. This knowledge was then used by the hunters if they wanted to collect bird plumes. That is, they knew the time and place to go to. It's like the people know when animals will move so they were ready to catch them (COM5, 152).

The ability of a regular TEK user to make connections between natural signs and resource abundance is seen to be associated with an in-depth understanding of nature. These users have also developed a system of observing natural cycles to determine specific animal and plant resources that were in season. A combination of this knowledge and understandings were implemented through various local beliefs and practices which were passed on through the generations. As people practised this knowledge, they demonstrated their connections with other entities in their environment. This knowledge about interconnections was regularly used to identify, locate and harvest resources to sustain subsistence living. Such buildup of knowledge, understanding and practices were seen to have been derived from many years of observation, acquisition and implementation of traditional environmental knowledge.

While TEK reinforced the importance of connecting with other components of the environment one existed in to access resources, there were also concerns about the decline in these practices in today's societies. This was expressed in the following:

One of the concerns I have is today's generation is not appreciative of the environment, natural resources and the traditional knowledge and practices we have. They think the modern changes they experience today is a good thing and they take for granted all other things around them (COM5, 140b)

A member of the community focus group also added:

In my view, this knowledge is still practised although some of us are slowly losing some of it. This is because of the external influences where we think that some of those changes happening outside are good for us so we adopt them and in doing so we are discarding some of our own traditional knowledge and practices (COM2, 57).

Decline in TEK practices as described above was triggered by many factors including introduction of new socioeconomic activities, increasing population and modernisation in general. This was also seen to threaten the loss of connections people had with nature developed from traditional knowledge systems and practices associated with living in the environment, particularly those relying on the rural subsistence lifestyles. Such declines have also been recorded elsewhere as in Singh, Pretty, and Pilgrim (2010) who highlighted the erosion of traditional knowledge systems and the related biocultural resources among three tribes in northeast India. Moreover, dependence on the environmental connections developed from TEK for sustenance would not change overnight for many of these communities in PNG. The physical and geographical conditions they exist in already pose challenges to accessibility from outside. This deepens their reliance on TEK as they continue to interact with other entities in their environment and enhance these connections

Indigenous communities in this study view various entities in their environment as connected through relationships that need to be regularly maintained and nurtured. Many of these people are regular TEK users with great dependence on natural resources and they demonstrate deeper understanding of such environmental connections that influence resource availability and access. The decline in TEK practices threatens the loss of knowledge of these environmental connections for resource access, and therefore management, which is discussed in the next subsection.

5.2.3 Traditional Ecological Knowledge for Resource Management

The third perception of traditional ecological knowledge that was viewed as essential was its application in natural resource management practices and its

potential in contemporary Papua New Guinea. This recognition of the practical significance of TEK was also similar to those perceptions reported by Gadgil and Berkes (1991) on the practical significance of TEK. The application of TEK is demonstrated through implementation of its key values of *respect*, *responsibility* and relationship building through *reciprocity* in their practices. Two subthemes that emerged in the findings where these values were utilised included traditional practices of resource management, and stakeholder collaboration and participation.

5.2.3.1 Traditional Practices

There is a sense of understanding that TEK had a significant role in ensuring availability of natural resources for indigenous people over many generations. This was believed to be associated with traditional practices of resource use and management. Two distinct practices identified by participants of this study reinforcing this understanding were clan-based resource management and use of traditional harvesting techniques.

Clan-based resource management was a common practice in forest communities where clan boundaries were used as the first point of resource control. This encouraged two significant measures. First, people were forced to control resource harvest within the defined clan boundaries, as explained by this community participant, “traditionally people harvested resources in their own areas. That is, if they went hunting, they would go to their own land and harvested what they needed” (COM1, 29). This action was taken by clan members for effective use of available resources. It involved having regular updates on resources that were declining or in surplus and the actions they were to take to address the shortfalls, such as putting a temporary ban on a particular resource.

Second, clans participated in rotational harvesting of resources where they all took turns to host other clans on their lands as described by the community focus group:

One clan would request for everyone to go hunting on their land.
On another time, it would be another clan’s turn to reciprocate
the action so we would all go hunting in that clan’s forest. In that

way they allowed the harvested area to recover from the hunting expedition (COM2, 49b).

Rotational harvesting on clan lands reinforced the practice of collective harvesting and minimised resource wastage. Not only did clan-based management practice allow overharvested resources to recuperate, it also strengthened social relationships through reciprocal actions of resource sharing. In the past, collective harvesting of resources was a technique used to address two shortfalls – small population and protection against tribal enemies⁵ although today they are practiced due to the remoteness of some of these communities who depend on other clans for assistance. With smaller populations many tasks such as hunting and gathering of resources across a wide area would not have been accomplished, so a collective effort ensured that everyone contributed towards completing a task and reciprocated this favour when it was needed later. Today, collective activities are maintained at sub-clan and family levels as described by a community participant, “These days it’s only our immediate family members or friends who come to assist us when we do gardening or harvest coffee” (COM4, 132). This is particularly the case for communities which are semi-rural.

While clan-based harvesting was vital for sustainable use of resources and strengthening relationships, the practice had been seen to be disrespected by the present generation. This was emphasised by most of the community participants, for example:

Hunting or harvesting of resources in another clan’s land was only done at their invitation. This resulted in surplus of resources that continued for a long time. But today’s generation has violated this rule by entering other clan lands without permission so resources are abused and overharvested. Because of their actions in violating this sacred practice of respect, they experience decrease in bush meat and other resources (COM3, 92).

And:

⁵ Traditionally, attacks from neighbouring tribes were quite common so kinship groups often travelled in groups to avoid these.

Today's younger generation don't seem to know most of this traditional knowledge about the natural world and practices in terms of resource availability within their clan boundaries. This lack of knowledge is problematic and the current generation is becoming abusive of the limited resources available to us (COM5, 152b).

Clan-based resource management practices reinforced control of how and when resources were used and the amount that was harvested. The decline in these practices was attributed to a change in the attitude and behaviour of the younger generations. Whereas in the past, other people or clan's resources were respected, this practice was seen to be lacking amongst the present generation.

The use of traditional harvesting techniques was the second traditional resource use and management practice that was seen to apply TEK values for sustainability. The findings showed these techniques were practised across many communities and were consistent with other studies (see for example Foale, 1998). Types of practices also varied depending on the species, availability of resources and the location this was used. For example, fishing is common in coastal areas of Solomon Islands, Fiji and Papua New Guinea. However, slight differences exist in the techniques used, from spearfishing and netting in the Solomon Islands to diving in the Fijian islands (Sebatian & Foale, 2006) and a combination of both in Papua New Guinea. From the findings, three common resource harvesting techniques were described as utilising TEK - seasonal harvesting of fruits, wild eggs or meat; open and close harvest seasons (temporary bans) and, use of species abundance.

Seasonal harvesting involved an understanding of seasons when food resources such as fruits, nuts, wild eggs and bush meat would become available. The knowledge about this drew from peoples' ability to connect natural signs such as flowering of plants to signal abundance of a particular resource, as discussed in section 5.2.2. For example, "when blady grass (*Imperata cylindrica*) flowers people know that it is time to catch prawns and lobsters from the fresh water

system” (PRT1, 7a). People’s ability to interpret these natural signs to determine availability of certain resources was a reflection of an understanding of the interconnectedness that existed between them and nature. This practice was also found to be consistent with other studies on traditional seasonal knowledge (see Prober, O’Connor, & Walsh, 2011).

Another resource harvesting technique applied was the open and closed harvest seasons, or temporary bans as they are commonly known. One community participant defined this as “a way of using and managing resources wisely so that it can sustain the plants and animals as well as the communities” (COM1, 43). The sustenance of plants and animals was drawn on the view that these organisms could replenish themselves if given sufficient time to recuperate and, in doing so, would be able to support human needs for food and other resources. This view harnesses the notion of finite resources and the need to ensure continuity of these for future generations. Such practices were seen as founded on the values of respect for traditional beliefs and practices about interconnectedness and indirectly influences people’s attitudes and behaviour towards other organisms that share the same space. Open and closed seasons are still common in many coastal communities in Papua New Guinea today where parts of the forests or sea are temporarily restricted from hunting and fishing, as described by the following community participant:

Temporary bans are demarcated by tying leaves or placing certain objects at different ends of the areas indicating these bans. Once these leaves or objects are removed; people know that the bans have been lifted (COM1, 41).

Prohibitions placed on fishing, hunting or gathering were demonstrated through a physical demarcation of land or water using symbolic artefacts such as *Cordyline* plants. The use of these artefacts signalled a cultural authority that directed an immediate act of respect from all who understood and practised the local TEK. In addition, temporary bans were also imposed to honour the dead (Macintyre & Foale, 2007), in preparation of a large feast (Cinner, Marnane, & McClanahan, 2005), and when a species was in low supply (Hviding, 1998). These examples

also reinforce people's understanding of limitations on natural resources and the need for these to recuperate and replenish themselves.

The third resource harvesting technique that was seen to apply TEK was species abundance. This involves critical observation of useful species to determine when they were in abundance, as expressed by this conservation practitioner:

We think about presence and absence as a way of knowing that a resource is there. That is, if there is a lot of presence of a species, it is in abundance. If it is lacking, it is in low supply and we know that there is a problem (PRT2, 39).

The emphasis of this practice was the availability of species which also required a lot of informal discussions and historical knowledge to determine the status of a particular resource. Often the values placed on resources monitored in this way depended on the emphasis of the users, whereby more attention would be given to a resource of importance.

Resource management through traditional ecological knowledge was viewed as essential for continuity. Clan-based resource management controlled use of resources within defined clan boundaries. It also encouraged rotational harvesting of resources hosted in turn by different clans to prevent overharvesting of limited resources. In addition, traditional harvesting techniques reinforcing seasonal harvesting of resources, temporary bans and species abundance were also practiced to manage resources. Differences in the traditional practices of clan-based resource use and management indicated that those in remote rural communities are still dependent on these approaches, whereas there is a decline in these practices in semi-rural areas.

5.2.3.2 Collaboration in Resource Harvesting

The second subtheme that emerged on the application of TEK principles and values in resource management was the notion of collaboration. This is not a new concept for many collective societies in Papua New Guinea, where values of collaboration and partnership between immediate and extended kinship groups for

resource harvesting was a common practice. As one community participant stated, “to harvest freshwater eels, people would meet and discuss about whose stream they would harvest these from” (COM3, 88). The community focus group also expressed:

In terms of river fishing or not hunting in a particular forest, no individual makes decisions on their own. Everyone sits down together and agrees or disagrees to harvest resources from a particular site (COM2, 59)

This emphasis on collaborative efforts stresses the priority TEK places on the need to confer with other kinsfolk on issues of resource harvesting. Such collaboration goes beyond the normal concern for resource availability to reinforce the value of relationship building. This also emphasises the responsibility of every member of a kinship group to respect their kinsfolk as well as the environment they live in. As a cultural value related to social living in collective communities, collaboration could also be viewed as serving two purposes in resource harvesting. First, some resources may be present in one area and not in another, as in the case of pandanus marita and karuka nuts discussed in Section 5.2.1.2. In such situations, collaborating to share seasonal resources creates an avenue for other communities or families to reciprocate the action when another seasonal resource was plentiful in their area. Second, one family or individual could not be able to harvest all seasonal resources in their area by themselves. To avoid wastage, the whole community gets involved or invitation is extended to nearby communities to participate in the harvest. Such practices were also seen to save time and maximise the limited human power to ensure the harvest was completed. Today, these practices are still common in remote rural communities.

With the emphasis of TEK on collaboration, extraction of natural resources on clan lands through mining or logging would follow such traditional protocols of collaboration through wider consultation with customary landowners (Berkes, 1999; Gadgil & Berkes, 1991). Such approaches would be seen to provide opportunities for community participation and involvement and ensure

misunderstandings between all parties are minimised. This was an area that was often overlooked by resource developers and the government, as described by one corporate participant:

The company has its own ways of approaching the community. It attempts to show that everything it is doing or intends to do in that community is going to be good. People with limited understanding tend to accept what is given by the company (COR1, 9).

Another participant also added:

Landowners are not given the opportunity to inform companies of areas of significant interest to them and so companies just work on their land because they have the money to do so. This is a real example that is happening because there is no concerted effort to ensure that all stakeholders have a say in natural resource management (COR2, 54).

Collaboration among all stakeholders of natural resources was vital to ensure different views and opinions were taken into consideration for resource development. These resources belonged to the people as they were seen to have a greater dependence on these for their subsistence livelihoods. With traditional practices of collaboration, the local people would be seen to be involved as they had a greater understanding of the particular environment under consideration and would provide better advice on where resources could or could not be extracted. One member of the community focus group expressed this concern about the lack of involvement:

Sometimes we as resource owners are surprised when resource developers show up in our community to conduct exploratory activities to establish the extent of a resource. This is not fair to us because this is our ancestral lands and we have to be informed or consulted first before such activities were carried out (COM2, 75).

Within customary or traditional ecological knowledge, custodians of these resources are viewed as having the ultimate rights of ownership. This view is quite strongly held by many remote rural communities such as the focus community, who still have an intact relationship with nature. It is for this reason that collaborating with them in the initial stages of project planning would signify respect for their rights and existence as the people of the land. In addition, the natural environment and resources within it portray the identity and origins of these people so involving them would mean that resource developers acknowledge their TEK practices and values of respect, responsibility and relationship building through reciprocity.

The application of TEK values in natural resource management was underpinned by clan-based management which utilises defined clan boundaries as the first point of control of resources. The practices also used rotational and traditional harvesting techniques through seasonal harvesting, setting up temporary bans and observation of species abundance. These practices were reinforced by clan elders who were the local authority and enhanced by collaboration among all stakeholders in the community. Remote rural communities have stronger collaborative harvesting practices but recognise the threat to this approach if overlooked by resource developers and the government in their consultation process.

5.2.4 Summary on Perceptions of Traditional Ecological Knowledge

The analysis of the findings showed participants' perceptions of traditional ecological knowledge (TEK) as:

- knowledge about survival and the way indigenous people live;
- holistic knowledge comprising other knowledge systems about human interactions and survival; and,
- ancestral knowledge about resource inheritance and kinship.

TEK practices were also found to reinforce the role of guardianship of the environment among its users. These were seen to strengthen people's connections

with other environmental entities through enhancing their understanding of the cultural and ecological values of these resources.

Continuity of TEK as a system of knowledge was found to be determined by its ability to be active, applicable in different situations, and evolving to meet the changing needs of its users. TEK was also seen as easily threatened by introduced ideas of individualism which drew the focus away from communal wellbeing and its values of respect, responsibility and relationship building.

TEK as knowledge about interconnections was found to be exhibited through a deeper understanding of animal breeding and foraging behaviour, fruiting cycles and harvesting seasons of wild food. It was also reinforced in the way knowledge about specific species were obtained and used for the benefit of humankind.

The uses of TEK in natural resource management were found to be reinforced by sustainable practices and collaboration amongst its users. These were demonstrated in the application of TEK through clan-based practices which utilised defined harvesting areas. These were also enhanced by rotational harvesting practices such as seasonal harvests, temporary bans and species availability. Practices of collaboration with kinsfolk were found to ensure resource sharing and minimise wastage. However, neglecting such practices increased the chances of resource abuse and lack of participation by traditional landowners.

Perceptions of TEK were found to portray the core values of respect and responsibility for humankind and other environmental entities. These were developed from a deeper understanding of relationships built through reciprocal practices. These views were more strongly held by remote rural communities as compared to semi-urban communities.

The next section presents data on the significance of TEK values and principles for sustainability and sustainable living.

5.3 Sustainability and Sustainable Living

Sustainable living is a long term vision for many countries and governments of the world as awareness of Earth's limited capacity increases. Definitions of sustainability may vary depending on individual and community perceptions, and may not necessarily be described in words, as in the case of this study. The findings showed that participants' understanding of sustainability were often demonstrated in non-verbal ways and were concerned with respect and responsibility towards kinship groups and the environment they lived in. Three themes that emerged from the findings reinforcing these views are discussed below in terms of taking actions for sustainability, natural resource management for sustainability and concerns about sustainable futures.

5.3.1 Taking Actions for Sustainability

Understanding sustainability in an indigenous context can be quite complex and requires an exploration of people's practices, which are deeply rooted in their belief systems (Berkes, 1999; Gadgil, Berkes, & Folke, 1993). Practices promoting sustainability may be identified from other traditional practices through an in-depth examination of complex connections that exist in the way indigenous people live, interact with each other and their environment, and their beliefs and value systems. In considering natural resource management and development, sustainability could be viewed through the lenses of the community involved and the resource developers including the Government.

From a community perspective, use of the term sustainability in day to day conversations is uncommon in Papua New Guinea as such terms are viewed as foreign. However, while it may not exist in the local vocabulary, the core ideas underpinning sustainability in terms of meeting emotional, social and environmental needs, equitable access to resources, and ensuring health and wellbeing of natural ecosystems for the present and future generations (World Commission on Environment and Development, 1987) are embedded in their practices.

In responding to the question of participants' understanding of sustainability, the findings revealed their explanations as based on personal and communal

traditional beliefs, values and practices. These included beliefs about maintaining, managing, and saving natural resources and the knowledge about these. For example, one conservation practitioner commented that “sustainability is to do with taking care of things and ensuring they are not destroyed, but be maintained for a long time” (PRT4, 121). Another added that it is also about “having ongoing resources available to people as and when they need them” (PRT3, 65). Other responses reflected a deeper understanding of sustainability as expressed by this natural resource policy maker:

Sustainability can be viewed as having two parts. That is, using resources while at the same time you need to sustain livelihoods. From forestry perspective, in order to sustain food, fish or wildlife from the forest, land and sea, it depends on how we manage and harness these places. In other words, it's to do with people's attitude and behaviour (POL2, 64).

A conservation practitioner focused not only on resources but also on wellbeing:

The way I understand sustainability is like using resources in a manner that it can sustain itself for a long term so future generations can also benefit from it. It is not only associated with natural resources but also development aspects and the social and spiritual wellbeing of the people (PRT1, 3).

These responses portray sustainability as more than just ensuring sufficient resource availability for present and future generations. It is also to do with ensuring equitable access to resources for everyone, developing positive attitudes and behaviour towards resource use and management, and ensuring the holistic (environmental, social and spiritual) wellbeing of individuals and groups of people. These perceptions of sustainability may not often be described in words, but are demonstrated in the actions people take as manifestations of their beliefs and practices about managing, protecting and saving natural resources within their local environment. These actions were also seen to be guided by the local TEK of resource use, including the values they uphold.

One aspect of natural resource use that participants viewed as crucial for the application of actions for sustainability was economic development. This much needed area of wellbeing was recognised as essential for co-existence with the need for considerate use of natural resources for their own survival and continuity. While development was recognised as essential, it was also viewed as requiring an integrated approach that could incorporate these TEK-related sustainable practices with introduced scientific knowledge, as expressed by the following educators:

I think traditional knowledge is important for us to use. Whatever harmful activities threatening our environment and livelihoods today could be resolved by reflecting on the past to see where the problem is so we could think about the best possible solutions. If we continue to use traditional knowledge and practices today with the current scientific knowledge we can have a balanced society (ED4, 188).

And:

Traditional knowledge of the natural world portrays sustainability and I believe if we hold on to this, it can help Papua New Guinea to be sustainable in how it does development projects around the country. (ED2, 70)

Participants acknowledged TEK-related sustainable practices as needing to co-exist with sustainable economic development initiatives. However, for this to work TEK needs to be incorporated with other introduced knowledge such as science to ensure PNG as a country followed a balanced and sustainable pathway. In addition, sustainability ideals already existent in TEK practices could be revisited to draw lessons from the past to inform current practices. This type of awareness and understanding of TEK-related actions for sustainability was seen to have been drawn from personal beliefs and values that guided the way people were taught to do things. For example, one environmental educator shared this experience:

What I have gathered as a young kid through traditional environmental knowledge helps me to connect different aspects of the environment. So I do not see trees or soil on their own, but as a part of a whole system (ED2, 58).

The view that values get remembered throughout one's adult life if embedded early in childhood signifies the importance of *early education on sustainable beliefs and practices*. This also calls for the need to revisit these values and ensure they are incorporated into development of early environment or sustainability education curriculum. In addition, there was also a notion that when people applied practical actions to use resources, that action was seen as reinforcing their beliefs and values. Most of these actions were also found to be common in activities related to subsistence gardening and hunting practices, as described by these community participants:

When people want to make a new garden, they climb onto big trees and cut only selected branches and leave the main tree standing. They do this because they could still go back and use it later if they want to. Also, in allowing the tree to stand, it continues to provide nourishment for the soil when the new leaves grow and fall to the ground where they decay (COM1, 7).

And:

One method of hunting cuscus⁶ involves construction of a temporary bush shelter under the fruit tree this animal was last seen on. The hunters lay await in this until the animal is sighted again. Then one of the hunters climbs up the tree and makes lots of noise which frightens the animal. In an attempt to escape, the cuscus climbs straight into the trap which is placed midway up the tree. This type of hunting involves a lot of planning because no trees are cut or weapons used in the process (COM3, 84).

⁶ Cuscus is a nocturnal arboreal mammal that looks like a possum and has a prehensile tail.

The above actions reflect two important ideas. First, cutting down of a whole tree to clear an area for gardening was seen as unnecessary, as whole trees could still be maintained to recycle nutrients and prevent soil erosion. Second, less harmful hunting methods were thought to be useful to avoid unintentional destruction of other animals and their habitats. These simple actions demonstrate two things. First, the local people understood the interconnectedness that exists within their environment and the need to maintain this. Second, their practices reinforced the values of respect and responsibility towards all animate and inanimate objects and the need to minimise the depletion of these and other natural resources. It is such actions of exercising concerns for continuity of natural resources that are considered sustainable practices, although not always in those terms.

Resource developers on the other hand, have different views on what sustainability means to them. These are often guided by their company objectives and priorities and could be influenced by their business focus. For instance, one corporate participant expressed that, “sustainability for the company is focused on economic wellbeing” (COR1, 25). This view portrayed the developer as interested in achieving economic benefits for its shareholders more so than environment and social wellbeing of the local people concerned. Such perceptions could cause locals to develop animosity against developers as in the case of the decade-long Bougainville crisis in PNG (see Thompson, 1991), where local people took the law into their own hands over mining, resulting in a civil unrest. On the other hand, some developers give much thought to the way they manage and operate their companies, including concerns for sustainability. This was expressed by another corporate participant:

Sustainability for the company is about working together with the community and taking into consideration environment, health and safety of the local people and other stakeholders. However, it also depends on the nature and priorities of the company i.e. mining sector has large negative impacts compared to oil palm industry, where it is controlled by sustainable guidelines (COR 3, 83).

The varying differences in developers' views of sustainability seen in the above discussions indicate that some of them give due considerations for sustainability in their operational guidelines. However, how much of these sustainability guidelines take into consideration TEK practices and local involvement is another question that was beyond the scope of this study. Another way developers demonstrate differences in their views of sustainability could be seen in their approaches to community development initiatives, as expressed by the following participant:

Many times, we do not tell people about the negative impacts of such projects. We just talk about benefits of what people will receive in terms of cash and the kind of services the company will provide. With limited knowledge and lack of deeper understanding, people do not raise concerns about the impact of these projects in terms of damages on their environment and livelihoods (COR1, 9).

These responses raise two points of concern. First, the awareness of local people about what was happening in their communities as a consequence of resource development was not a priority for some developers as long as the locals were well compensated. Second, the important priority for developers is the economic benefits that communities obtain from these development projects through royalty payments and other services as promised by the developer. The irony is that local people continue to be left out of the consultation processes, which overlooks their need to be part of the project as would be required through their traditional decision-making protocols (see Section 5.3.2.2). This is an unfortunate situation because such needs could ignite confrontations, as reported by Semos and King (1999) on the conflict of resource sovereignty in Bougainville, where local people wanted to be recognised as owners, controllers and managers of the mine and the resources that were developed there (p.4). Community consultation and involvement is a crucial part of these communities as it encourages equitable participation and collaboration from all those concerned and could also be seen as supporting the ideals of sustainability.

The community perspective of sustainability was about having sufficient resources for the present and future generations as well as equitable participation and involvement that develops positive attitudes and behaviour towards resource use. It was also about ensuring environmental, social and spiritual wellbeing based on natural resource use and management. Sustainability for these people was based on beliefs, values and practices founded on TEK and often explained in non-verbal ways that were manifested through practical actions performed to exercise these beliefs and values. On the other hand, resource developers perceive sustainability as achieving economic wellbeing and being able to meet present and future needs through economic security. These perspectives also depend on people's attitudes and behaviour towards sustainable natural resource management as discussed in the following subsection.

5.3.2 Natural Resource Management

An area of concern for participants was the increasing trend in unsustainable harvesting of natural resources through extractive activities like logging and mining. These have been seen to surpass replacement activities and to require strategies to ensure resources are replaced. This was expressed by one natural resource policy maker:

Current statistics on forest resources, especially timber products, show that the rate of annual harvest is about two times more than resource replacement projects, particularly reforestation and afforestation. This is still low and as a regulating agency, my department has to make drastic changes to address these. That is, if 120,000 hectares are removed in a year, at least another 120,000 hectares should be replanted to balance it (POL1, 4).

This call to balance disparities in resource harvest and replacement demonstrated the stakeholders' understanding of communities' need for continuity of natural resources, particularly among rural populations. For forests to continue supplying the demand for timber resources, they need to be replenished through reforestation or afforestation activities, as acknowledged by a regional natural resource policy maker:

People need timber from specific trees for building houses or firewood. To sustain this supply, we have to make sure that what we cut today is replaced by raising tree seedlings in a nursery and replanting them or encouraging natural regeneration where native species are encouraged to be grown and managed (POL2, 64).

Replanting and regeneration of native species were considered as vital actions to ensure timber resources were replenished. The value of replanting to replace what was cut was associated with the view that sufficient resources needed to be available for the present and future generations. Ensuring continuity of the supply of trees and plants would require replanting either from raised seedlings or natural regeneration of native species.

The lack of consideration for environmental and social livelihoods of impacted communities was identified as another area of concern by some resource developers. If these developers were to incorporate these concerns into their development plans that could be seen as a positive action to address the situation. Some corporations were found to have sustainable strategies already in place that incorporated community wellbeing as an aspect of their operations. As explained by a corporate participant:

The company I work for does take into consideration aspects of sustainability such as pollution e.g. emission of carbon and management of effluent. The company strictly abides by the guidelines set by Department of Environment and Conservation who visits every year to check environmental aspects of the operation (COR3, 85).

This offers a contrasting view on sustainable natural resource management from resource developers' perspectives. That is, some corporations felt that they had included sustainable principles in their operational policies with due considerations for the natural environment and impacted communities. Others may have something recorded in writing but lacked tangible actions to convince

their critics. This may also be linked to the nature of their activities, as elaborated by this corporate participant:

I think the palm oil industry, for instance, is a controlled environment because the company uses sustainable guidelines to direct its operations. This is also in accordance with the Roundtable Sustainable Palm Oil (RSPO) model organised by the World Bank, which dictates that the company must not cut virgin forests to plant oil palm but to develop grasslands and deforested areas. This allows for any forested area to be left and at the same time deforested areas are re-vegetated (COR3, 81).

Application of sustainable principles in a resource development operation is dependent on the company's objectives. The type of industry they were associated with also influenced their operations. For instance, some companies may be interested in the positive economic, environmental and social impacts their projects had on the communities as well as their business. There may be others who are concerned only with economic returns for the company and whatever little spinoff benefits that impacted communities received as compensation for destruction of their land.

Sustainable resource management ensures indigenous communities, both present and future, and which are mostly rural, have access to available resources. In addition, it enables resource developers to incorporate sustainable principles into their operations to ensure economic, environmental and social wellbeing of impacted communities were achieved. Such issues require concerted efforts by all stakeholders and could ensure resource developers uphold their corporate social responsibilities. In addition, two further ideas emerged from the data on sustainable resource management concerning actions that stakeholders could take and the decision making processes and structures that underpin these actions. These are discussed in the next subsections.

5.3.2.1 Community Actions for Natural Resource Management

Sustainable resource management issues are addressed through efforts of all stakeholders including communities, practitioners, government agencies and resource developers, as indicated by the findings. For instance, communities have developed ways of managing resources based on their TEK as reflected in section 5.2.2. This was also highlighted by a member of the community focus group:

A practical output of our traditional beliefs and practices is the declaration of the wildlife management area (WMA) for conservation purposes. It is our action to demonstrate our beliefs in how our ancestors lived in the past and the need to conserve for the present and future generations (COM 2, 82).

The view that their traditional resource management practices were consistent with conservation ideas enabled this community to develop partnerships with conservation organisations to set up a Wildlife Management Area. This action taken by the community was viewed to be a useful approach for ensuring their traditional resource management practices continued to be maintained.

Policy makers also described the efforts their respective departments have taken to address concerns for natural resource management. For instance, in deforested areas, one agency has set up resource replacement programs to ensure deforested and grassland areas were replanted with tree seedlings to ensure continuity of timber and other associated resources. This action could also help to protect the remaining pristine forests from being logged, as explained by a natural resource policy maker:

Forest resources are renewable and we have deforested areas and fast grassland valleys that we can do more afforestation and reforestation and reserve our natural forests (POL1, 10).

A regional natural resource policy maker added:

I think the last 20-30 years were more focused on logging and all forest policies and operations were targeted at this. In the

highlands region we have decided to get involved more on reforestation extension and social forestry to address community needs for natural resources. It is about time that we take heed of the voices and wishes of the land owners and help take actions to review the way we manage resources (POL2, 60).

Afforestation and reforestation activities were common resource replacement programs established in many parts of PNG, where deforestation through logging or continuously shifting agriculture has occurred. A concept that was introduced in the central Highlands is social forestry which is associated with sustainable livelihoods. The approach involved replanting of trees in areas that were intended for use by the communities in various ways to support their need for timber or fuel wood. Social forestry had been used in other parts of the world like India, Indonesia and Africa as an alternative measure for poverty alleviation through ensuring basic needs for timber and timber products continued to be met for poor communities (Thompson, 1999). Diverse views on the effectiveness of social forestry projects as a sustainable measure were described in the literature; however, it is beyond the scope of this study to discuss these in detail. The intention of mentioning this here was to highlight social forestry as a suggested approach for addressing sustainable resource management issues by responsible government agents. One of the concerns raised by participants regarding this was the challenge of implementing such interventions, as expressed by another policy maker:

In PNG, we have land issues which are the biggest hindrance for resource replacement programmes over the years. The other problem is financial constraints faced by our department. Most funds go to administration costs and then there is less available to carry out programme activities. These have resulted in setbacks for resource replacement programmes (POL1, 8)

While both financial constraints and the customary land tenure system⁷ were viewed as a challenge for this agency, what was unique in the Papua New

⁷ More than 80 per cent of the land in Papua New Guinea is under customary ownership. This is also recognised by the PNG Lands Act.

Guinean context was the latter. The structure of customary land tenure system enables clan or family groups to own portions of land on which projects are intended to be implemented. For these projects to convene, negotiations needed to occur between the agency and landowners which often take years as all parties need to reach a consensus on the benefits of such projects for the landowners. There were two issues of concern in this debate – loss of traditional lands to the disadvantage of the landowners and the limitations of the government through its agencies to access available land for resource replacement projects. These issues were quite sensitive for all parties concerned and required proper consultation through policies that could incorporate concerns of the local people and ensuring sufficient land was made available for projects of sustainable values.

The findings also showed resource developers as having their own strategies for sustainable resource management which varied and depended on their objectives. For example, some resource developers reinforced small scale economic activities in impacted communities to help establish regular income through their community development sections, as described in the following:

Through the community development section, we were involved in planting and rehabilitation of coffee and vegetable gardens. This was done to help communities prepare for life after the company leaves when oil wells run dry. The projects were intended to help them learn how to plant vegetables and coffee for personal consumption as well as for sale (COR1, 25b)

The activities described above were initiatives of the company whereas those initiated by the communities could not be ascertained. While it is a requirement for companies to ensure economic sustainability of impacted communities were safeguarded, there were also concerns about how well communities (who are often rural) were equipped to manage such projects, particularly in terms of financial management. In addition, there were also concerns about the extent to which these company initiatives had influenced local people's views about economic benefits of natural resources as more important than their own immediate needs for these resources. For example, one corporate representative

expressed this:

In my view, reaping of economic benefits from natural resources is taking priority over the lives of many people in impacted communities and they are only thinking about using their resources to access more of these. They don't seem to explore other alternatives of preserving their resources for later (COR1, 5).

The focus on economic benefits may be problematic for these people if they decided to sell their natural resources for money. In such situations sustainability of such company initiatives become questionable as it could distort people's perceptions of their resources as a commodity for sale to extractive corporations and not for their own use for survival. It could also affect their traditional knowledge and practices associated with accessing and obtaining these resources and may lead to loss of TEK values resulting in unsustainable practices. On the contrary, some company initiatives had a profound basis on sustainable principles, as described by another corporate participant:

The company encourages locals to grow pipe vine plants which were food sources of an endangered insect. This was to allow the organism to flourish beside the palm oil industry (COR3, 81b).

This resource developer was viewed as not only concerned about economic wellbeing of local communities, but also continuity of their surrounding ecological systems to sustain natural resources and particularly their food sources. These actions could lead to long-term ecological and social wellbeing of the local people because they will access much needed income from sale of their produce, and their food supply and other natural resources would be abundantly available for long term use. These actions were found to be consistent with debates on self-sufficiency and sustainability in terms of increasing food security and encouraging self-reliance as described by Gale (2014) and Princen (2005). A combined effort by corporations and communities like this could also lead to a self-reliant and sustainable society.

Sustainable actions in resource management were viewed as a shared responsibility for all stakeholders. Some of these were dependent on specific activities related to the industry or role each stakeholder played. Moreover, the findings revealed the need to review legal documents such as the National Forest Act and others related to resource management to accommodate community voices and sustainable TEK values to encourage community involvement. The findings also suggested the need for changes in the management structure of natural resource agencies to incorporate a bottom up approach, where communities could appreciate being part of the conversation through consultation. This was also seen as vital for encouraging collaboration and equitable participation. A possible outcome of such an approach could be the release of customary lands by clan groups for resource replacement projects like social forestry through reforestation extension.

A collaborative effort from all stakeholders in taking sustainable actions was viewed as essential. With a customary land tenure system in PNG being dominant, community participation and involvement were considered to be crucial to ensure land was made available for resource replacement programs. Concerns about involvement of local people in decision-making in resource use and management are discussed in the next subsection.

5.3.2.2 Decision-making and social structures

For collectivist societies such as in Papua New Guinea, decision-making involving communal issues is collectively done, and natural resource management is no exception. These concerns were expressed by nearly all the participants in this study with two emerging ideas on aspects of decision-making. The first concerns process in decision-making while the second was about traditional institutions of power that reinforced decisions made in the past and present.

The findings showed that traditional decision-making processes followed a consultative approach whereby all community members were collectively consulted in their respective kinship groups, particularly in clans and sub clans. The decisions were debated in these groups before their leaders presented them at

the larger community leaders' group for further deliberation and final decisions. As one educator explained:

In a multicultural society like PNG, everyone comes together to debate and discuss issues until they agree on what can or cannot work for them. This involves people from all walks of life so when a decision is made, it is fair and also balanced, which their leader takes to the next level (ED4, 192).

A member of the community focus group added:

Our society promotes communal decision making and harvesting, and sharing of resources. Therefore, it is not fair to resource owners if we are not consulted first about the use of our ancestral lands before any resource development project begins (COM 2, 78-82).

Collective decision-making was founded on traditional practices and needed to be done in consultation with members of kinship groups as a first step in resource use and management. Consultation was considered essential as the land and resources within it were viewed as communally-owned and everyone who was affiliated to a kinship group either by inheritance, marriage or other customary protocols had equal rights of access (See Macintyre & Foale, 2007). This process could be threatened by individualistic ideologies that promote accumulation of personal wealth and success, as argued in the debates on the commons (Ostrom, 1990) and common property resources (Berkes, 1989a). In addition, proper consultation was seen to bring out the cultural, historical and spiritual connections that existed between people and the land, allowing further deliberation. A member of the community focus group expressed this:

The stakeholder who should make the last decision is the resource or landowner because this is our customary land and our umbilical cord is buried on this land. We also have customary rights to these resources (COM2, 73).

The metaphorical relationship described in terms of the connection between an unborn child to its mother through the umbilical cord expresses the deeper value of one's emotions and connection to the land. As this was expressed by the focus community, it also emphasises their strong views and great dependence on the land and the natural resources. Literally, this could mean that a person cannot be disconnected from the land on which their livelihoods are dependent on, as severing these connections would be like the death of this person. With no resources to live on, they could die of starvation or other causes. The reminder from such practices is the value of the land which could not be replaced. No monetary compensation could replace the true values associated with owning or holding onto something that could sustain life forever.

The inclusion of TEK values and principles in decision-making on resource use and management was also seen as important. The findings indicated that an integration of TEK was fundamental for indigenous communities who could relate easily to its principles and values if introduced in the dialogue on natural resource management. This was noted by an educator:

Traditional knowledge can help to influence decision-making because like our ancestors, it helped them to know the changes and effects of an action on the environment. So having traditional knowledge will enable us to be better informed so that we can weigh out the pros and cons of our actions on resource use and management. (ED1, 27)

The incorporation of TEK in natural resource management was seen to set the pace for dialogue on the decisions to be made on resource use. The local people would not need much convincing because what was commonly known and understood by the communities on resource use based on TEK (familiar knowledge) could be easily put into practice. In addition, the data indicated influences of TEK on decision-making could also be determined by how well the values it promoted were practiced in principle. This was expressed by the following educators and policy makers:

Traditional knowledge can influence decision-making, especially when it is grounded in practice. For example, as I was growing up, I was told that when you cut sugar cane to chew, you must make sure to plant another one. The idea of ‘replant to continue harvest’ stuck with me and has influenced my life (ED2, 72).

Also:

We learn our traditional knowledge which we hold on to and practice. Whatever new things we learn, we then try to blend it together with this so we should not let go of our traditional knowledge. It informs the decisions that we are making now (ED4, 190).

And:

TEK is like a bridge that can connect communities and other stakeholders in decision making in natural resource management. I think proper awareness at their community level may explain things better and they can be willing to open up their land resources (POL1, 14).

The lesson from the above views is that if this influential nature of TEK was well grounded in practice and integrated in decision-making processes, it could connect local communities with other stakeholders of natural resources. It could also be used as an innovative approach to encourage full community participation as it involves familiar knowledge recognised by people who identify with it. Building on TEK as a foundation, other knowledge systems, including scientific knowledge, could then be introduced to enhance community understanding of the outcomes of their actions on natural resources and enable them to make informed decisions. These views were shared by this conservation practitioner:

The ideas about resource management should start from the knowledge system that is already in existence such as traditional

knowledge. It is better to take advantage of this system and incorporate ideas from other systems to enhance it. Replacing the existing traditional knowledge systems can be harmful because people already know the good and bad practices and they can accept good elements within another system that is applicable. It is important to use traditional knowledge as foundation for making decisions about natural resources (PRT2, 49).

The second aspect of decision-making highlighted from the data is existence of social structures that reinforce decisions made on access to resources, how these are used and managed. Social structures are very important in any community as they establish order in how people interact with each other and their environment from which resources were obtained. One of the first structures identified in the data was inheritance of land and resources, as this determined who could make decisions about how these were managed or used. This was explained by the following community participant:

Apart from immediate family inheritance (father to son), there is another way in which land is also inherited. This is based on the principle of supporting and caring in times of need. For example, if my father died and someone came to my aid in killing a pig during the funeral feast, later when I share the possessions or properties of my father, I can allocate a portion of land to this person. This is a practice that is still alive today. Land and resources inherited in this manner is not disputed in any way or taken back by the original owners (COM4, 134).

Resources acquired through immediate family inheritance (father to son or mother to daughter⁸) was one approach to resource accumulation and also a common practice in many parts of PNG. This practice ensured that land and resources were maintained within a particular family or sub-clan. Another way resources were acquired, as highlighted in the above quote, is through fulfilling customary obligations, such as aiding in feast preparations in honour of the dead relative (see

⁸Acquisition of land and resources through family inheritance in Papua New Guinea is either from father to son (patrilineal) or mother to daughter (matrilineal).

also Macintyre & Foale, 2007). This practice is active today and has a lot of influence in the decisions on resource use, particularly when dealing with resource developers.

Another social structure which was traditionally active but was found to have lost some of its mandated decision-making powers today is the chieftaincy, big men or clan headmen system. These traditional leadership systems enabled both resource inheritance from parent to offspring i.e. father to son, or mother to daughter, and instilled order and direction in terms of decisions affecting communities. This was expressed by an educator and a policy maker:

There are people who are called paramount chiefs and their role is to look after the people and the land. With the inclusion of others, they decide whether the resources should be taken out or not.
(ED1, 31)

And:

In the leadership style that was established before where the chieftain or big men systems were used, there was order in our communities (POL2, 66).

The chieftaincy, or the alternate big men system, was influential in the traditional decision-making processes as they reflected an aura of authority and leadership. These were also attributed to the inherited status of these individuals which prepared them for leadership roles later in life. Such leaders were mindful of their responsibilities to the whole community and ensured that decision-making processes were correctly adhered to. The decline in these old leadership styles and an increase in more mixed leadership practices are producing varied results, which were seen as not in the best interest of the community, as expressed by a policy maker:

The existence of the paramount chief system goes with the inheritance of land and resources and [they] have their own structure of decision-making. But today it is the opposite because

everybody is trying to become a leader, councilor or member of parliament, even if they are not mandated by the people on the ground. Hence, they tend to produce unfavourable results (POL2, 68).

These mixed leadership practices do not work well with indigenous or tribal leadership systems for various reasons, including the way they are structured for decision-making processes. Indigenous systems were seen to involve collective consultation of all members of a community through the established leadership and decision-making systems. Many of the introduced new systems seek out only a select group or individuals and this was seen to be problematic for the community. A community participant described this:

There are designated leaders for each sub-clan and spokespersons for the whole clan. Every issue, including resource use and management, is discussed in a way starting with sub clans to the major clans and then at the tribal levels (COM5, 162).

The already established indigenous or tribal leadership structures followed a systematic order whereby views and opinions on issues were raised at the sub clan or family level and discussed. If the issue was significant, it was taken up by the clan leader for discussion with other clan leaders. In other words, the flow of decision making went from sub clan/family level to the clan leader, who then raised it with other village leaders at their meeting. This indigenous decision-making structure highlights first, the view that indigenous communities had their own social structures emphasising leadership and decision-making processes that needed to be acknowledged by resource developers, as well as natural resource management policy guidelines for sustainability. Second, collective consultative processes and communal decision-making were key components of indigenous decision-making systems. These findings on indigenous decision-making were also found to be consistent with other studies on indigenous and tribal leadership in Papua New Guinea (See also Ambang, 2007, and Tivinarlik & Wanat, 2006).

The third aspect of decision-making highlighted in the findings drew attention to the principle of men's houses. These were houses constructed by sub clans and major clan groups as a meeting house for men in those kinship groups, as described by these community participants:

If there are big issues to discuss, men go into these men's houses and talk about them. They would blow the conch shells or beat the drums to gather all the people and then inform them of the decisions such as putting temporary bans. Today this practice continues as part of the community day or week. This is the day or week put aside to do community work (COM1, 39).

And:

Traditionally, men's house was a special house constructed for men only to meet and practically stay there. The cultural significance of this house was the dissemination of traditional knowledge about inheritance, resource use and management, social relationships and obligations, warfare and decisions which were all discussed, shared or made in there. Sadly, many of our good traditional practices such as these are lost because of colonisation (COM4, 138).

The above views suggest that traditional men's houses were crucial avenues for knowledge sharing, collective decision-making on all aspects of community living and other related issues. While the actual practice of constructing men's houses had declined in many Papua New Guinean communities today, the moral and philosophical values on which they were established were seen to be very much alive and practiced in many communities. The decline in these practices was also attributed to colonisation which failed to acknowledge the existence of these systems and introduced their own. The values learnt from the principle of men's house system that are still practiced today include processes of assembling people, collective consultation and communal decision-making, which were also founded on common TEK values of mutual respect for the environment and resources, responsibility to kinship groups and cultural obligations for reciprocity.

Notably the preceding discussions clearly demonstrated the existence of traditional institutions of power such as resource inheritance, chieftaincy or big/head men systems and men's houses as social structures through which decisions were made and handed down or up. These institutions were founded on traditional knowledge, values and practices and followed collective consultation and communal decision-making processes that involved all members and levels of community. The data also suggested the need to review and understand community structures to recognise existing processes and build on them. This was seen to be where stakeholder collaboration for integration and reinforcement of community perceptions and practices was significant. By returning to the basics to understand community structures on how resources were distributed or decisions made, one could ensure community perceptions were integrated into government plans and policies. Such collaborations could reinforce sustainable values through creating the right linkages for achieving sustainable resource management.

Decision-making processes within indigenous and tribal societies like PNG followed a socially structured system reinforced by institutions of power. These processes favour collective consultation resulting in communal decision making and equitable participation and need to be reinforced to encourage community involvement and participation. As an approach, they need to be integrated into existing natural resource management strategies used by policy developers to increase involvement of traditional landowners who have a better knowledge of their natural environment and resources. This would increase the need for fair and balanced natural resource policies encouraging integration of values of traditional decision-making processes and power institutions with introduced ideas. This would work towards a sustainable future, which is discussed next.

5.3.3 TEK and Sustainable Futures

Concerns for sustainable futures through TEK practices was repeatedly emphasised by the participants, when describing the importance of continuity of natural resources. Two aspects that were highlighted in the findings were concerns for future generations and social responsibilities that enhance sustainable futures. When considering the former, future generations were viewed as having the right

to access resources (Weiss, 1989;1992) in their original conditions, and that other humans who occupy the same space have the responsibility to ensure such rights were respected. As referred to by a member of the community focus group:

Our way of life depends on the value of continuity. That is, resources should continue to be available for a very long time, so future generations can be able to use them (COM 2, 82).

A corporate participant also commented:

Sustainability is a very big idea but for me, it is about wise management. It's about how you manage your resources with consideration for the future generations. That is, think about the future and leave some, do not finish everything today (COR 1, 23).

Resource continuity was seen as essential for supporting subsistence livelihoods which are common practice in many rural communities. It was also prompted by the need for reasonable use of resources for the benefit of unborn generations, to whom the health and wellbeing of the environment were owed. Within this perspective, communities were required to ensure maintenance of sufficient resources at all times and one way this was achieved was by ensuring sustainable extraction of resources for economic purposes. This was an area of concern for indigenous Papua New Guineans who recognised the significant role of natural resources as raw materials for various products, and that overexploitation of these could have a detrimental effect on future generations. A corporate participant reiterated this:

There is a need for companies to reinforce respect for natural environment and the people who live off it. This means as much as possible, environmental damages must be minimal so that there is continuity in the supply and availability of resources for future (COR2, 64).

Natural resources had many uses for indigenous peoples in rural communities. This dependence needed to be recognised by resource developers in order to put

in place measures to reduce environmental damages. Such actions would also be seen as efforts to reinforce maintenance of the interdependent relationship between people and their environment. Such actions could also increase the chances of improving rural livelihoods, as pointed out by an educator:

If we over-use our resources today and it's depleted, what will we use tomorrow? There's no life without natural resources for us as we cannot progress without it. So sustainability in everything is important for us (ED4, 172).

The view that resources have limitations and could be depleted if unwisely used stems from a deeper understanding of the interconnectedness that exists within one's environment. The possible decline in resources could also mean a decline in healthy livelihoods and a lack of economic, environmental and social development of a community and the nation at large. This also portrays the need for all stakeholders to be responsible for resource use and management.

The findings also revealed two types of social responsibilities as important in maintaining sustainable futures. The first is the kinship responsibility at the community level which is based on TEK values and practices, while the second is corporate social responsibility (CSR) which requires the commitment of resource developers towards a sustainable future. This also raised the issue of social responsibility towards generations past, present and future as discussed in the following subsections.

5.3.3.1 Kinship Responsibility

Continuity of environmental resources and the social relationships between present and future generations may also depend on community wellbeing. For collectivist societies like in PNG, one individual, family or community's welfare was the concern for all kinship groups, as described by this community participant:

If people in the nearby village didn't have enough food, some of our elders would visit all the gardens to check the kinds of food we

had and what was ready to harvest. They would then tell us to harvest these foods and gather them in piles. Each of us then allocate a pile from our gardens to a family in that needy village and then invite them to come and get it. This supply keeps them going until their food gardens are ready. They then reciprocate this action to us when we are in need (COM4, 132b).

The kinship responsibility described above was a form of social responsibility that ensured members of a kinship group had immediate access to available resources. As an approach to encourage equitable distribution of resources, this practice reinforced the value of reciprocity whereby the recipients had an obligation towards their kinship members to reciprocate this deed when the giver was in need. This practice was viewed as a nonverbal commitment demonstrated in deeds and encouraged between two consenting parties which continued for generations to the present day. An application of this was practiced in the exchanging of culturally significant resources like *Pandanus julianettii* and *Pandanus conoideus*, as discussed in section 5.2.1.2

This practice of sharing and caring for one another was very useful in the past as everyone provided for each other so nobody missed out. People knew that when they were in need, others would help them and that they had an obligation to return the favour whenever it was needed. In today's generation, there are mixed practices whereby while people still shared and cared for each other, this was viewed as more at the family level than the clan, as was practiced in the past. Apparently, support from immediate relatives was viewed as important when needed but the frequency varied depending on when it was required, as described by this community member:

Today's practices are becoming more individualistic and contradicts our cultural ways of life. These days only our immediate family members or friends are coming to assist us when have some jobs to do like gardening or harvesting coffee and so on (COM4, 132a).

One important observation from the findings was this decrease in the assistance given to kinship members by individuals or families. This was attributed to the cash-driven society we live in today which has influenced a lot of indigenous practices, where many people are now focused more on individual needs than those of their kinsfolk. The introduction of a cash economy was seen to result in the decline of collectivist lifestyles and increase of individualistic ideologies. This raises the debate on individualism versus collectivism (see also West, 2006) where concern for community wellbeing was seen to disintegrate at a faster rate and may lead to further social disparity and abuse of resources. A member of the community focus group expressed this concern:

The cultural practice of sharing and caring for one another is diminishing. If it does, then I believe the practice of looking after and managing resources will also be reduced (COM2, 61).

A second community member also spoke on this:

In the past people always travelled in groups, particularly to harvest resources. These are not practiced regularly these days as parents and children seem to be doing their own thing, which is affecting their wellbeing (COM5, 160).

Traditional ecological knowledge and practices reinforce shared responsibilities of kinsfolk in providing and caring for each other. Through collective harvest these groups were seen to ensure every member had access to resources obtained. The decline in these practices as indicated above may lead to a reduction of available resources as the population increases and as each individual attempts to fend for themselves. This may also lead to overharvesting of resources as more people would mean more resources are extracted for personal use. The decline in resources for the present generation may lead to a decline in available resources for future generations which could be in conflict with their rights to access resources (Weiss, 1989, 1992)

Kinship responsibility as a social responsibility was based on the principles of caring and sharing for one another. It reinforced the TEK values of reciprocity and responsibility and also ensured continuity of resources, immediate access to resources and reciprocity between kinship groups. The next subsection discusses the responsibility of resource developers to ensure that the needs of present generations do not jeopardise those of future generations. The subsection discusses the responsibilities of resource developers in ensuring sustainable futures are maintained.

5.3.3.2 Corporate Responsibility

Participants have also raised concerns about the responsibility of resource developers in ensuring availability of resources to meet the needs of future generations. Like many other stakeholders, these developers also have community obligations according to their corporate social responsibility (CSR) policies. Within this framework, these developers undertake an obligation to the society towards its overall wellbeing which includes environmental and social objectives, not just their economic welfare (see also Weiss, 1989). Experiences and observations from the participants indicated mixed views on the application of CSR by resource developers in PNG. For example, a corporate participant explained:

I believe one of the company's roles is to help communities organise themselves as part of the corporate social responsibility (CSR). This can be done through providing awareness and education on pros and cons of the project apart from economic benefits they will receive from it. This CSR should not be used as a cover to maintain the company's reputation without actually fulfilling its social obligations (COR1, 13).

A second corporate participant expressed a view about the responsibility of the company:

I think the company was interested in providing some sort of cash crop for people, focusing on developing the area where the project

is and providing income for the small landholders
(COR3, 69).

These responses indicate responsibilities of resource developers towards communities under the banner of corporate social responsibility (CSR) and need to ensure that their operations are guided by this. Often a focus on economic activities takes first priority for these companies and they can overlook environmental and social needs. Resource developers are seen as being well positioned to empower communities through their CSR commitments. This could also be used to create awareness on benefits and dangers of the project on the people's cultural and environmental livelihoods, and the opportunities that are available for them to participate in the project development. It would also enable communities to express their views on the impact on significant areas of cultural and historical importance both for the present and future generations. This would also mean that damages caused to areas of cultural and social significance need to be acknowledged, as implied in the following observation by an educator:

The extractive companies must also take responsibility for any damages caused to the environment and address them. If all parties work together they will know each other's responsibilities and ensure that resources are managed and used well. (ED4, 194)

A collaborative effort by all stakeholders could enable resource developers to take responsibility for their actions and ensure resources are sustainably maintained and utilised. In addition, concerns from participants highlight the need to incorporate sustainable practices into the developers' policies and strategies. Responsibility towards future generations is a value that was embedded in people's beliefs and practices and exhibited in their attitudes and behaviours. The emphasis on corporate social responsibility (CSR) should be to ensure these values are incorporated into the resource developers' sustainable policies and guidelines.

Resource developers have social obligations under their corporate social responsibility (CSR) guidelines to ensure sustainable futures are achieved for

impacted local communities. Consideration for culturally-related sustainable practices and principles could ensure environmental and social wellbeing of impacted communities are maintained along with their economic wellbeing. This action could enable continuity of resources to meet the needs of present and future generations.

5.3.4 Summary on Sustainability and Sustainable Living

The analysis of the findings showed that participants perceived sustainability as the manifestation of people's beliefs and practices about managing, protecting and saving natural resources through their actions. For the communities, sustainability was about:

- ensuring sufficient resource availability for present and future generations;
- equitable access to resources for everyone;
- developing positive attitudes and behaviour towards resource use and management; and,
- ensuring holistic environmental, social and spiritual wellbeing of people.

For resource developers, sustainability was about achieving economic wellbeing and being able to meet present and future needs through economic security. This meant that they may not be concerned about whether people understood the negative impact of their development projects. This would be an area for further consideration for natural resource policies and strategies.

Emphasis from participants' responses also indicated sustainable natural resource management as being about access to resources and finding a balance between resource harvesting and replenishment. Replanting and regeneration of native species were suggested to ensure sufficient resources were available for the present and future generations. In addition, sustainable action taking was found to require a collaborative effort from all stakeholders. This was particularly so for resource developers who need to involve local people more often and incorporate sustainable TEK principles into their operations.

The indigenous decision-making processes were found to follow socially structured systems that are reinforced by traditional institutions of power. These

processes favoured a collective consultation leading to communal decision-making and equitable participation. An integration of these processes into current natural resource management strategies and policies was seen as essential for increasing community involvement and participation for better resource management.

Concerns for sustainable futures continued to be a core focus of TEK practices as they sought to ensure future generations had sufficient resources available to meet their needs. This was clearly reinforced by the emphasis on kinship responsibility (a social practice of the past but currently very active) and corporate social responsibility (an introduced responsibility towards community wellbeing as a result of natural resource development).

5.4 Chapter summary

This chapter explored indigenous perceptions of the relationship between traditional ecological knowledge (TEK) and sustainability and some key findings were discussed as indicated below.

Firstly, TEK comprised of several knowledge systems about survival and the way indigenous people lived in the past that informs the way they live today. TEK is also a holistic knowledge about human interactions and survival acquired from ancestral knowledge about the way resources were inherited and reinforced through kinship relationships. TEK practices embracing these knowledge systems were also instrumental in reinforcing the indigenous role as guardians of the environment and strengthened their connections with other entities. Moreover, continuity of TEK depended on it being actively used and applied in different situations as well as being able to evolve to meet changing needs. As a system of knowledge, TEK is easily threatened by introduced ideas of individualism which forego the emphasis on communal wellbeing and its values of respect, responsibility and relationships building through reciprocal actions.

Secondly, the relationship between TEK and sustainability could be seen in the application of TEK in natural resource management. This is where the use of TEK reinforced sustainable practices of resource harvesting and sharing through

collaboration to ensure equitable access to resources. By neglecting such practices, there is a risk of abuse of resources and lack of stakeholder participation. This is because TEK's core values were founded on respect and responsibility for humankind and other environmental entities, developed from a deeper understanding of relationships built through reciprocal practices. These views are more strongly held by remote rural communities compared to semi-urban communities.

Thirdly, sustainability was perceived as the manifestation of people's beliefs and practices about managing, protecting and sustaining natural resources through their actions. From the community perspective, sustainability was about ensuring sufficient resource availability for present and future generations; equitable access to resources; developing positive attitudes and behaviour towards resource use and management; and, ensuring people's environmental, social and spiritual wellbeing are met. These views may contradict those of the resource developers, who can perceive sustainability as achieving economic wellbeing and sufficiently meeting present and future needs through economic security. Resource developers may not be concerned about whether people understood the negative impact of development and this would be an area for further consideration for natural resource policies and strategies.

Sustainability was also perceived as being about access to resources and maintaining a balance between harvesting and replenishing resources. These require a collaborative effort, particularly by resource developers to encourage local involvement through incorporation of sustainable TEK principles into their operational guidelines. This could also be reinforced by integrating indigenous decision-making processes, which follow socially structured systems, are reinforced by traditional institutions of power, and favour collective consultation towards communal decision-making and equitable participation. These could be further reinforced by enhancing social responsibilities through the traditional kinship responsibility and corporate social responsibility of resource developers.

Fourthly, the findings in this chapter showed that participants from rural communities had a deep understanding of the relationship between TEK and

sustainability and expressed concerns about the declining practices of these values due to introduced ideas and practices. These participants also expressed strong views about the threats to their dependence on natural resources and the need for developers to involve them in the consultation processes as rightful traditional owners and people of the land.

In summary, the relationship between TEK and sustainability is demonstrated in their core values of respect, responsibility and relationship building through reciprocity.

The next chapter discusses the findings of phase two of the field work which illustrated the connection between TEK and education.

Chapter Six

TEK and Sustainability Education

6.1 Chapter Overview

This chapter further explores stakeholders' perceptions of the relationship between traditional ecological knowledge (TEK) and sustainability, with a particular emphasis on the role of education and policy. It addresses questions about the ways people learn about natural resource use and management, the reasons they might learn in such ways, the core concepts and values about TEK and sustainability in natural resource management that could be learnt, and the ways that these could be emphasised in the learning processes. These questions were administered through the interviews (see Appendices C and C1 for interview protocols) and were specifically targeted at participants from the community, conservation practitioners, educators and policy participants in natural resource management who have direct or regular contact with TEK users or who themselves are users of TEK. The community participants, who are mostly subsistence farmers, in particular were found to have significant contact with TEK. These data were also collected in the first phase of field work in 2013 and analysed using the thematic approach described by Miles and Huberman (1994) and coded according to La Pelle (2004).

The findings highlighted the need to reinforce core values of respect, responsibility and relationship building through education and policy development to reinforce the relationship between TEK and sustainability. Section 6.2 discusses participants' views about educational approaches that could strengthen the core values and practices that reinforce sustainability. To achieve this, the role of education and lessons from traditional education practices were explored with suggestions for documentation and integration of sustainability-related TEK. Section 6.3 discusses the suggestions on integrating core TEK values and practices of sustainability into policies. Section 6.4 provides a summary of this chapter.

6.2 Education for TEK and Sustainability

In responding to a question about what lessons people could learn about traditional knowledge of the natural world, participants highlighted the need for education about sustainability-related TEK principles and values. These principles and values were perceived as promoting ecological, cultural and social wellbeing of indigenous and tribal communities, and may lead to their economic wellbeing if carefully implemented. These views were also consistent with debates on education for sustainable development (ESD), which reinforce the importance of imparting ecological, economic and social sustainability values through education (Fien & Tilbury, 1998; Taylor, Littledyke, & Eames, 2009; Tilbury, 2006; Tilbury et al., 2002; World Commission on Environment and Development, 1987). Further analysis of the findings also revealed that participants recognised the role education plays in strengthening TEK and sustainability in natural resource management, that current practices for education about sustainability could be informed by traditional education practices, and that continuity of sustainability-related TEK principles and values is dependent on their documentation and integration into the existing education curriculum. Each of these aspects is discussed further in the following subsections.

6.2.1 Role of Education

When asked to explain how they saw the role of education in natural resource management, participants responded according to their different stakeholder perspectives. Generally, they viewed education as a process involving exchange of instructions through giving or receiving information, and that this could be achieved through various ways. Education was also described as a significant tool for reinforcing sustainability-related TEK values and practices, which could potentially be lost if not passed on from one generation to the next, as is the nature of any indigenous traditional knowledge (See Chapter 5). Community participants, in particular, expressed concerns that TEK and other forms of indigenous knowledge were entwined with their ways of life and, as such, should continue for many more generations to come. This could be seen in the following response from a community participant:

I don't think PNG as a nation is ready to let go of our traditional

knowledge and practices. It is therefore important to continue creating awareness about the significance of what we have and educate the young generation to be informed about their responsibility to care for, use and manage their resources well (COM 5, 140).

This view implies that while TEK was still actively used in their daily subsistence livelihoods, the threats of declining practices among the younger generation were inevitable. This generation was seen to be easily enticed by external factors that often promised paid employment and a supposedly better lifestyle in cities, which drew them away from their sustainable rural lifestyles. Participants also expressed the need to increase this generation's awareness of the usefulness of TEK, as highlighted by a member of the community focus group:

There is a need for education to ensure that traditional knowledge and practices of resource use and management is enhanced through teaching and learning (COM2, 80).

Being from a remote community, members of the focus group could easily recognise the decline of TEK users among their youth, and saw the need to reinforce sustainability-related TEK values of respect, responsibility and relationship building for their benefit. This view was echoed by an education policy maker who also recognised the impact this could have on children:

Education is the way to sustainability. We need to ensure that children are taught through the curriculum about importance of caring for all ecosystems. They in turn can carry out awareness and advocacy in the community about importance of sustainability and interdependence of life on planet Earth (POL5, 197).

The suggestions that enhancement of these values could be achieved by teaching and learning through the curriculum describes the role of education as a medium of empowerment. Within these views, education could enable the youth and children to be advocates for sustainability, as the learning then becomes embedded in their way of thinking and doing things. These young people do not just become learners; they also acquire additional skills to improve their critical

thinking abilities, and get involved in planning and making decisions to address issues about sustainability (Tilbury & Wortman, 2008).

As a medium of empowerment, education was seen to have a role in reinforcing sustainability-related TEK values through both the formal and community education curriculum, as suggested by nearly all the participants in this study. The idea of integrating TEK into formal and/or community education was also encouraged by various United Nations documents, particularly Chapter 26 of *Agenda 21* which supports empowerment of indigenous people through capacity building and education (UNCED, 1992) and the Declaration on Science and the Use of Scientific Knowledge which recognises the contribution of traditional and local knowledge systems in science (UNESCO, 1999).

One other role that education was suggested to have was the ability to change the understanding of, and values about, the environment. This would require an in-depth reflection on people's attitudes and values that form the basis of their motivation for behaving in the way they do. Often a person's negative perceptions may influence their attitudes towards the way they harvest or use resources, as a conservation educator explained:

I believe education can help to change people's perception about the environment, as they begin to unlearn some things from the past that may have influenced their negative attitudes towards the environment (ED2, 114).

This view portrays people's perceptions about things around them as influenced by their experiences and the values they form out of these. The attitudes they develop were also thought to be shaped by these values, which could start early in life and evolve over one's lifetime, as highlighted by this conservation practitioner:

Value building is important and starts from our foundation as individuals or part of a group of people. It takes time to build values in people and I think how we nurture that process of building these value systems while one is still young is very

important (PRT2, 49).

Construction of sustainability values early in a person's life encourages them to acknowledge and appreciate their surroundings, as well as the resources they have access to and the relationships they have developed. This also cultivates in a person the sense of responsibility that encourages them to be respectful. Values that are of significance to a person or members of a group could influence their attitudes towards a given object and encourage (or discourage) responsible behaviour (see McLeod, 2009). The role of education in this situation is crucial in reinforcing the values and principles underpinning sustainability-related TEK. Moreover, positive attitudes in a person may take a while to manifest in their behaviour which then becomes evident in their actions. For example, the findings indicated that a respectful behaviour was thought to result in obedience to the elders and older generations who were presumably knowledgeable about the ways of the land, as expressed in the following:

The value of respect people hold encourages them to be obedient to their clan leadership. Such practices ensure that resources are always available in abundance (COM3, 104).

While this view demonstrates a positive result of obedience, there are other cases around the world where disobedience of such could lead to negative behavior, such as the case of the Kayapo Indians in Brazil where young people disobeyed elders (Posey, 1985). These views suggest that education could be a medium that could create a sense of awareness and responsibility in the young people. It could also provide avenues for reflective thinking about the consequences of their actions on the present and future generations, an expected outcome for community education for sustainability (see Tilbury & Wortman, 2008). By revisiting the past through TEK, people could also reflect on sustainable beliefs, practices and values used by their ancestors for sustainable living. This could influence their decision-making processes, and their attitudes and behaviour towards management and use of natural resources.

Moreover, education was seen as having a role in enabling people to reflect on their past to determine relevant practices for the present and future. The process of re-learning from the past enabled the users to explore their local TEK in order to develop deeper understanding of the interconnectedness between cultural, ecological and social functions of their world. This was highlighted by a community participant:

Through education our young people can learn about the past which will help them to understand that the way they live today may not be helpful for the environment (COM3, 102).

A policy participant also saw the possibilities of educating for the future and added:

Education is a powerful medium for information dissemination and knowledge transfer through human resource development. It builds a knowledgeable society that is responsible for caring for the environment instead of abusing it. This also helps people become good environmental stewards (POL3, 122).

Education as a process of learning from the past to learn for the future (reflective learning) can empower the users with new or improved knowledge about resource use and management. This could be seen as an enlightening process for the local people, as they develop and enhance their knowledge of the world that could free them from lack of confidence of the importance of their TEK when compared with the dominant Western scientific knowledge. For example, as in the case of the Maiwala people who felt that their language was inadequate when compared to the English language (Nagai, 1997, 2004). Through a reflective process, the Maiwala could be assisted to appreciate the importance of their language and be emancipated from this inferiority complex. This process could be aligned with the critical theory of emancipation (Geuss, 1981) as education could empower people to make well-informed decisions regarding resource use. Moreover, achieving an emancipated state was seen to be dependent on other factors such as attitudes and

values that people hold as important. These are often not easy to change and evolve throughout a person's lifetime.

Another role that education was viewed to have was empowering people to participate in natural resource management. This was where involvement of community education that harnesses sustainable values of TEK, combined with improved scientific knowledge, was seen to be essential for a better understanding of natural resource management. Within this context, not only were the types of education approaches used crucial, but they may also have to be user friendly. One of the concerns raised by participants was that many people in these communities have limited or no formal education, therefore they would require educational approaches that they could easily relate to. This was highlighted by a conservation educator:

In the informal setting (community), resource management can be learnt through hands-on activities like land use planning. People have direct connection to the land and if they are involved in an exercise in distributing their land amongst living family or clan members, they will realise that it is insufficient for everyone. This can lead to wise use of resources (ED 2, 104).

A community educator also shared his perspective on this approach:

Through land use planning, people are beginning to realise that they are losing some things. These raise questions about links, and connections and tapping into what people already know to help them revive their knowledge. This process involves revisiting concepts of linkages, interactions and interrelationships involving people and environment (ED 3, 136).

The experiences of this educator and other participants emphasised the need to build community capacity through linking approaches, knowledge, processes and skills that local people could easily relate to. This also suggested the importance of using language(s) that communities were comfortable with. That is, information dissemination as well as teaching and learning about changing

practices in sustainable resource management, particularly for local indigenous communities, need to be conducted in a known language. This was reiterated by a conservation practitioner:

If we utilise traditional knowledge of resource use, there will be some control in natural resource management. But using western approaches to emphasise this does not always work. This information has to be translated into our local ways of thinking, knowledge, dialect or language so people can understand (PRT1, 9A).

A community educator also provided a view on this:

As a local person, I use the local vernacular to deliver most of the training and education stuff. This has had a greater impact on the community as they now see the value of natural resource management activities we are implementing in the community and have taken the responsibility of ensuring that their resources are managed and used wisely (ED3, 164).

Both views suggest a need for translation and actual dissemination of information about natural resource management in local languages. Translation for community education may be required for two reasons. First, rural Papua New Guinean communities often do not speak or understand English and may have difficulty interpreting certain concepts or terms. This reinforces concerns about misinterpretation and misunderstanding of certain terminologies used by different parties in natural resource management (see Morrow & Hensel, 1992; Nadasdy, 1999) that could result in disagreements between these parties. Second, indigenous people's culture and identity are embedded in their language which describes their way of life and often enables them to have a deeper understanding of, and connections with, the natural, physical and spiritual world they live in. Thirdly, language encapsulates ecological relationships and knowledge which cannot be translated as such into other languages. For example, the name of a fruit can reveal an ecological relationship with a bird that may eat and help disperse its seed. This emphasises the importance of languages as not just functional but that

they embody TEK hence, it is important to ensure languages survive. In addition, maintenance of these local or native languages could also reinforce valuable traditional knowledge about indigenous ways of life (Kasten, 1998).

In addition, participants' responses also suggested language difficulty as a hindrance to widespread dissemination of information and learning about sustainability as well as other general issues. This could lead to problems of understanding and a possible inferiority complex, where one could assume their language or practice is of less value than those of Western origin, feelings that are often associated with colonialism (see for example Nagai, 1997, 2004). The issue of language suppression was a concern for equity and social justice as it deals with power imbalance, particularly between coloniser and the colonised. In Nagai's example on Maiwala of the Milne Bay Province in Papua New Guinea, the people were prevented from speaking their local vernacular, which eventually effected the decline in their native language, a challenge faced by the present generation of Maiwala. This shows that education about TEK and other knowledge systems about resource use and management would be beneficial if conducted in local languages; or simply delivered in these languages for easy access and understanding by the local people, at the same time maintaining their native languages.

The use of local languages in disseminating information on natural resource management was also seen to have an advantage for community education. That is, dissemination of scientific knowledge and skills about resource management using local vernacular would enhance people's understanding and enable them to identify synergies with their local TEK practices that are essential. This was expressed by a community educator:

Communities need assistance to understand what they are getting into, as some of the content provided may be difficult for many ordinary villagers. The support from other stakeholders is crucial to help them understand the content, processes and protocols involved as well (ED3, 148).

A community member also echoed this need and saw a role for government to play:

I think through training and awareness, key sustainability values or ideas in traditional knowledge about the environment can be reinforced. But this should also be done in collaboration with existing government systems, particularly district and local level governments (COM 5, 150).

The above views suggest three points of interest about community education. First, use of local vernacular to explain scientific knowledge and approaches for improving natural resource management would enhance people's understanding. Such concerns for appropriate language use in education has been highlighted in various literature, such as its importance in bicultural education (Kasten, 1998), science and indigenous worldviews (Michie, 1999), and community education for sustainability (Tilbury & Wortman, 2008). Second, a collaborative effort may be necessary for community education to use local vernacular in its awareness and training programmes to increase people's ability to understand issues and critically reflect on these. Third, valuable knowledge on ecological relationships are embedded in local languages, which would be lost if the language is lost. Hence community education for sustainability is strengthened by its use of local languages - it is not just a one-way process of information transmission.

Critical reflection would enable communities to take control of what they learn, identify problems and develop solutions, plan and take actions, and make informed decisions for changes for a sustainable future (Tilbury & Wortman, 2008). These would also have implications for curriculum integration and policy reinforcement for TEK in education and natural resource management (Michie, 1999). The strong point for community education would be the support of TEK using local languages in curriculum and policy. This would allow rural citizens to access valuable scientific knowledge and skills that may not have been accessible to them.

The data presented in this subsection has illustrated that education has a role in enhancing stakeholders' understanding of resource management and environmental values. Education was also seen to be important for empowering communities with knowledge and skills to understand past and enrich present sustainable natural resource management practices. Delivering natural resource education programmes to meet the needs of illiterate or semi-literate communities would require semi-structured programmes that take into account people's practices. This could also mean revisiting traditional education practices to understand different methods and approaches used, as discussed in the next subsection.

6.2.2 Traditional (Indigenous) Education Practices

The delivery of natural resource education highlights the need to revisit past practices to draw lessons from these experiences in order to reflect on the present. This could then be used to inform current practices and plan for the future to enhance teaching and learning about natural resources. The data highlighted two core ideas in traditional education practices – traditional education structures and methods of disseminating TEK.

Like formal school education, traditional or indigenous education had its own structures which guided delivery and dissemination of knowledge and skills. This was alluded to by an educator:

Through use of traditional structures such as the men's houses, knowledge about living in the society were discussed. In addition, we were also taught through hands-on experiences. For instance, if you catch fish that are too small, the elders would educate you about what you should and should not harvest. We were taught on the spot, no formal gathering was needed to learn something like this (ED1, 36).

In this example, traditional structures such as men's houses were sites where exchange of knowledge and skills about life occurred. It was also here that male

members of the community would learn about different ways of living in a collective society. Moreover, learning about resource use was not restricted to these houses, because exchange of knowledge and skills continued to occur informally, as and when necessary. This was particularly so where knowledge holders and protectors such as elders and leaders were available to do this. They continued to ensure younger generations were taught the values of life, and the knowledge, skills and words of wisdom about living in these societies.

Other structures that reinforced the teachings from sites like men's houses were the home and community environments. These structures were instrumental in the teaching and learning of children and young people, and occurred through the support of grandparents, older relatives or other kinsfolk who were often considered the authority in different knowledge types (see also Reta, 2010). Learning that occurred within the home and community was seen to continue throughout a person's life.

In terms of disseminating TEK, the findings indicated that the obligation for ensuring any knowledge or skill was passed on to the next generation lay with the older kinsfolk. As stated by a community participant, as the "resource personnel, they need to pass this traditional knowledge and practices on to the present generation" (COM5, 147). The possible consequence of elders failing to disseminate this could be that TEK would stop with them and not get disseminated afterwards. The argument is that "holders of TEK have been ceremonially initiated and have acquired special knowledge of the place, people and environment" (COR2, 60). This was also alluded to by Reta (2010) in her statement: "the elders' authority was bestowed upon them through their lifelong experiences and the initiation rites they underwent" (p.130). Their status as elders was seen to be worthy of possessing such knowledge and practices in order to pass them on to the next generation. Such practice could possibly be compared to formal education processes of obtaining a degree and becoming qualified in a field of expertise that could enable one to teach others.

While responsibility for disseminating TEK lies with the eldership, actual methods for dissemination vary. From the findings, these methods were identified

as either formal or informal. The former was associated with formal school systems as established by the National Department of Education with a fixed curriculum, while the latter refers to anything outside of this. As one educator stated, “People consider education as more formal when they send their children to school” (ED3, 160A). This categorisation of learning as formal or informal is presumed to “create further gaps between traditional ways of doing things and the formal process of passing on information, knowledge, and practices” (ED2, 66). Indigenous Education approaches were seen to have no set curriculum, in comparison to formal education where the existence of formally recognised curriculum could reinforce dissemination of TEK. This was noted by an educator:

In terms of formal learning, the curriculum is already there.
Curriculum developers can adopt and integrate ideas of TEK that
promote sustainability into the curriculum and implementers
can draft it into appropriate student learning approaches for use
(ED3, 160C).

A conservation educator also noted teachers’ change of views about the significance of TEK:

In order for us to revive or maintain our traditional knowledge,
curriculum is important. From my own experience in
conducting training on culture and environment, teachers often
expressed that they didn’t think highly of their own TEK as
they thought it was just some other knowledge that was not
relevant today. But through the training, they really got
thinking about the importance of their traditional way of
doing things. So curriculum is an important way forward
(ED2, 68).

Formal education curriculum was viewed as vital for revival and maintenance of TEK. This was possibly attributed to existing subjects and learning areas that TEK values of sustainability could easily be integrated with. The possibility of an integration of TEK with formal curriculum was seen to be encouraging for teachers, who often viewed TEK as old knowledge with no relevance in

contemporary PNG. This process could encourage positive responses both from teachers and the students and young people who are learning about TEK.

In addition, there were also other views on the challenges of integrating TEK, which was very informal in nature, with formal education curriculum. This was alluded to by an educator:

Traditional knowledge about nature and people's way of life was not recorded or written in any books, or taught in any formal school. The transfer of this knowledge from one generation to the next was done practically. For example, if a father constructed something, the son observed and practised the knowledge and skills involved and learnt how to do it (ED4, 178).

Another educator noted this and also highlighted the flexible nature of informal education:

While both formal and informal education is vital for promoting traditional knowledge and sustainability in natural resource management, formal education is time consuming because it requires a lot of effort to integrate TEK. Informal education, on the other hand, is an ongoing process that enables anyone who is skilful in particular TEK skills to disseminate this knowledge in their own way and at their own time (ED1, 44).

TEK was viewed as practical knowledge. The possibility of this knowledge being easily applied by the present generation was seen to be partly dependent on the regularity with which it was practised. The basis for this assumption is that regular practice enables people to memorise things and TEK could be memorised if it was practised more frequently. This could be seen as a challenge for integrating TEK into formal education curriculum, as difficulties could arise when trying to link TEK to appropriate subjects and learning areas that promote TEK or cultural knowledge. It could also be conducted as extracurricular classes in collaboration with other stakeholders involving knowledgeable elders who are willing to teach the young people (see Tiu & Mirisa, 2014). In addition, others observed informal

education as an appropriate medium for disseminating TEK. This is possibly due to the view that TEK has a flexible nature that encourages spontaneous teaching and learning to occur (see Jeffs & Smith, 2011). Like other types of indigenous knowledge, TEK could be discussed, taught and disseminated at anytime, anywhere, in any situation where need arises. Traditionally, acquisition and dissemination of TEK occurred over time and did not follow a rigid structure. This possibly positions TEK more closely with informal education.

It was not surprising to note that both the process of disseminating TEK and the approaches used in doing this were viewed as consistent with informal education. Both were thought to address the needs of those who continue to live their subsistence lifestyles, as was referred to by this educator:

To engage those who don't get into formal education, I think use of informal approaches such as storytelling or chatting by the fire place or organising an informal workshop to allow them to share their experiences and views would be useful. Let them draw from these to help contribute ideas towards making decisions (ED3, 160B).

A conservation practitioner also highlighted this and added the need to use real life simulations:

We can have discussions on the idea of finite resources to make people think about traditional systems of land distribution. For example, use a case where a man had 10 hectares of forest land and had to split this up between four sons equally. This is divided further between the number of children each son had so over time it gets divided until they reached a point where it cannot be split anymore. These sorts of examples make people stop to think because there is a particular point in life where you can't go beyond what you already have (PRT2, 55).

The approaches used in disseminating TEK could involve culturally-relevant strategies that intend to meet the needs of local people, such as storytelling, casual conversations and clan meetings. These casual approaches could also be

incorporated within a semi-structured meeting such as informal workshops where discussions could utilise simulations of resource allocation as described above and land use planning.

Traditional education practices were reinforced by traditional structures such as men's houses, home and community environments, and enhanced by regular teachings from elders and parents. Both the process and approaches of disseminating TEK utilised informal methods which were already embedded in the local cultures, aligning them with informal education. A combination of informal teaching and learning approaches could enable TEK to be integrated and disseminated within the formal curriculum, as discussed in the next sub-section.

6.2.3 Documenting and integrating TEK

Education was seen to ensure sustainability-related TEK values are maintained through documentation and integration in the formal curriculum from elementary to primary and secondary education systems in Papua New Guinea. These concerns were raised as participants recognised the threat to TEK, especially by external influences which do not value and acknowledge TEK. There were views about documenting TEK from older generations by collaborating with them to record their TEK, as expressed by a community participant:

We need to identify living elders who still have these traditional knowledge and practices and work with them to record it. This recorded information can then be used to teach children and young people in schools and communities (COM1, 13)

The elders are an important source of TEK in the communities and possibly considered as more knowledgeable. This possibility is seen to be decreasing as elders pass on without sharing their knowledge. This increases the need to identify living elders and record as much local TEK as possible. The question of who would be willing to impart their TEK for documentation is a tricky one, as specific TEK is often a guarded knowledge of a certain family or clan (McCarter & Gavin, 2011) and some may be reluctant to let go of this knowledge, especially considering that many would have earned the right to this knowledge through

ceremonial initiation or as eldership of a kinship group. In addition, with both school children and young people in the communities being target recipients of this knowledge, “communities need to take the initiative to document their local TEK” (COM2, 72) which could be utilised locally to reinforce sustainable natural resource management. Such initiatives can enable communities to take pride in their own efforts and be responsible for passing their TEK to the next generation. This could also be seen as encouraging positive attitudes towards sustainable livelihoods.

Documentation of TEK for natural resource education appeared to be the concern of community participants. This could be due to their own experiences which indicated an actual decline in the practices of this knowledge. Participants have also suggested lack of awareness and emphasis on TEK as possible reasons for this decline, as mentioned by a community participant:

Whatever useful practices that we learnt about from the past about resource use and management are not known by the young people. For example, when they are sick they know that they will go straight to the modern hospital because they don’t know what type of traditional medicine and herbs to use (COM5, 146C).

A member of the community focus group noted this in comparing the decline across three generations:

In my father’s time, everyone knew all these knowledge and practices about using and managing their environment and its resources but in my time, only few young men know and practise them. The children of today know very little, so we need to teach them about these (COM2, 53A).

The decline of traditional knowledge about natural resource use and management amongst today’s generation as expressed above is a cause for concern. This was particularly true for the community focus group members, who were from a remote area and were able to clearly see the decline of TEK across generations.

Such decline could be associated with many factors including increased access to and use of processed goods and modern medicines, which would mean less dependence on TEK. Other suggestions indicated lack of awareness of TEK and TEK holders about disseminating it, parents favouring formal education systems for their children over informal learning where TEK is emphasised, or the younger generation today just not being interested in learning TEK. Such widespread decline in TEK was also seen to be a threat to sustainable livelihoods, for when people lose their TEK, they could also lose their ability to sustainably utilise natural resources.

Another issue that was found to be of utmost concern by nearly all the participants of this study was the integration of TEK into the formal education system. Curriculum was viewed as a vital link for TEK to be learnt and taught in schools, as expressed by a conservation educator:

I see curriculum as a facilitating tool to introduce traditional knowledge into the formal system. From my own experience in conducting training on culture and environment, teachers realised that when dealing with resource development, they may need to revisit traditional knowledge because land, which is passed on through family lineage, is owned through traditional systems (ED2, 68).

A corporate participant also highlighted concerns for children who are disengaged with their traditional roots:

The current system of education allows for ideas on sustainability and traditional knowledge to be included in the curriculum. It is important to incorporate these values into education because many children are not in touch with their roots, particularly those in towns and cities. They need to learn about sustainability as it is their traditional way of life (COR1, 43).

Formal education curriculum was seen to be a medium through which teaching and learning about TEK could be facilitated. It would allow both teachers and

students to revisit traditional knowledge about resource distribution, such as traditional systems of land inheritance or knowledge of cultural food plants. The possibility of integrating TEK and sustainability in the PNG education curriculum was also thought to be enhanced by the restructure of the National Education Curriculum, which was seen to allow some flexibility to build on traditional knowledge and/or practices, reflect on cultural values, and promote sustainable use of resources (National Department of Education, 2003). This was also seen as useful for many young people who have lost touch with the natural environment and their need to rekindle the traditional knowledge of sustainable living.

The integration of TEK with education curriculum would require documentation, particularly production of relevant resource materials for different education levels. This was noted by a community participant:

Through development of curriculum materials such as cell books for elementary and primary levels, useful traditional knowledge and practices can be incorporated into these materials for use by teacher and students. This will ensure continuity because every child, as they go from one level of education to the next, they will be taught (COM5, 148).

Development of teaching resources that incorporate core TEK values and practices could encourage children to learn it. Also, reinforcement across the different year levels could ensure that a child was consistently reminded of TEK, which could enable them to develop an understanding of its value. This consistent reminder and reinforcement could build in the child positive attitudes and beliefs about the environment and natural resources.

Both integration of TEK with existing learning areas, and documentation of a separate resource material for use in local schools were thought to be approaches through which the decline in TEK and sustainability could be addressed. Such approaches would enable students to learn both theory and practice, as expressed by a member of the community focus group, “if children learn only theory in school without practising it in the village, they will forget” (COM2, 56a). TEK

was found to be a practical knowledge as discussed in Chapter 5 and, as such, it may need to be practised regularly in order for it to be continued for many generations. In addition, those in rural communities may need to apply this TEK more frequently in order to access resources, so having this knowledge would be beneficial for them in the long term.

Another benefit of integrating TEK with formal curriculum was that its application was thought to be significant for resource development projects, as TEK was seen to integrate real life experiences that promoted sustainability. Also, with the flexible nature of TEK that enables it to be integrated with formal curriculum, there is an opportunity for the natural environment to be incorporated as an education hub, so practical learning can occur. This aspect of TEK could be associated with the notion of learning ‘in’ the environment, a core principle of environmental education that enables students to improve their knowledge, skills and attitudes while learning in natural settings (Awasthy, Popovic, & Linklater, 2012; Ballantyne & Packer, 2002, 2009).

Integration of TEK into the formal education curriculum through documentation was viewed as a useful approach to reinforce sustainability principles that are already embedded in it. Its implementation at different education levels may require reinforcement from policy development as discussed in the next section.

6.2.4 Summary of Education for TEK and Sustainability

The analysis of the findings showed education as a tool for learning about sustainability through TEK. This was found to be achieved both formally through the curriculum and informally through community education. Education was also found to have several roles that included being:

- a medium for empowering people,
- a catalyst for change of attitudes and understanding about and for the environment, and
- a reflective process of learning from the past to learn for the future.

Education as a medium for empowerment was seen to have the ability to reinforce critical thinking skills and active participation among the youth through planning and decision making. As a catalyst for change, education could also cultivate respectful and responsible behaviour and influence positive environmental attitudes.

Critical reflective learning in education about sustainability was found to empower TEK users with new and improved knowledge about resource use and management. This was also seen as an enlightening process that empowers people and overcomes their lack of confidence in the significance of TEK compared to a sometimes dominant Western scientific knowledge.

The findings indicated that successful dissemination of sustainability-related TEK could be dependent on factors such as use of a local or familiar language, and locally appropriate approaches such as storytelling, informal conversations and clan meetings. These approaches were common in traditional education and were reinforced by traditional structures and enhanced by regular teachings from elders. Therefore, an integration of formal, informal and non-formal approaches to learning TEK would enhance its continuity.

Continuity of education about sustainability through TEK values was also found to be dependent on documentation and integration into formal education curriculum in Papua New Guinea. This would require policy intervention as discussed in the next section.

6.3 Policy for TEK and Sustainability Education

Policies were viewed to have a significant role in strengthening the integration of TEK values of sustainability in both formal education curriculum and community natural resource awareness and education. Other suggestions caution that collectivist societies like PNG usually have traditional rules about resource use and management, and decision-making systems for addressing concerns related to these. Such rules need to be clarified before new policy ideas are developed or they may not get implemented at all.

The data from the findings highlighted two respective concerns associated with these – the need to incorporate existing systems, and to reinforce stakeholder collaborations for sustainability. These are discussed in the following sub-sections.

6.3.1 Incorporating Traditional Systems

Indigenous communities have social structures that guide how they live and make decisions that affect resource use and management, as discussed in Section 5.3.3.2. Participants' responses suggested the need to revisit existing systems of traditional natural resource management to identify values or knowledge systems that could set the foundation for formulating policy ideas for contemporary natural resource management. One conservation practitioner expressed this:

Our policy systems have been borrowing ideas a lot, so we need to revisit our roots to identify ways to formulate policies of our own. We need to build on what we already have instead of replacing it with external ideas. Building our own systems will also mean incorporating values of interrelationships and limited resources (PRT2, 59).

The current policy systems in PNG were viewed as founded on western ideologies, which often overlook local perspectives of decision-making and resource management. One reason for this, as suggested by Mowbray and Duguman (2009a), was that PNG had no record of local environmental policies prior to colonial rule, until after it gained self-government. Such suggestions are not surprising as PNG was traditionally an oral society and kept no written record of its governance or management systems until colonisation by Europeans. The findings also indicated the need to review PNG's policy systems, to reflect its true state of affairs with consideration for traditional knowledge and practices of sustainable resource use and management, as stated in the Fourth National Goal and Directive Principle of its Constitution (Independent State of Papua New Guinea, 1975). The Fifth National Goal also encourages fostering of Papua New Guinean ways (ibid), in every aspect of economic or human development. This provides the basis for locally developed policies and policy systems that could

incorporate Papua New Guinean values of sustainable natural resource management.

Borrowed policies and policy systems do not always work for indigenous communities such as in PNG, as often these policies contain foreign concepts and terms which could be misinterpreted, or are misplaced in local contexts, creating more confusion. Another reason for borrowed policy systems not working may be associated with epistemological or contextual differences which may make modern conservation practices different from those that are based on traditional ecological knowledge and practices (see Dwyer, 1994). There is possibly a need to review traditional systems and identify common principles and processes that could be incorporated towards development of culturally-relevant policies. This would also enable vital TEK values of respect, responsibility and relationship building through reciprocity, and issues of resource ownership and traditional leadership systems to be incorporated into policy documents. A natural resource policy officer observed that:

As a government agent, we have failed to acknowledge the traditional land ownership and leadership structures in our key policies. I think we need to improve in this area (POL2, 76).

A conservation practitioner noted a loophole in the policy systems in decision-making about resource development:

I've seen a lot of examples of how local communities were not involved in some of those initial stages in the planning process before projects were given the permit and then the operations sort of began. It's always been the national government and the developer, we need policies to change this (PRT1, 27b).

Government agents were found to overlook existing traditional systems and structures when dealing with natural resource development and management projects. One suggestion from the findings was that the long periods of using culturally-irrelevant policies and policy systems would have led to little or no

consideration for traditional practices, structures and systems of using and managing resources. Failure to reinforce the above suggestions could also be related to: lack of agency and key stakeholders' capacity to monitor natural resource policies and strategies; weak coordination between stakeholders to reinforce implementation of existing policies, and decreasing influence of core partners in natural resource management to take the lead in reinforcing policy changes (Mowbray & Duguman, 2009a). There is also a possibility that ignoring these concerns could lead to a decline in the social and ecological wellbeing of local people and their environment, if not carefully addressed.

The effect of borrowed ideas are apparent in some current policy documents such as the Mining Act 1992, which was written using colonial ideologies emphasising the National Government as the sole custodian of all minerals existing in, on or above the land and water (Department of Mining, 1992). Such policies were put in place without due consideration for indigenous beliefs and practices, and their traditional structures and systems of ownership of the land and resources, as emphasised by PNG's *Mama Lo* or Constitution (Independent State of Papua New Guinea, 1975). There are two concerns associated with such thinking – the need for clarification of the context in which such laws are written, and an understanding of local TEK to help rephrase and reframe these, so that the policy and policy statements are reflective of the culture, beliefs and practices of the local people.

6.3.2 Collaboration for Sustainability

Integration of sustainability-related TEK in education curriculum would need the reinforcement of policy. The findings noted that this could be achieved if several factors were taken into consideration, such as the collaboration of key stakeholders involved in natural resources. Ensuring sustainability-related TEK gets integrated into policy would require a collaborative effort from all stakeholders, particularly in terms of collective consultation to seek wider input, including those from the communities. Government agents responsible for natural resources, such as the National Forest Authority, and Department of Environment and Conservation, have well-established policy development mechanisms that involve stakeholder consultation. For example, the Forest Authority has a

“provincial forest management committee comprising different stakeholders who make policy recommendations to the national forest board for endorsement” (POL1, 42). Theoretically, this process was set up to ensure full consultation for any policy development by all stakeholder groups. However, it had not been practically workable, as this educator recalled:

Policy development should involve all stakeholders but when other important groups have not been consulted, then these policies portray only views of certain groups (ED2, 96).

A policy participant also noted this and highlighted the weakness in the policy systems:

It’s at the department level that policies are developed and these are often unfair. All stakeholders should be involved in policy development so that they too can understand the policies. This will allow fair and transparent policies to be developed (POL4, 140)

Another natural resource policy participant added that:

Prior to policies being approved by the government, there needs to be wider consultation to seek collective views from all concerned stakeholders and citizens. This is so the policy is accepted by all who can take responsibility and ownership (POL3, 102).

Policies affect people’s lives and for them to embrace changes associated with these, they need to be involved right from the beginning (Bacchi, 2000) through proper consultation. This does not mean random selection of people to attend as representatives on the consultation team. It requires careful selection of citizens within the stakeholder groups, then proceeding with the consultation at grassroots level, particularly with people who interact with the land and resources regularly. In addition, the government has the role of formulating policies regulating sustainable management of resources, empowering its agencies such as Department of Environment and Conservation to administer and monitor this

(Mowbray & Duguman, 2009a) and collaborating with other stakeholders to ensure this is achieved.

The findings also suggested that to increase collaboration from all stakeholders concerned, government agencies responsible need to improve communication and networking between themselves and with other stakeholders. A natural resource policy officer reiterated this:

There needs to be improvement in communication, networking and integration at both policy development and implementation levels between sectors, levels of government, private sector and government, and the community and the government (POL3, 106b).

Improved communication was viewed as an important first step involving different levels of government at national and subnational levels. For instance, it could start with communication between Local Level Governments and Central Government, and then between the government departments themselves such as Environment & Conservation and Forestry. This process allows for an improved network of collaborative partners in resource development and management, and ensures their engagements are in accordance with specific natural resources-related Act(s) of Parliament. This was also suggested by a natural resource policy participant:

I think we need to seriously re-look at natural resource Acts and policies to accommodate the current status of specific resources such as forest. We need to open up and review the existing policies and regulations with the understanding that our landowners have become more aware and are better educated about their environment and what is happening on their land (POL2, 60).

Reviewing and improving natural resource policies to capture the best interest of all citizens, as stipulated in the *Mama Lo* (Constitution) of PNG (Independent State of Papua New Guinea, 1975), would be a way forward for resource management in PNG. As highlighted above, traditional landowners, who are often

the ordinary citizens, were seen to have become more aware about resource development and its impact on their subsistence livelihoods. Many were thought to have become well educated in the Western education sense and are more informed, so they advise their people to take actions against development if they are unhappy about the way the government handles their grievances. For example, in 2010 a group of landowners in Madang Province of Papua New Guinea took a court injunction to stop Ramu Nickel Mine from dumping its wastes in the sea (Ramumine, 2010). The actions by these landowners was seen to result from their increased awareness of the harm dumping of mine wastes can do to the sea, including to the rich biodiversity of the sea and human lives. This increased awareness of ordinary citizens about the impact of resource development indicates the need for increased involvement at policy consultation levels to ensure people's views are captured in the sustainable natural resource policies.

Inclusion of sustainability-related TEK for education in natural resource policies would require considerations of factors causing the decline of natural resources in the first place. Protection and continuity of natural resources would require careful management and development of sustainable policies that embrace economic, environmental and social aspects of the people, their environment and TEK. This was expressed by a policy participant:

There is a place for traditional environmental knowledge in natural resources management because its application is less destructive to our natural resources. Often strict protection and conservation of resources were used to encourage sustainable use. This knowledge can be maintained through strengthening our natural resource policies and incorporating traditional knowledge in policy development (POL4, 132).

Application of TEK in natural resource management would emphasise less destructive approaches, where stricter rules that controlled and maintained resource use traditionally would be employed. Also, the sustainable ideas embedded in these TEK practices could have a place in natural resource management if strengthened by appropriate policies. TEK in policy was seen as crucial for strengthening connections between different aspects of people's livelihoods, the environment, natural resources and development aspirations.

Integration of TEK in the present that reflects the past would help to contextualise the reality people are faced with each day. This would also enable the participation of people in policy discussions as crucial for providing directions for the future. A natural resource policy officer recognised this in highlighting the gap in current policies:

Under the current National Forest Policy (1991) there is nothing specific about traditional environmental knowledge, although education is broadly mentioned. People have been surviving based on customs and beliefs for a very long time. I believe it has to be documented at the policy level to provide direction for implementation by stakeholders (POL1, 12).

The absence of TEK in natural resource policies could be seen as a gap in policy that needs to address the needs of traditional landowners. In terms of forest resources, the people were seen to have had a very long connection with these resources over generations and had their own rules and practices based on TEK that guided its uses. Traditional landowners' need for recognition of their resources and practices could be seen to be upheld for many more generations if natural resource policies ensure TEK values for sustainability are captured. This is because current legislations such as the previous Forestry Act that was repealed in 1992 have been found to fail many resource owners (see Bird, Wells, van Helden, & Turia, 2007). That is, the system set up through this Act led to abuse as "landowners were often not in a position to negotiate equitable settlements with large logging companies" (ibid, p. 3).

For natural resource policies to be effective, they need to be seen to support sustainable development initiatives that incorporate TEK and sustainable resource harvesting and management practices. These policies also need to develop specific criteria and standards based on a Papua New Guinean system of values for sustainable management and development as stipulated in the Five National Goals and Directive Principles (Independent State of Papua New Guinea, 1975).

6.3.3 Section Summary

The analysis of the findings in this section highlighted the following concerns:

- Policy has a role in ensuring sustainability-related TEK is reinforced in natural resource management and education processes.
- Incorporation of existing traditional systems of natural resource management are crucial for ensuring sustainability and need to be reinforced through policy.
- Integration of sustainability-related TEK into policy would require collective, collaborative consultation, particularly including those from the communities.
- Government agencies in natural resource management may need to improve communication and networking between themselves and other stakeholders to strengthen policy considerations.

6.4 Chapter summary

This chapter expanded on participants' perceptions of traditional ecological knowledge (TEK) and sustainability in discussing findings on the importance of education in strengthening the relationship between TEK and sustainability. Some key findings emerged. Firstly, education has several roles which could be achieved through both formal and community education. This includes: empowering the present generation with critical thinking skills for improved decision making; cultivating respectful and responsible behaviour resulting in positive environmental attitudes; and reinforcing reflective learning to empower TEK users with new and improved knowledge about resource use and management. The process of reflective learning was found to be an enlightening process that could empower TEK users and emancipate them from their lack of confidence in the significance of TEK compared to dominant Western scientific knowledge.

Secondly, successful dissemination of sustainability-related TEK could be dependent on the methods of dissemination. These were found to include the use of a familiar or native language, combined with locally relevant methods of dissemination such as storytelling, informal conversations and clan meetings.

These approaches were commonly used in indigenous education and were found to be reinforced by traditional structures such as men's houses and regular teachings from the elders. In addition, delivery of natural resource education programmes may need to use semi-structured programmes using these informal methods to meet the needs of illiterate or semi-literate communities. In addition, continuity of education about sustainability through TEK values was found to be enhanced through documentation and integration of TEK within formal education curriculum.

Thirdly, policy was found to be significant in reinforcing integration of sustainability-related TEK in the formal curriculum. This could be achieved through incorporating existing systems and strengthening stakeholder collaborations in policy consultations. In addition, sustainable policies may need to reflect the Papua New Guinean culture, beliefs and practices; and ensure that core values of traditional decision making and consultation systems were incorporated. Policies for sustainability-related TEK would also require collective, collaborative consultation, which relies on communication and networking between all stakeholders.

In sum, sustainability-related TEK values and practices could be strengthened through education, both formal and community education. The integration of TEK with formal curriculum would need policies to reinforce it.

The next chapter discusses the findings from phase two of the field work which deliberates on policy considerations for TEK and sustainability in natural resource management.

Chapter Seven

Traditional Ecological Knowledge for Natural Resource Education Policy

7.1 Chapter Overview

This chapter discusses the findings from two workshops conducted in March 2014 as part of the second phase of data collection. The purpose of the workshops was twofold: first, to present preliminary findings of the phase one data for feedback, and second, to consult stakeholders on the draft recommendations for development of a sustainability policy framework. The key points of the phase one data presented to the workshop participants for feedback were:

- TEK comprises holistic indigenous knowledge systems.
- TEK in natural resource management encourages equitable access to resources through traditional decision making systems.
- People's traditional beliefs and practices about resource management demonstrated through actions reinforce sustainability principles.
- Education has a role to empower present and future generations to develop critical thinking skills, respect and responsibility.
- Documentation and integration of TEK in education curriculum for continuity needs to be reinforced by policy.
- Unsustainable resource extraction activities are a threat to the loss of TEK values and practices.
- Western ideologies encourage individualism and threaten TEK values which promote communal lifestyles.
- Lack of awareness and education about the significance of TEK in resource management leads to its declining use.

In addition to the key findings, a summary of the recommendations for a sustainability policy framework were also presented for feedback. These were as follows:

- Resource development projects should incorporate TEK values and practices that reinforce principles of equity, interdependence and

responsible actions to allow for equal participation and collaboration of all stakeholders.

- The natural resource sector should strengthen TEK values that guide traditional decision making processes through stakeholder consultation.
- The natural resource sector should incorporate TEK awareness, education and research as the basis for community empowerment and capacity building for resource management.
- Formal education curriculum should integrate TEK values that reinforce sustainability principles of equity, interdependence and responsible actions to encourage value building, and develop in young people an appreciation of the significant role of TEK in educating for, and about, sustainable living.

These summaries were presented as a PowerPoint (see Appendix D1). Then participants were given time to provide oral feedback and comments on the content. This was followed by the completion of a post workshop evaluation form where participants responded to three key questions and their subsidiaries (see Appendix D2). Of the 15 forms distributed at the workshop, 14 were returned. The oral discussion sessions were audio-recorded and transcribed along with responses from the evaluation forms. These were coded according to related themes using the codebook approach as described by La Pelle (2004).

The transcribed data were categorised into six thematic areas related to normative values of TEK, sustainability, equity, decision making, policy development and education. These were then clustered into themes, analysed and presented in the findings as quoted text with an attribution based on the role of the participant and a number showing the utterances. The findings highlighted the importance of policy in strengthening TEK in natural resources education. Section 7.2 discusses the role of TEK for natural resource management and its reinforcement through policy. Section 7.3 deliberates on the role of TEK in education for sustainability. Section 7.4 discusses the importance of TEK in natural resource education policy ideas. Section 7.5 provides the summary of this chapter.

7.2 TEK and Natural Resource Policy

Feedback from workshop participants validated the notion that TEK is an important strategy for natural resource management and the need for it to be reinforced through both education and policy. In discussing these after the PowerPoint presentation, one participant commented:

This is very encouraging, as for the first time we are able to sit down and systematically look at our own TEK practices and the theory behind it. It also enables us to think about our way forward and how we can incorporate TEK into the policy to push natural resource management forward. (WP11, 190A)

A community participant also noted this and added:

These findings are very crucial for cultural and environmental protection because this is a challenging period where our traditional knowledge and culture are clashing with Western ideas and practices. The Western influence is so strong that it has also affected the way we do things today, resulting in a lot of chaos and confusion. (WP7, 123A)

In acknowledging the social and economic situations experienced in many parts of contemporary PNG, the significance of TEK was expressed as crucial for the way forward. The participants also commented on its relevance both in enhancing the understanding of its users, and safeguarding the local culture and environment when integrated into policy. This was possibly due to the view that maintenance of traditional knowledge and practices in an evolving society can be challenging, as reported in other literature on TEK and natural resource management (see Dudgeon & Berkes, 2003; Moller, 2009; Stephenson & Moller, 2009; Turner & Berkes, 2006; Usher, 2000). Ensuring TEK values were reinforced by policy was one way its application in today's society can be maintained. This is because TEK was seen as promoting life skills aimed at encouraging communities to be self-reliant, which is a positive approach towards development. In addition, social aspects of TEK were also described as a crucial area of concern by a participant:

TEK is vital for everything that happens in our world with a focus on people. Thus TEK promotes respect, responsibility and sustainability through fairness and equality. But the dominant capitalist system geared towards economic development is affecting this, thus the need for policy to reinforce the social values of TEK. (WP10, 171A)

This comment signifies an aspect of TEK that underpins the reason for it to be integrated in natural resource policy. That is, TEK values were concerned with human and environmental wellbeing and encouraged inclusiveness in all areas. This was an area found in Chapter 5 as being overlooked by most resource development projects and needed to be addressed at policy level. An integration of TEK values of respect, responsibility and reciprocal relationship building in policy would address this concern in ensuring equitable participation and inclusion of communities in all resource management projects. However, achieving this process could also be challenging. Two suggestions that emerged from the findings to address these challenges were to understand the reasons for incorporating TEK in natural resource policy and to identify culturally relevant natural resource policy to strengthen this process. These are discussed in the following subsections.

7.2.1 Why TEK in Natural Resource Policy?

The challenges of incorporating TEK in the policy process includes concerns about values, particularly in terms of what the local community considers important as compared to the State and developers. These values were seen as vital when developing a policy framework for sustainability, as they needed to be aligned with existing education and natural resources policies and strategies. The differences in what each stakeholder considers important raises concerns about two core areas of TEK – its potential uses, which is the focus of much TEK literature (Nadasdy, 1999), and the actual application.

According to views expressed by participants, both the potential uses and application of TEK were significant, as discussed in Chapter 5. However, the TEK values and practices, their benefits to users and their overarching role in resource availability and access were viewed as of paramount interest to different

stakeholders, hence, TEK needs to be applied for its true values to be appreciated and continued. The actual application of TEK was seen to be demonstrated in natural resource management (Berkes, 1999; Gadgil & Berkes, 1991; Turner & Berkes, 2006), as natural resource management is TEK in practice. In the context of PNG, the findings indicated a lack of emphasis on the application of TEK in contemporary natural resource management, due to its absence in existing policies. For example, one participant wrote in their workshop feedback:

Incorporating TEK into policies will ensure it is used within various State systems and organisations and at the same time, build vital principles and values that are essential for cultural preservation (WP3, 51).

Another participant also noted the holistic approach of TEK and wrote:

TEK encompasses sustainability, community values, which guide relationships and interactions, and ways of managing resources. If TEK is incorporated into policies, these would only strengthen what is known and obtained from traditional knowledge and practices (WP5, 81).

The need to integrate TEK into sustainability policies was perceived as essential for reinforcing values that could achieve long term environmental sustainability. One reason for this is that the State was often seen as being responsible for making or amending policies for the wellbeing of its citizens; hence, if it takes into consideration aspects of TEK in its education and natural resource departments, the issue of reinforcement of TEK values in policy could be potentially addressed. In addition, concerns about the environmental and social wellbeing of rural people could be strengthened if national policies were to direct resource developers to integrate TEK values of respect, responsibility and reciprocal relationship building into their operational policies. The value of relationship building was viewed as an essential factor for access to resources, as also reported by Crawley and Sinclair (2003) on a case of five Australian mining companies who attempted to reinforce relationship building between their

companies and local indigenous communities to access more land. This Australian case could be seen by some people as resource companies trying to take away indigenous lands; however, it is the gesture of acknowledging the importance of building relationships by company policies that could make the difference in the perceptions of local people. Positive policy actions incorporating significant TEK values could strengthen community involvement through sharing of responsibilities.

Other suggestions highlighted the need to incorporate TEK values into policy as a way of recognising local people as an important stakeholder. Including them in policy would enable them to take ownership and actively participate in natural resource management and development. This was alluded to by one participant who wrote in their evaluation:

Incorporating TEK values into policy would be easily embraced by local people because they could relate to its principles which would also make more sense to them. (WP12, 196)

Another participant wrote:

By integrating TEK into policy we will be able to reinforce familiar knowledge for local people, thus not introducing totally new ideas of natural resource management. (WP4, 70)

Reference to the notion of familiarity in the above examples imply that policies developed for use by local communities need to be grounded in commonly accepted or known values and practices. Familiarity is a psychological phenomenon associated with human memory in terms of recognition and recollection of information or ideas based on prior experiences (Mandler, 2008). Being in familiar territory or recalling familiar practices enable local people to be at ease with themselves and freely participate in the exchange of information. In addition, policies grounded in familiar values and practices could also encourage ownership and equitable participation, as illustrated in other studies on integration of TEK in natural resource management policies and practices among Indigenous

and First Nations people (see Berkes, 1999; Gadgil & Berkes, 1991; Nadasdy, 1999). Moreover, the focus of TEK on people, their cultures and interactions, values the environment and promotes sustainable livelihoods. It is this nature of TEK that was seen to be aligned with the focus of public policies on communities and their efforts to achieve common goals that are of interest to those involved (Stone, 2012). Sustainability policies encouraging collective participation and community involvement would be readily embraced by the people.

Another reason for incorporating TEK in natural resource policies as suggested by the participants was the view of TEK as a management strategy for achieving sustainable natural resource management. One participant wrote:

TEK could be used as a strategy for natural resource management and utilisation because of changing phases of globalisation, whereby resources are being extracted at an unsustainable rate without due consideration for future needs. (WP1, 5A)

Another participant wrote:

Incorporating TEK in policy will help put in place guidelines to safeguard our traditional resource management practices before they erode or are destroyed by civilisation as is the current situation. (WP6, 96)

Participants expressed their concern that unsustainable extraction of resources, both by developers and increasing population, could threaten human survival if needed resources became less available. This concern was also seen to be exacerbated by the current Western scientific resource management models, which are not always sustainable for indigenous communities (Gadgil & Berkes, 1991). Many of these Western models were designed to function in a Western context, and their implementation in non-western situations does not always work. For instance, Mantjoro (1996) described a case study in Indonesia where introduced fisheries management strategies failed to function effectively. This forced the Department of Fisheries to reconsider adoption of traditional fisheries

resource management systems which provided alternative approaches that enabled them to co-manage the fisheries with local people, an implication of the value of TEK in resource management.

One key perspective of traditional resource management practices expressed was that it is not just about a species or its ecosystem that supports it; it's a holistic approach to protecting one's biological and cultural resources that support social livelihoods. One participant noted this in writing:

Integration of TEK with Western knowledge will help to develop appropriate, locally based approaches in natural resource management that are directed at achieving sustainable development. (WP10, 159)

The inclusion of TEK as an alternative resource management strategy was also seen as crucial for reinforcing the values of respect and responsibility. However, to ensure this happens, the role of policy is crucial. As noted by another participant who wrote in their workshop feedback:

Incorporating TEK values and practice into policies would benefit all stakeholders by strengthening sustainable approaches towards respecting and protecting one's natural resources. (WP9, 143)

The recognition that both TEK and Western knowledge were essential for natural resource management indicated that stakeholders did understand the significance of both knowledge types in contemporary resource management in PNG. A combination of TEK and Western knowledge would fit into "new approaches to resource management which synthesises the best of old and new wisdom towards a more sustainable future" (Gadgil & Berkes, 1991, p.137) and could be supported by ecology, a branch of science that is the study of relationships of all living organisms to their environment and is also concerned with diversity and adaptation (ibid). Such collaboration of old and new wisdom could be underpinned by policy and would be seen as a step in the right direction towards strengthening sustainable values and practices.

The findings indicated that participants believed there was a lack of emphasis on the application of TEK in natural resource management. A key reason for such lack was believed to be the absence of TEK in existing policies. Moreover, the stakeholders recognised the value of TEK, particularly in ensuring sustainable natural resource management and emphasised the need for policies to incorporate TEK values. The suggestions also implied that integration of TEK values of respect, responsibility and reciprocal relationship building in natural resource policies would strengthen community involvement through giving them the recognition as an important stakeholder group.

Holistic policies grounded in familiar values and practices encourage ownership and equitable participation and therefore, are readily embraced by local people. These holistic policies could ensure the protection of biological and cultural resources, and strengthen the perception of TEK as a sustainable natural resource management strategy. This also means if TEK was strengthened by policy as an alternate strategy for natural resource management, it could be combined with Western knowledge to provide direction for a more sustainable future founded on old and new wisdom. It also sets the foundation for enhancing natural resource policies, particularly those surrounding culturally sensitive issues as discussed in the next sub section.

7.2.2 Culturally Relevant Natural Resource Policy

Global concerns about sustainable natural resource use have been prompted by various reports and conventions that call for collaborative efforts for sustainability such as the report on *Our Common Future* (World Commission on Environment and Development, 1987) and the Convention on Biological Diversity (United Nations, 1992). These reports recognised the plight of indigenous peoples and their right to safeguard their biological and cultural resources in this expanding, modern, materialistic world. Ensuring food and water sources were protected for the benefit of the present and future generations were of primary interest to these communities. The workshop participants acknowledged these concerns and expressed the significance of policy in rectifying issues of food and cultural security. For example, one participant wrote in their evaluation:

Policies can address all types of issues about resources because they will call for sustainable management and utilisation. Current global concern on sustainable use of resources already calls for creation of new policies, enhancing of existing policies and reviewing of old ones in light of the emerging issues. (WP1, 7)

The view that policy was vital for addressing sustainable natural resource issues and that ensuring these policies reinforced TEK was seen to be necessary if PNG wants to achieve its medium and long term goals for sustainable development. For example, PNG's Vision 2050 clearly reiterates the importance of achieving holistic social, economic and environmental sustainability without compromising the wellbeing of its citizens (Temu, 2009). The notion of holism in this context refers to the aspects of social, spiritual, physical and emotional development of humans that could be enhanced by these aspects of sustainability. Such goals could be achieved through a collaborative effort between all stakeholders because where communities are involved, the familiar principles they value and practice through their TEK also become crucial, and can result in culturally-relevant policies. This was expressed by one participant on their evaluation:

For PNG as an indigenous society, it is critical for policies to incorporate TEK. For too long we have been borrowing Western policies to manage our resources, and development aspirations. It's time we develop policies that acknowledge and promote TEK for our benefit. (WP11, 178)

Development of culturally-relevant policies could enable existing and borrowed policies from the colonial administration to be reviewed in order to create ones that are sensitive to indigenous Papua New Guinean needs. For instance, a document on the history of forestry in PNG reported that the National Forest Policy (1991) appeared to give more control to the State, and not the traditional landowners, about who could access customary lands to do industrial logging (Bird et al., 2007). Such a situation was viewed as restricting people from being involved in any negotiations except with the State, and implicated the use of

colonial policy ideas to suppress traditional landowners. Such examples could be seen as a case of inequitable power relations between the privileged State and the vulnerable traditional landowners. This could also be considered a case of “social realities that need to be critically reviewed in order to bring about change” (Roderick, 1986, p.7). Change in this context may refer to the renewed state in which traditional landowners and communities could be empowered with new or additional knowledge and skills to freely engage in dialogue and negotiations involving their natural resources. This was an area of concern for Habermas’ critical theory (Geuss, 1981), whereby an empowered community could become fully engaged in issues that concerned them, and in the process be emancipated from their state of inequality and disempowerment, resulting in a more just society.

Participants also emphasised that integration of TEK during the policy (re)development phase would be critical, as it could allow for local traditional values on resource management to be incorporated. This was noted by one participant in their evaluation:

TEK is embedded with sustainability principles which, if incorporated into policy, will provide direction towards balancing social, economic and environmental challenges. TEK’s holistic principles and values will certainly enable PNG to develop a sustainable pathway for conservation, forestry, mining, fisheries and agriculture. (WP11, 180)

Another participant added:

If TEK is tied into policy, it will enable policy makers to develop strategies to emphasise the importance of TEK in resource management and make people aware of these. (WP1, 5b)

Aligning TEK with natural resource policies was an approach, policy makers could use to re-assess the values of traditional resource management practices and developed strategies to strengthen these. The holistic nature of TEK discussed in Chapter 5 would allow TEK principles of intergenerational equity and access to

resources, communal ownership of resources, collaborative decision making processes, and social responsibilities to be considered to address specific need areas in natural resource management. With these principles being central to an indigenous Papua New Guinean way of life, they could readily be integrated into public policy systems to influence sustainable development in PNG. Banks (2002) noted this holistic nature of TEK in stating that, “Melanesians do not differentiate between environmental, economic, historical, political and social aspects of their landscapes” (p. 41), as all of these are intrinsically interwoven and are viewed holistically. The inclusion of core TEK values in natural resource policies in all areas of governance would encourage collaborative efforts from all stakeholders to promote environmental, social and economic sustainability.

While incorporation of TEK into natural resource policies was deemed to be the right thing to do, one participant also wrote about the possible impact this could have on resource developers:

If you look at it, natural resource management is part of TEK, TEK incorporated into the policy would be welcomed by local people but it can also cause problems for extractive industry. This is where economic incentives might undermine such policy. (WP12, 204)

The view that incorporation of TEK in policies could be problematic for developers highlights the importance of extractive industries and their contribution to the economic development of PNG. Policies integrating TEK could be seen to restrict them from extracting resources, however the indigenous people are often disadvantaged by the extractive activities. For example, the passing of the Bougainville Mining Bill in early 2015 was criticised by landowners as not transparent as it was seen as ravaging indigenous lands and environment (Ramumine, 2015). This Bill was also seen as being set up to promote the developers’ interest, as it lacked proper consultation with landowners.

Integration of TEK into policy would be aimed at capturing the interests of indigenous people who are the customary landowners, and was therefore seen to be the obligation of the State to ensure the wellbeing of its citizens was protected

by supporting policies that can safeguard them. Moreover, the ability of local people to be consulted and to understand the content of what got incorporated into policy was also seen as an essential process. One participant noted in their evaluation:

Having a legal document that could be understood easily would enable it to be practically implemented at the local level to reinforce sustainability. (WP9, 145)

Not only were indigenous communities' consultation of what goes into natural resource policies seen to be important, but that their understanding of locally developed sustainable policies was also perceived as necessary for effective implementation. This understanding was thought to be associated with their familiar knowledge because of their connection to customary lands and seas, and the natural resources found in these places. TEK represented familiar knowledge and practices commonly used by these communities and hence were thought to be fundamental for policy development and implementation. These views were also found to be consistent with Nadasdy's argument that "improved management of natural resources and local empowerment could not be achieved unless local beliefs, values and practices were accepted as a valid basis for action" (1999, p. 13). In addition, an integration of TEK into policy would need to consider the wider impact on environment and social wellbeing of local people, and not just the economy, as expressed by another participant:

With most of our sustainability guidelines today linked to economic well-being, TEK would provide not only an alternative approach but one that also broadens the scope to include concerns for environment and people. (WP5, 83)

Concerns for people and places were seen as an important aspect of TEK that embraced the indigenous notion of interdependent systems. For these people, there was no differentiation between natural environmental resources and social resources (Banks, 2008), as both were viewed as intertwined. It was for this reason that perceptions on interdependent systems in policy were crucial for

understanding the impact of environmental degradation on various components of life. In addition, this notion of connectedness was also viewed as vital for strengthening policy development and implementation, as it could connect all stakeholders through (re)establishing links and connections. This was also viewed as vital when developing realistic management plans, tools and mechanisms to manage resources, as one participant wrote:

Policies that incorporate TEK can strengthen collaborative approaches where key stakeholders are utilised, and practical policies, plans and strategies are devised to be implemented and enforced. This will create a sense of ownership, enforcement and adherence from all stakeholders to strengthen the policies. (WP1, 15)

One of the key characteristics of the application of TEK in everyday collective activities as discussed in earlier chapters was the sense of belonging. This is a human behaviour associated with being affiliated to a group that enables interaction for survival (Dean, 2013; Hagerty, Williams, Coyne, & Early, 1996). In indigenous communities like PNG, this behaviour was seen to be fundamental for ownership and management of resources and strengthens the value of comradeship. Thus, TEK in natural resource policies could ignite this sense of responsibility and encourage individuals and communities to take ownership.

A final issue raised by the participants was for policies that take into consideration cultural norms, values and practices generally accepted by the local citizens. Gaps created by introduced ideas that often clashed with the cultural norms and practices of society today need to be addressed by culturally-relevant policies. For instance, during the post workshop discussions, one participant commented:

Resource management has become a challenge in the community because renewable resources like timber are now losing their value. That is, people are selling their timber for amounts that are far lower than the true value. This is a clear picture of people devaluing their resources because of increased need for other goods and services that require cash. (WP7, 123G)

Replacing sustainability values to satisfy urgent cash needs could contribute towards deteriorating environmental morals as contemporary PNG societies are bombarded with new ideologies which clash with traditional practices and values. The modern cash economy has had a strong influence on indigenous Papua New Guineans' decisions about the way they use and manage their natural resources today. Some of these decisions were also found to be influenced by poor access to health and education services and other infrastructure like transport. These seem to be enhanced by lack of proper policies to monitor and implement these services creating an unnecessary burden on the people to make unsustainable decisions on resource use that affects their own livelihoods. One example of such was the National Forest Policy which had driven forest development in exchange for infrastructure like road, schools, and hospitals (Bird et al., 2007). Sometimes after communities lose their forests and garden lands, they wait for a very long time because the promised infrastructure does not come through. This forces them to travel miles to access health or education services. This results in additional strain on communities who have had to resort to other unsustainable practices.

Natural resource policies that incorporate TEK could address sustainable development goals through reinforcing familiar knowledge and practices about land and resource use and management embraced by local communities. The integration of TEK into natural resource policies would also enable local traditional resource management values and practice to be incorporated, resulting in culturally-relevant policies.

The next sub-section discusses stakeholders' views about TEK in sustainable resource management policy.

7.3 TEK in Policy for Sustainable Resource Management

Values and practices of TEK, if captured in policy, would be beneficial for sustainable natural resource management, as TEK was seen to promote holistic approaches that encompassed sustainability and community values. Incorporation of TEK values of respect, responsibility and reciprocal relationship building in policy would enable people to take care of their natural environment, have respect

for themselves and the natural resources that sustain them. They would also participate in using and managing these resources for the benefit of the present and future generations. This was an aspect of the indigenous way of life whereby, humans were viewed as “part of the complex web of life ” (McGregor, 2004a) and continued to interact with other components of this life system to meet their own needs. As one participant commented in their workshop feedback:

People will continue to understand and value what is in their natural resources and accept every plant, animal, stream, or physical environmental component as having a certain cultural or aesthetic value placed on it. This requires policies that would enhance and strengthen what is already known and accepted about these resources today. (WP5, 89)

Making sure this support system continues into the future is a critical concern for PNG as an indigenous society, for amidst the need for development are the increasing threats to natural resources which are the sources of people’s livelihoods. The loss and devaluation of these resources from increasing extractive activities could also threaten the loss of valuable TEK for locating, accessing and sharing resources, resulting in increased poverty and inequality. The findings also indicated that sustainable principles of fairness and equality embedded in TEK values needed to be strengthened by policy, as expressed by another participant in their oral evaluation:

One of the effects of policies that incorporate TEK and sustainability on natural resource management is that it encourages and promotes respect, relationships building, equality and general social and environmental harmony. (WP8, 136)

Another participant acknowledged this view and added:

I think it is high time we acknowledge the immense contribution of TEK for generations and its relevance in sustainability and ensure that this is also reinforced in policy. (WP13, 212)

The emphasis on acknowledging the importance of TEK and ensuring some aspects of it were integrated into policies indicated the realisation that core TEK values of respect, responsibility and reciprocal relationship building have a role in providing a sustainable pathway for PNG. Systems of TEK have been in use over generations to observe, identify, locate and use resources (Turner & Berkes, 2006) both for consumption and management purposes. These systems used core TEK values as principles to guide their understanding and utilisation of resources. To capture these and ensure a sustainable pathway was achieved, considerations may need to be given to policy approaches and strategies in education and natural resource management that could both safeguard TEK as well as strengthen its implementation. One of these approaches is through education which is discussed next.

7.4 TEK for Natural Resource Management Education

In acknowledging policy as crucial for reinforcing TEK for natural resource management, the participants also agreed that education for natural resource management was equally significant as highlighted in the following.

Education was described by the participants as vital for strengthening TEK values of respect, responsibility and reciprocal relationship building that promotes sustainability principles of intergenerational equity, interconnectedness and equitable participation. Education also has a role in reinforcing TEK for natural resource management as it has a well-established system with processes that could inform and influence the present and future generations. As noted by the United Nations Conference on Environment and Development (1992), education was “critical for promoting sustainable development, improving the capacity of people to address environment and development issues, and could also be a process by which human beings and societies can reach their full potential” (p. 320). This also reinforce Tilbury’s arguments that “closer links between environmental quality, ecology and socio-economic aspirations and the political threads needs to be created to portray a holistic outlook” (Tilbury, 2006, p. 210). These perceptions reinforce the notion that education is a medium for reinforcing TEK for natural resource management, which needs to be strengthened through policy.

Ensuring TEK is included in mainstream education would require supporting legal systems that are also commonly recognised and used by all stakeholders. Policy was in this case seen as pivotal as noted by one participant in their oral feedback:

Education can be supported by policy by way of devising strategies after developing policies especially on natural resources management and use. It can become one part of a policy document and strategies can be devised on how education can be used to address the issues raised. This will allow implementation to be possible if it is clearly spelt out in the policy documents. (WP1, 9)

A second participant wrote:

By incorporating TEK into the education policy and having it practiced at all levels of education would be one way of reinforcing indigenous knowledge and practices of resource use and management and ensuring they are not lost. (WP2, 40)

Recognition of education and policy as two important mechanisms for strengthening TEK values in natural resource management and that these could set the foundation for further collaborations between all stakeholders. It could also provide an avenue for teachers and students to discuss respective views and perceptions on balancing sustainable livelihoods and development. As Tilbury (1995) pointed out, “young people need to be given opportunities to explore links between their personal lives and wider environment and development issues” (p. 199). Such approaches would broaden their horizons in understanding wider sustainability issues through exploring local issues and applying these in the global context. Moreover, attempts to find solutions to addressing environmental issues through TEK would require an understanding of the benefits, if integrated into education policy.

7.4.1 Benefits of TEK in Education

TEK values of respect, responsibility and reciprocal relationship building were viewed as significant to be learnt by children from early stages of their education

and throughout their lifetime as adults. These values are about living sustainably particularly within one's environment and making sure it continues to provide for one's needs and those of the future generations. Participants' agreed that the process of capturing and disseminating TEK values through education was an important approach that needs to be reinforced through both formal and community education. For example, one participant expressed in their oral feedback:

TEK values for sustainable livelihoods need to be disseminated through community education and awareness because most of the population in the community have not been through formal education. So through community education and awareness, presentation of information can be done so they can be made aware. (WP1, 33)

Another participant also noted this:

The National Department of Education has put in place too many programs in schools that our kids do not have enough time to learn about our culture and traditional knowledge. The types of things they learn in schools are not applicable for village and community living while knowledge about living in communities is being lost. Therefore, inclusion of TEK in the education curriculum is crucial as it will reinforce teaching and learning of these important values. (WP7, 123g)

Participants agreed that sustainability values embedded in TEK are vital for sustainable livelihoods and everyone regardless of their education status, need to be made aware of these. While formal education appears to be the most appropriate medium for disseminating these values, community awareness and education program was also acknowledged as equally important for the majority of the people who don't go to formal school or have not been educated in the formal system. In addition, the issue of too many subjects to teach can be addressed by integrating the teaching, learning and development of these values. This approach would ensure a culturally-relevant content was integrated so future generations could continue to learn about having a safe and healthy environment.

In addition, community education was recognised as vital for many of the local people who, while formally not educated, had the right to recognise and appreciate the importance of their TEK values and practices, and learn additional livelihoods information, knowledge and skills to improve their livelihoods. This notion was also shared in Tilbury and Wortman's (2008) also viewed community education for sustainability as a platform, where not only community engagement and participation for action were nurtured, but people's understanding would also be enhanced. Formal education enables the current generation to re-learn TEK values and practices through the curriculum to enhance their knowledge, understanding and dependence on environmental resources.

Formal education was also seen to have the potential to enable this same generation to re-learn TEK values and practices through the curriculum to enhance their knowledge and understanding of environmental resources and their dependence on these. These sentiments were also expressed by Mehta, Alter, Semali and Maretzki (2013) in describing the need to include indigenous knowledge of sustainability in the formal curriculum, where the wisdom of the past could be an additional knowledge for understanding and solving environmentally related problems.

The participants also agreed that the role of education in information dissemination was a crucial one. Within community education, the focus was seen to be on local people with no or limited formal education, but who were also considered knowledgeable in their TEK and the ways of the land. In the formal education setting, the intended target was children and young people who represented the present and future generations of their communities. To ensure dissemination of TEK values and practices were strengthened through education, awareness was seen as critical as it not only enhances general knowledge, but also reinforces cultural and traditional knowledge, as described in the evaluation by this participant:

Awareness on TEK must be taught in all environmental sectors
including groups or organisations that deal with sustainability of

environment so that everybody must understand TEK and its link to social livelihoods. (WP3, 63)

Community and school awareness at any scale was seen to be fundamental for reinforcing linkages between TEK and sustainable livelihoods. However, it may need to involve structured programs including action taking (Tilbury & Wortman, 2008) and practical hands-on learning about real issues (Slattery, 1998). This could also set the basis for communities to draw from their TEK and build on new information about the concepts of sustainability and natural resource management. In addition, education would also be responsible for setting the foundation for value building in young children, which would likely to remain with them throughout their lifetime, as reiterated by the following participant in their written feedback:

Education has an important part in reinforcing principles of equity, interdependence and responsible actions because half of a child's life is spent on formal education and this is where their character can be shaped. (WP4, 74)

And another added:

Working with kids at the very early stage of learning is important because that's where they can actually absorb a lot more information and start developing their own value systems for sustainability and TEK. (WP11, 192c)

In contemporary Papua New Guinea, children are placed in formal schools at a very young age where they begin learning foreign knowledge which was seen to be abstract and have no immediate significance in their daily lives (Rena, 2011), particularly for those in rural communities. It was at this stage that dissemination of sustainable TEK values could be a critical component of their learning. This was due to these (values) being developed over time, so an early start could expose the child to traditional ecological knowledge and practices of the land. In addition, as a medium for information dissemination in this century, the school was seen to be an important avenue for education about TEK for sustainability.

Early childhood learning was also considered a good starting point for value building, since it may enable integration of TEK values for sustainable resource management to be emphasised from an early age.

One of the concerns raised in terms of the role of education in TEK was that it had lost some of its initial responsibilities in family and community life. As pointed out in the post workshop discussion by one participant:

In our traditional systems, education was everyone's responsibility. This has changed today and parents are expecting teachers to teach children everything, including the values of respect and responsibility when some of the teachers are not trained in these. The current education system has also caused us to give away this responsibility of teaching our children TEK values so they miss out. (WP11, 190G)

The shift in responsibility of who should be educating children was viewed in two ways. First, parents and family members were seen to be removed from contributing to the education of their children and young people, particularly in learning their TEK. Second, the teaching and learning of TEK was viewed as not very well structured into the education system and curriculum in particular, resulting in young people missing out on learning this. There appeared to be a shift in the role of delivering and disseminating TEK knowledge and skills from immediate relatives to teachers, who are often themselves lacking in these specific areas to effectively deliver them. One reason for this was that teachers were not always from the local area, making it difficult for them to teach local TEK with confidence. This was where inclusion of older citizens and elders at the school level would be critical as they were the holders of TEK (Reta, 2010), and could be involved in reintroducing important values through various approaches. This could be done both at the school and outside of the school and can be organised by the teachers or other partners. An example of such an approach is reported by Tiu & Mirisa (2014) on the bio-cultural⁹ classes facilitated by a not for profit conservation organisation in Papua New Guinea as an after school activity where

⁹ Bio-cultural classes involve the teaching of culturally related knowledge and skills that have a biological significance. Often these are environmentally related.

children are instructed by local holders of traditional cultural knowledge and skills. This enables the children to interact with elders and instructors and learn in the exchange of knowledge and information.

Participants also agreed that another area of importance was the documentation and integration of TEK in the education curriculum. One participant expressed this in the workshop discussion:

Education material production is important and we all have the responsibility of producing appropriate TEK materials for use. This knowledge needs to be sourced from the older generations, many of whom have passed. (WP7, 123L)

Capturing of TEK in education materials was critical for ensuring sustainability values were reinforced for a very long time. The knowledge acquisition is important and needed to be sourced from older generations who were passing on without sharing what they know.

Another obvious reason for documenting TEK was that the current education system tended to take children away from the village and community values, and introduce new ideologies through formal education which could be confusing (Reta, 2010). This type of education system did not prepare young people to live in rural communities, so those who stayed in the formal school systems for much longer tended to lose communal values such as respect, responsibility, and reciprocity relationship building (Rena, 2011). Rena also described the school system as “too academic and focused on passing examinations and acquiring certificates” (2011, p.10).

It could be noted from these arguments that emphasis on abstract knowledge was seen by some respondents to be irrelevant to the Papua New Guinean context as it often resulted in a high number of school leavers looking for jobs in the city (ibid). The shift from rural to urban areas in search of work and services which could not be easily accessed in rural areas, could lead to the young people moving away from the village where they would use TEK more frequently or the town where

they use it less thus the possibility of forgetting TEK values and practices from their upbringing.

The notion of integrating TEK values in formal education curriculum could be challenging and requires some thoughtful approaches in recognising the existing subjects in different levels of education and deciding whether some of these already encompass core ideas and values that provide the opportunity to integrate TEK values with. On the other hand, for informal or non-formal education, there is flexibility to either integrate into existing programmes or developing new projects that could focus on teaching and learning TEK values. In natural resource management, Nadasdy (1999) argued that while the idea of incorporating TEK, the process, was new, historically there had been some recognition of its existence among resource managers and indigenous people. This could also mean that incorporation of TEK values into education would be a complementary effort to strengthen existing efforts of many natural resource management projects.

7.4.2 TEK and Natural Resources Education

Traditional ecological knowledge was perceived as having the ability to “offer biological insights to resource managers, provide a cultural framework for environmental problem solving that incorporates human values, and comprises of an extensive body of knowledge which is valuable when applied” (Kimmerer, 2002, p. 434). These abilities of TEK when reinforced by natural resource policies could result in ensuring a balance between social, economic and environmental development. One participant noted in their oral evaluation:

TEK values promoting sustainable natural resource management could be strengthened through incorporation into policies that are enforced and implemented. (WP8, 138)

And another wrote:

Having one or two statements on TEK in the policies will have a rippling effect, in that it would be implemented as compulsory

activities or projects through all levels in natural resource management. (WP10, 163)

Strengthening of TEK in natural resource policies would require a collaborative effort to implement and enforce these. Partnerships between stakeholders were also seen as an essential step in this collaboration when developing policy ideas or statements. This process would ensure policy implementation and enforcement stages were clearly stated and explained, resulting in all stakeholders understanding their specific roles and responsibilities towards a better future. Ignorance of such processes could lead to dissatisfaction and conflicts with traditional landowners which often resulted in drastic actions, such as the case of the Bougainville crisis, where traditional landowners developed resentment for outsiders benefiting from their resources while they themselves were missing out (Oates, 2011). There was also a need to recognise the parties to a decision making process such as this so they could be held accountable, as noted by one participant in their oral evaluation:

With regard the aspects of decision making, one of the key ideas often overlooked is 'Parties to the decision making processes. I think we should know who are or will be the rightful decision makers so they take ownership of that decision. (WP13, 214)

Ensuring agreeing parties were held responsible for their decisions was one way in which each stakeholder could take ownership of such policies emphasising TEK. Ownership of resources, rights to participate in decision making and shared responsibilities for resource access and distribution were some aspects of the core TEK values of respect, responsibility and reciprocal relationship building. These need to be reinforced by policy to promote a sustainable natural resource management in PNG.

By having TEK in education policy would enable it to be considered as a part of the curriculum and implemented in the education programs. (WP7, 115)

Another participant also noted this and added:

I believe TEK enshrined into education policies would not only provide a model to guide planning, organising, administration and implementation of natural resource management, but also ensure that sustainable values are continued. (WP10, 169)

The critical role of education in integrating TEK in sustainable resource management was found to require policy reinforcement. These policies needed to emphasise core TEK values of respect, responsibility and reciprocal relationship building which were targeted at promoting equity, interdependence and responsible actions for a better future. These policies were also seen as providing a formal avenue for TEK in natural resource education so “teachers could apply this in their schools as instructed and guided by policy” (WP10, 173F). In addition, policy ideas for this purpose may need to:

- reinforce core TEK values from elementary through to primary, secondary and tertiary education levels;
- emphasise TEK as essential for future education;
- provide guidelines to direct TEK in curriculum implementation in schools.

Implementation of TEK in education for natural resource management could be dependent on clearly defined policy ideas and statements that could guide it. In the context of PNG, policy ideas need to emphasise common TEK values that focused on respect for people and environment, responsibility towards kinship groups, and strengthening reciprocal relationships that supported resource access. These values when applied could provide direction for a sustainable pathway that captures both cultural and aesthetic values of environment and society, and at the same time, provide a way forward.

In light of TEK in natural resource education, policies need to strengthen the principles of fairness and equality, capture approaches and strategies that would safeguard TEK, reinforce the need for collaborations and partnerships and ensure parties involved in any resource decision making be accountable for their actions.

7.5 Chapter Summary

This chapter presented the validation of the phase one findings as agreed upon by the workshop participants which are as follows.

- TEK is an important strategy for natural resource management thus it needs to be reinforced through education and policy.
- TEK promotes communal decision making which is a critical aspect of social wellbeing, which through collective consultation engages all members of a community.
- Culturally relevant policies can be produced if TEK values are incorporated into natural resource policies. These encourage collaboration and involvement, and reinforce ownership of resource management strategies and plans. TEK in natural resource education policies reinforced sustainability through values and principles.
- Core TEK values of respect, responsibility and reciprocal relationship building have a role in providing a sustainable pathway for PNG.
- TEK values of respect, responsibility and reciprocal relationship building need to be emphasised within natural resource education policy to:
 - strengthen the principles of fairness and equality,
 - capture approaches and strategies that would safeguard and strengthen TEK,
 - encourage collective participation and community involvement,
 - reinforce the need for collaborations and partnerships, and
 - ensure parties involved in decision making were accountable.

The next chapter discusses the current positioning of TEK and sustainability in policy documents on natural resources and education.

Chapter Eight

Analysis of Natural Resource Legislation in PNG

8.1 Chapter Overview

This chapter provides an analysis of documents related to natural resource legislation in light of the recommendations from the findings of the previous chapters to establish whether and in what ways TEK is currently addressed or if there is a gap that needs to be addressed.

Legislation regarding the environment and natural resources in Papua New Guinea has been founded on the country's National Constitution, which was established on 16th September 1975. There are several pieces of legislation associated with natural resources as discussed in Chapter 3, but those that are of particular interest to this study are the Environment Act 2000 and its associated policies such as the Protected Areas Policy 2014, National Forest Policy 1991, and the Mining Policy Draft 2012. Another important piece of legislation for this study is the PNG National Curriculum Statement for different education levels from Elementary to Upper Secondary. These pieces of legislation provide a platform for policy considerations to strengthen the integration of TEK for natural resource management education, as recommended in the previous chapters.

The strategy used in this process involved critical discourse analysis, an approach that “introduces the critical tradition in social analysis and contributes to critical social analysis that focuses on discourse and relations between discourse and other social elements such as power, ideologies, institutions and social identities” (Fairclough, 2013, p. 178). As noted by van Vinjik (1985), this study also attempted to analyse ideas of policy writers to uncover any mention of the relationship between TEK, sustainability and policy. With the view that policy is value-laden (Stone, 2012) and influenced by social structures and interactions (van Vinjik, 1985), understanding the writers' perspectives of policies and legislations would provide an insight into the context in which each of these policies were written and the reasons for writing them.

Using critical discourse analysis, each of the policy documents was analysed. Section 8.2 discusses the Fourth National Goal of PNG's Constitution and its implications for natural resources legislation in PNG, including the Environment Act 2000, Protected Areas Policy 2014 and National Forest Policy 1991. Section 8.3 discusses the Mining Policy Draft 2012 which was based on the Mining Act 1992. Section 8.4 discusses the National Curriculum Statement for elementary, primary and secondary schools, and Section 8.5 provides a summary of this chapter.

8.2 Fourth National Goal on Natural Resources and Environment

Papua New Guinea's National Constitution or *Mama Lo* was put into effect on 16th September 1975 on Independence Day. As a cornerstone, the *Mama Lo* was the founding legislation on which all other natural resources and environmental legislation were developed. The emphasis on natural resources, environment and traditional knowledge was evident from the outset of *Mama Lo*, particularly in the preamble which states:

We, the people of Papua New Guinea, united in one nation pay homage to the memory of our ancestors; the source of our strength and origin of our combined heritage, acknowledge the worthy customs and traditional wisdoms of our people which have come down to us from generation to generation; pledge ourselves to guard and pass on to those who come after us our noble traditions and the Christian principles that are ours now. (Independent State of Papua New Guinea, 1975, p.1)

The acknowledgement of traditional ancestral wisdom portrays the connections present generations have with the past, particularly in terms of accessing and utilising environmental resources which form the core of their existence. It also indicates the possession of this wisdom by those who wrote the Constitution (Mowbray & Duguman, 2009a) in an attempt to safeguard traditional knowledge and practices of indigenous Papua New Guineans to ensure their social and emotional wellbeing. An analysis of the Constitution indicates a professed stance in favour of this knowledge through the declaration of the five National Goals and

Principles emphasising integral human development, equality and participation, national sovereignty and self-reliance, natural resources and environment, and the Papua New Guinean ways (Independent State of Papua New Guinea, 1975). The first three goals target individual and community freedom from any form of oppression in order to achieve holistic development, equal opportunity and benefits, and self-reliance through political and economic independence. The fourth goal is aimed at achieving general environmental protection and conservation of fauna and flora in consideration of the present and future benefits and wellbeing, while the fifth goal embraces the essence of the Papua New Guinean way of doing things, whether in politics or economic endeavours, being mindful of the diversity of people and cultures, and the need to consider all of these aspects for the betterment of its citizens.

In light of this study, the fourth goal on natural resources and environment is particularly significant, given the important role it plays in guiding various environmental and natural resources legislation within PNG. It states:

We declare our fourth goal to be for Papua New Guinea's natural resources and environment to be conserved and used for the collective benefit of us all, and be replenished for the benefit of future generations (ibid., p.1).

This goal is enhanced by the statements that call for wise use of all resources including fauna and flora on or under the land; in, on or under the sea and in the air; and their maintenance and replacement (ibid.). The declaration of the fourth goal also acknowledges high dependence on natural resources and the need for environmental management and protection, an aspect of TEK discussed in earlier chapters. Concerns about dependence on natural resources and environmental management can also be aligned with what Filer describes as environmental policy paradigms, particularly within the context of wildlife management and environmental planning (Filer, 2011). The paradigm of wildlife management is associated with the concerns for wildlife protection as wildlife is still a food source for many rural Papua New Guineans, while the paradigm of environmental planning has to do with ensuring that approaches to protect and manage the

environment and resources are in place for posterity. In addition, the Fourth National Goal was pivotal in the development of various environmental and natural resources legislation, such as the Environment Act 2000, Protected Areas Policy 2014 and National Forest Policy 1991. These are discussed in the following subsections.

8.2.1 Environment Act

Environmental management and planning as a policy paradigm has evolved in many ways in the past decades of Papua New Guinea's existence as an independent nation (Filer, 2011). There are many contributing factors to this evolution, including rapidly changing environments caused by human impact (Mowbray & Duguman, 2009a), such as increasing population, climate change and mineral extraction. As noted in the previous subsection, PNG's National Constitution has been significant in setting the context for environmental legislation. The overarching legislation that addresses general issues of management, planning, implementation, monitoring and enforcement is the Environment Act 2000, later amended in 2010. The Act provides the administrative mechanism to evaluate impacts on the environment through an environmental approval and permitting system under the administration of the Department of Environment and Conservation.

An analysis of the Act shows that its conceptual underpinnings are founded on cultural and social environmental values, understanding of ecological interdependence and sustainable development aimed at economic, environmental and social wellbeing. It comprises eleven parts, of which Parts 1 and 2 are concerned with the historical and conceptual underpinnings of the Act while Part 3 describes the administrative powers, functions and responsibilities of the minister, director and department of environment and conservation. Part 4 focuses on the formulation and implementation of environmental policies, and Part 5 defines aspects of the conditions and procedures of issuing or refusing environmental permits. Various aspects of environmental management involving audits, investigations and improvement plans are addressed in detail in Part 6. This is followed by directions on ownership, use and abuse of water,

compensation for use of land on which water was accessed from and other water-related issues in Part 7. Instructions for fees and charges associated with different aspects of the Environment Act including levies, bonds, costs of services, permits, offences and damages are explained in Part 8. Further instructions for enforcement, registration, operational procedures and regulations in regard to the Act are elaborated in Parts 9 and 10, while general repeals on various environmental legislation and regulations on transitional issues are addressed in Part 11.

Like other environmental legislation, the Act was set up in response to the Fourth National Goal to safeguard PNG's environment and natural resources, preserve its traditional social structures and protect its biodiversity with its vast ecosystems. Its core objectives, of relevance for this study, are to:

- promote wise management of natural resources for the collective benefit of all and ensure renewable resources are replenished for future generations;
- protect the environment while allowing development that improves quality of life and maintain ecological processes on which life depends; and,
- sustain the potential of natural and physical resources to meet the reasonably foreseeable needs of future generations;
- and safeguard the life-supporting capacity of air, water, land and other ecosystems.

(Independent State of Papua New Guinea, 1975, p. 9)

These objectives clearly emphasise the significance of environmental resources for human wellbeing, which can be protected through providing the means for environmental objectives to be encouraged, set and observed. This can be achieved through “consultative policy formulation that reinforced important community environmental values and ensured appropriate Codes of Practice were clearly stated in the environmental permits, improvement plans and management programmes” (ibid.). The emphasis on a consultative approach to policy formulation captures aspects of consultative decision-making in TEK, as indicated in Chapters 5 and 6, and is reflective of Stone's notion of the community as a

starting point for political decision-making, where collective will and effort are negotiated to establish understandings of public interest (Stone, 2012). In addition, the Act's directives to follow a thorough process of public consideration for the environment through an environmental impact assessment process would allow beneficial community values to be protected through preventative measures such as awareness and education, or prosecutions for offences of environmental harm. The Act also offers measures to mitigate the increasing levels of changes caused to the physical environment, human livelihoods, and the fauna and flora. It provides directives for enforcement of environmental Codes of Practice and permits, and punishment for violators of the Act.

As indicated above, the focus of the Act is on environmental management, planning, monitoring and implementation of laws and responsibilities to safeguard and protect the environment in the best interest of Papua New Guineans. With over 80 per cent of the population being rural and having great environmental dependence, this study has demonstrated significant usage of local TEK to access these resources, as discussed in Chapters 5 and 6. This could imply that the Environment Act may need to strongly demonstrate the connection of people and their environment and provide very clear directives to ensure their needs for resource use were also protected. Although the Act allows for environmental policies to reinforce significant community values, at least two significant limitations emerge from the analysis, as discussed below:

- There are no specific instructions for ways that policies could incorporate TEK into environmental management, planning and implementation, and
- It does not provide clear directives for use of local TEK in the preservation and protection of social structures, biodiversity and ecosystems, and overall environmental management.

Such an absence of directives to operationalize the principles around the use of TEK could lead to non-enforcement of TEK in policy ideas and statements, and lack of implementation of local TEK that promotes cultural, environmental and social wellbeing. This lack of legislative direction could also create challenges,

particularly in terms of ownership, and implementation of the Environment Act and policies for the benefit and protection of the people, their environment and resources. This suggests a need for reconsideration of various sections and clauses of the Act to provide specific directives for integration of TEK and practices of value to sustainable resource use and management.

The next subsection discusses the protected areas network policy.

8.2.2 Protected Areas Policy

Another legislative document that plays a significant role in environmental management is the Policy on Protected Areas which was recently published in 2014. Protected areas are a network of designated land and sea areas set aside for the protection of marine and terrestrial biodiversity as a collaborative effort by the State through the Conservation and Environment Protection Agency (CEPA), Provincial and Local Level Governments, traditional landowners and other stakeholders. Like other environmental legislation, the Protected Areas Policy had its foundations in the Fourth National Goal and the Environment Act 2000 in terms of safeguarding the environment and protecting natural resources. Other legislation that also supported this policy includes PNG Vision 2050, New Strategic Directions (2007) that provides for decentralisation of plans and strategies, National Strategy for Responsible Sustainable Development for PNG (2014), PNG Development Strategic Plan 2010-2030, Conservation Area Act (1978) and the Mid-Term Development Plan 2011-2015.

An analysis of the document indicates that the Policy was developed around the conceptual ideas of designing and managing the Protected Area Network; applying and managing ecologically designed principles and practices, and ensuring management systems that embrace traditional knowledge and practices. This can be seen in the Policy vision which states:

Our protected area network across land and sea safeguards our precious and outstanding natural and cultural heritage. Together we manage these areas effectively for all the people of Papua New Guinea. (Independent State of Papua New Guinea, 2014, p.17)

Inferences to natural and cultural heritage implies that the Policy recognises connections between people, their environment and culture as an integrated system whereby one could not exist without the other, a notion that was often discussed when attempting to establish the basis of environment and resource use and management in PNG and Melanesia (Banks, 2002, Filer, 2011). The purpose of the Policy vision was to “establish a network for and by people which was based on ecological design and management so it resulted in a fair and thoughtful management” (Independent State of Papua New Guinea, 2014, p.17). This statement emphasises the inclusion of people in the management process, an important value of TEK reiterated in previous chapters.

To ensure this purpose was achieved, the Policy is structured around five core pillars that describe its presumed outcomes, objectives and how each component of the policy is to be achieved. This also includes conflict resolution, an unpreventable issue when dealing with land and resource use in Papua New Guinea due to the customary land tenure system (Banks, 2008). The focus of Pillar 1 is on Protected Areas, Governance and Management, which intend to “deliver improved scope and support for volunteers, mentors and partners to work with governments and communities in Protected Area management” (Independent State of Papua New Guinea, 2014, p.28). Pillar 2, on the other hand, emphasises Sustainable Livelihoods for Communities in recognition of customary practices for enhancing and protecting the environment, strengthening traditional livelihoods, and nurturing support and enthusiasm of customary landowners for Protected Areas. This Pillar acknowledges the existence and significance of TEK as clearly stated in the following:

We recognise the importance of improved understanding of
Traditional Ecological Knowledge and sustainable cultural uses and
practices and the incorporation of this knowledge into Protected Area
planning and management. (ibid., p. 47)

The recognition given to TEK indicates that the Protected Area Policy does take into consideration, at least in principle, the existence of local knowledge that

traditional landowners already possess, which can be used jointly with other knowledge systems for environmental management.

Pillar 3 reinforces the need for Effective and Adaptive Biodiversity Management through ensuring appropriate management and monitoring policies, systems and tools are in place to support and maintain the value of Protected Areas network. Pillar 4 recognises the significance of Managing the Protected Area network for the benefit of the present and future generations. This is done by reinforcing the need to make the network *relevant* to PNG people, as well as being representative of different regions, *comprehensive* to protect biodiversity and ecosystems that adequately support life forms; and *resilient* to increasing environmental problems such as climate change (ibid.). For various aspects of this policy to function effectively, it would require financial support and Pillar 5 addresses this in highlighting the significance of Sustainable and Equitable Financing for Protected Areas. By having in place clearly outlined areas of priority and detailed financing strategies, the Policy seeks to ensure that sustainable funding options from within PNG and overseas may be secured for supporting and maintaining protected areas management.

The analysis also indicates that, while the Protected Areas Policy was developed to address threats to PNG's biodiversity from major environmental harm caused by resource development projects, and increasing population whose need for resources has also escalated, it clearly highlighted the need to incorporate familiar knowledge and practices into the five pillars. This is where the role of TEK becomes important because familiar knowledge is often associated with ancestral and traditional ecological knowledge. It may also be seen that Pillar 2 of the Protected Areas Policy provides very clear directives about use of TEK for sustainable environmental management. However, one limitation evident in this Pillar is the lack of reinforcement of the connections between TEK and natural resource management through education. Education and awareness are seen by stakeholders to be a vital part of sustainable resource management and can reinforce the vision and purpose of the Policy. Clear directives on how TEK may be incorporated through education to reinforce sustainable natural resource management would provide increased awareness that has the potential to ensure

continuity of resources. It would also increase the chances for present generations to become more knowledgeable about TEK and its practices to manage natural resources. Lack of such directives, on the other hand, can lead to inadequate emphasis on the implementation of TEK for natural resource education through defining linkages and providing policy directions to implement TEK for biodiversity conservation.

The discussions in this subsection indicate a strong emphasis on TEK in the Protected Areas Policy, particularly through Pillar 2 which reinforces the importance of the application of TEK in natural resource management. TEK was described in Chapter 7 to be a strategy for natural resource management, so clear directives in the Policy on how these could be implemented through education would ensure its continuity. It would also reinforce integration strategies for TEK in natural resource education.

The next subsection offers an examination of the national forest policy.

8.2.3 National Forest Policy

The National Forest Policy 1991 is another important piece of legislation associated with forest resources that can have a direct impact on indigenous communities in accordance with the Fourth National Goal. It was set up as an amendment to the Forest Policy 1979, and was to be used with the Forestry Act 1991. Amendments to the Forestry Act and Policy were prompted by the Barnett Inquiry Report (1989), as well as the World Bank Report (1990). The Barnett Report, in particular, highlighted a number of loopholes in the Forestry Industry in PNG including lack of policy directions and inconsistencies, as well as malpractices in the harvesting and exporting of timber resource (Barnett, 1989). The recommendations from the Barnett Commission directed a review of the forest policies which resulted in the development of the Forest Policy 1991 to address problems of abuse of landowners who were not able to negotiate for equitable settlements from logging companies within the forestry industry, unsustainable harvest of timber resources and increasing threats to PNG's forests caused by large scale extraction of gas, mineral and timber resources, as well as the growing human population. The conceptual ideas underpinning the Policy are

based on management and protection of PNG's forests as a renewable natural asset, which can be the basis for economic growth, employment creation and greater participation through use and management of the forest resources. This obviously implies an emphasis on the environmental and economic wellbeing of PNG as a country with little consideration for the cultural significance of forests and forest products and sustainable management of these, a concern also highlighted by the Report on the History of the Forestry Sector in PNG (Bird et al., 2007; Shearman et al., 2008) and the State of the Forest Study (Shearman et al., 2008).

An analysis of the National Forest Policy document highlights that it is categorised into seven parts, each highlighting a policy area and the strategies to address it. Part I of the Policy outlines the objectives of the policy with regard to forest management and economic development, while Part II addresses forest management issues, providing directives for resource ownership, forest classification, sustainable yield management, reforestation, the environment, and resource acquisition and controls. The management strategies describe various ways to ensure these are implemented, including: resource inventory, development of a National Forest Plan, diagrams of the planning process, feasibility study; acquisition, tenure and allocation of resources; timber permits and authorities, forest management controls, forest resources replacement, environmental management and community forestry. Despite the forest industry affecting the lives of ordinary Papua New Guineans with dependence on these resources, there is no acknowledgement of the local forest knowledge or management practices derived from TEK as a management strategy. Instead, any reference made to customary owners is to do with acknowledging and recognising their rights as forest resource owners, as indicated in Clause 1(a) which states:

The rights of the customary owners of a forest resource shall be fully recognised and respected in all transactions affecting the resource.
(Independent State of Papua New Guinea, 1991, p. 4)

And in Clause 1(c):

Priority must be given to the development and promotion of forms of ownership and organisation based on traditional percepts and appropriate to the particular aspects of customary ownerships in Papua New Guinea. Customary land registration procedures and the procedures under the Land Groups Incorporation Act (Chapter No, 147) shall be applied where available to establish clear title over resources on customary land.

(Independent State of Papua New Guinea, 1991, p.4)

While both Clauses 1 (a) and (c) acknowledge rights of customary owners of forest resources to be recognised in any form of development involving forests resources, this does not always happen. There have been cases of gross neglect both in terms of collective consultations between National Forest Authority and customary landowners, and implementation constraints associated with Land Group Incorporation and benefit sharing (Bird et al., 2007; Holzknecht & Golman, 2009). This clearly raises questions about how the forest industry intends to reinforce sustainable forest management without enabling customary owners to incorporate aspects of the traditional management practices associated with TEK.

Part III, on the other hand, focuses on the Forest Industry with specific mention of viability, participation, offshore processing, marketing and promotion, and revenue generation and distribution particularly to do with levy, royalty and tax payments. The strategies to achieve these are focused around viability, development priorities and resource allocation, participation and promotion of processing operations, small scale forest based industries and marketing the domestic market, and revenue generation and distribution. It is noted again that the emphasis of this section is on economic development and income generation aspects of the forestry industry with little or no reference to local people, their TEK and how the industry can enhance the relationship between communities, their culture and knowledge. In addition, Part IV of the policy provides directives that support PNG Forest Research Institute. The suggested strategies for those were to outline the role of the National Forest Research Institute, other research programmes and priorities to be undertaken, dissemination of research results and the function of the research advisory committee. An analysis of this indicates no

mention of incorporating research on local traditional ecological knowledge and practices associated with understanding and managing the forest resources.

Part V of the Policy describes the directions for training and education in the forest industry with a focus on human resource development within this sector. While there is a mention of making available information on forestry techniques to schools and other education institutions, there is no specific statement on how to educate communities on whose land forest resources are either harvested or planted. In addition, there is a lack of emphasis on education about connections between forest products as cultural resources for economic, environmental and social wellbeing, and on TEK as the forest knowledge base for communities to build on. Such gaps can lead to unsustainable forest management, mismanagement of forest products and less cooperation and participation from customary landowners, and need to be addressed by policy. Forest resources continue to be an integral part of many indigenous communities in PNG as they are the source of raw materials and resources for food, medicine, shelter, and other cultural purposes. The forest industry may need to inform these communities on the impact timber harvesting may have on their environment and what measures they can take to minimise these. The final Parts VI and VII of the Policy are concerned with administration of the forestry industry including functions and responsibilities of various boards, committees and institutions. There are no direct implications for local communities or the use of TEK.

In sum, the National Forest Policy, while intending to ensure management and protection of PNG's forest resources as a renewable natural asset to achieve economic growth and development, is focused on directives and strategies to ensure this becomes a reality without due consideration to the 80 per cent or more rural PNG population who depend on these resources for their own livelihoods. The following gaps may be seen from these actions:

- no acknowledgement of the local TEK on forest management practices in any directive or strategy,

- emphasis on economic development and income generation from forest industry and resources with little or no reference to local people and their TEK,
- no mention of incorporating research on local TEK and practices associated with understanding and managing the forest resources,
- no specific mention of how to educate customary resource owners management of forest resources, and
- lack of emphasis on education about connections between forest products as cultural resources for economic, environmental and social wellbeing, and TEK as the forest knowledge base for communities to build on.

Such gaps may lead to unsustainable forest management, mismanagement of forest products and less cooperation and participation from customary landowners. For forest management to be sustainable to meet present and future needs, there may be a need for Policy to acknowledge the existence of traditional local forest knowledge and practices, and the possibility of building on these to promote sustainable forest management.

This section on National Forest Policy indicates that while a policy is there to guide the operations of the Forest sector in PNG, there are gaps in the management and implementation plans on the directives for utilizing local TEK as the foundational forest knowledge for communities to build on. The Policy also lacks emphasis on education to connect the cultural, economic, environmental and social values of forests.

The next subsection provides an analysis of the Mining Policy Draft.

8.3 Mining Policy

The Papua New Guinea Mining Policy Draft 2012 was developed in consultation with the Mining Act 1992 and other related policies on exploration, operation, administration and regulation of the mining industry. Other pieces of legislation that were instrumental in setting up this Policy included the Organic Law on Provincial and Local Level Government, the Environment Act and its regulations,

Papua New Guinea Vision 2050, PNG Development Strategic Plan 2010-30 and PNG Medium Term Development Plan 2011-15. In addition, the Policy was drafted in response to the second and fourth National Goals and Directive Principles of PNG's Constitution of which the former reads:

We declare our second goal to be for all citizens to have an equal opportunity to participate in, and benefit from, the development of our country. (Independent State of Papua New Guinea, 1975, p. 1)

The Second Goal reinforced the notion of equality and participation for all citizens so that each person could be fully involved in the economic and social development of PNG, and consequently have the opportunity to prosper as the country progresses. The Policy highlighted this as the foundation for equitable distribution of resources and benefits from mineral development, a subject which was found to be a core principle of collectivist societies, yet it was an area of concern when dealing with benefit sharing from mineral revenue (Filer & Imbun, 2009; Oates, 2011). The focus of the Fourth Goal (see 8.2 above) was on significance of the environment and natural resources and the importance of the fauna, flora and the ecological systems that contain these. The mention of this Goal in the Policy signified the connection between people, the physical environment and other natural resources and the impact that destruction of one resource could have on others.

The Mining Policy Draft 2012 was set up to address unsustainable mining practices and unequal benefit sharing issues. The conceptual underpinnings of the Policy were based on the need to improve benefit sharing opportunities amongst all citizens and regulating sustainable development to improve better life and wellbeing of PNG citizens. To achieve these, the Policy aimed to “encourage investment in the mining sector; create opportunities for local participation in the benefit sharing for the State, landholders and for all Papua New Guineans, and regulate the mining activities so they were done in a social, economic and environmentally sustainable manner” (Department of Mineral Policy and Geohazards Management, 2012, p.1). These aims provided the framework for the Policy to be categorised into twenty-four short briefs for core policy areas that

addressed specific mineral development issues. These ranged from the purpose and guiding principles of the Policy to legal issues, agreements, ownership and exploration rights, training and employment, infrastructure development and project completion issues.

An analysis of the Policy content outlined some limitations in the light of sustainable economic development that utilised traditional ecological knowledge and practices as the foundation. One area of concern is the notion of ownership of minerals, as indicated in Part 7 on Mineral Ownership and Exploration Rights, particularly Clause 1(a) which reads:

All minerals on or below the surface of any land, waters lying over the land and the seas within PNG jurisdiction are the property of the State. The State has the sovereign right to allow “suitable persons” to explore for, mine and sell the mineral resource. (Department of Mineral Policy and Geohazards Management, 2012, p. 7)

This is also seen in Clause 2(a) of Part 8 on Fiscal Provisions, which states:

All mineral royalties from mining in the PNG jurisdictions belong to the State as the sovereign owner of all minerals in PNG. (ibid)

Both Clauses above define ownership of all mineral resources and the payments received from these as belonging to the State. This notion of ownership by the State tended to contradict the traditional values of communal ownership by related kinship groups, where “land is traditionally owned collectively by the clan” (Oates, 2011, p. 2). Ignorance of this value had been known to cause many tensions between customary landowners and the State. For example, in the case of the conflict at Panguna Copper Mine in Bougainville between 1988 and 1998, which developed into a fully-fledged civil unrest, the State was seen to be overriding the decisions on the benefit sharing associated with the mine, and other Papua New Guineans were seen to have benefited more from it than the customary landowners who were missing out (Oates, 2011; Semos & King, 1999).

Another area of concern is found in Clauses (1), (2) and (3) of Part 22 on Community Awareness and Consultation. These Clauses are targeted at the developer's effort to collaborate with the State and other community based organisations to disseminate relevant information and conduct awareness programmes on the mining projects. For example, Clause (1) states:

The developer in consultation with the State shall conduct periodic social, economic and environmental awareness programs in the mining project area during the lifecycle of the project. (Department of Mineral Policy and Geohazards Management, 2012, p. 14)

While this Clause is concerned with community awareness, it is for the benefit of the developer, not the local people. The absence of local knowledge and practices, including TEK, in this and Clauses (2) and (3) demonstrate that the focus is on the developers' concerns and expectations, with the collaboration of the State. It is not favourable for the community, which is wholly absent as a key stakeholder in any program for social, economic and environmental awareness.

The third area of concern in regards to this Policy concerns the processes to undertake social mapping and identify landholders as specified in Part 24 Clause 1, which states:

The developer and the State shall carry out social mapping and landholder identification study at the exploration phase of the project in accordance with internationally recognised guidelines (ibid., p.15)

It may be seen from this Clause that social mapping and landholder identification is expected to be approached using guidelines that may not be familiar within a local context. According to Filer and Imbun (2009), the decision on who is a landowner is decided by the Minister as mandated by the Oil and Gas Act (1998) and identified by the social mapping process. This process has had its own challenges resulting in disputes and court cases because "traditional Melanesian owners still view that which is in their ground as being still theirs to own" (Oates, 2011, p. 2). To address this, it would require the Clause to be revised to recognise

and include locally relevant techniques associated with indigenous and traditional knowledge as an initial approach, which are later verified with appropriate international guidelines. Resource access, distribution and ownership are communal responsibilities, and the shift to having only one owner (the State) has become a sensitive issue. Such a shift reflects a continuation of practices instituted under colonialism, where the colonial state appropriated all resources for its own profit, destroying in the process centuries-old communal/clan ownership norms and practices. As has been evident elsewhere in the newly independent states of the Third World, the state in Papua New Guinea too has continued such colonial practices, resulting in on-going conflict with local communities over unfair resource extraction. This remains a critical policy challenge to develop approaches to address the gap between traditional and Western governance, decision making and benefit sharing systems.

This subsection has highlighted three areas of concern that would need to be addressed by policy. These include debates on ownership of mineral resources, the control by private developers of awareness programmes directed at local communities affected by mining projects, and integration of locally relevant techniques based on indigenous and traditional knowledge into the process of social mapping and landholder identification.

The next subsection provides an analysis of the national education curriculum statement.

8.4 National Education Curriculum Statement

The legislative documents guiding National Education in Papua New Guinea range from the Education Act to specific policies such as National Assessment and Reporting Policy to various Education Plans and Reports. In the context of this study, the policy document of relevance is the National Curriculum Statement 2003 which provides a framework outlining “what was educationally valuable for all students from Elementary Prep to Grade 12 in the national education schools’ system” (National Department of Education, 2003, p. 1). The Statement was developed in response to the Ministerial Committee Report 1986 which reinforced the values of integral human development, as emphasised by the National

Constitution. Other legislative documents that also provide the background for this Statement are the Education Act 1983 and the National Education Plan 1995-2004. The purpose of the Statement is to guide the development of a reformed curriculum that recognised the limitations of a Western-based education system to provide useful education for all citizens. This system could equip students with community survival skills which could enable them to go back to living in the rural communities, instead of creating more school leavers who contribute to increasing unemployment and other social issues. The Statement sets out directives for all curriculum materials developed within the education reform process which began in early 2000. It is structured around six main sections addressing the rationale, goals, aims, curriculum principles and overview, and the assessment and reporting processes.

An analysis of the Statement indicates that its Rationale in Section 2 is very well grounded on the five National Goals aimed at producing a curriculum that achieves “consistent and stable education for all, be reflective of cultural values and respect and is oriented towards meeting national and local community needs” (National Department of Education, 2003, p. 3). The Statement also recognises the need for this curriculum to “build on traditional knowledge, values and attitudes in order to support the development of relevant knowledge, skills and attitudes, and promote and encourage sustainable use of natural resources” (ibid., p. 4). Expectations of the National Curriculum Statement favour TEK for natural resource management as there is space for it to be incorporated into the education curriculum for implementation if needed. In addition, the Statement Goals in Section 3 reinforce the Constitutional values and support the view that the national curriculum should guide students to further appreciate their environment and rich cultural diversity so they could develop pride in their own cultures and those of others (ibid.). Curriculum directives also encourage students to develop national identity and pride through acquisition of knowledge, skills and attitudes of community importance that reinforce respect and appreciation for people, natural and physical environment, culture and life, and their protection. Without any direct mention of TEK, the emphasis on environment and culture already provides a space for TEK values to be incorporated into the teaching and learning process directed at helping students develop an appreciation and recognition of

their cultural and natural heritage. As projected above, a curriculum founded on local values of significance, culture and language is viewed as directed towards education for continued lifelong learning, a notion that was also highlighted in the findings of the previous three chapters on TEK and can be reinforced through the school system.

The Statement Aims in Section 4 reiterate the rationale and values of the goals in the previous sections and outline the aims of each of the levels of education in the National School System in PNG. For example, one of the aims of the Elementary Level for students aged 6-8 years is to develop a community-based curriculum that involves the community through inviting local people as resource personnel or using it as a place for students to continue developing their understanding of local traditional knowledge and practices. Another aim is to enable students to continue building on their lifelong skills for effective communication as well as the social, spiritual and resource development, and at the same time prepare them to continue to Primary School. The examples given above demonstrate the desire for the elementary curriculum to encourage community ownership and participation, and provide a potential space to reinforce TEK values for natural resource management.

The Statement on Primary Curriculum for students aged 9-14 years is aimed at maintaining some aspects of the community and local connections through reinforcing cultural values and encouraging development of interpersonal and lifelong skills. This Curriculum is also aimed at introducing specialised subjects and developing knowledge, skills and attitudes in these areas. On the other hand, the Secondary School curriculum for students aged 15-18 years focuses on enhancing specialised subject areas and improving interpersonal skills in young people. Applicable lifelong skills are also a focus of this curriculum as it is intended to empower students with the ability to use these skills in real life. In the context of communities, lifelong skills are associated with survival skills, particularly those required for accessing food and other resources and these are skills used in TEK. This implies that this is another avenue where TEK can be incorporated into the secondary school curriculum.

Curriculum Principles outlined in Section 5 are based on cultural, social and educational values and beliefs that promote bilingual education, citizenship, law and order, and lifelong learning. These beliefs and values emphasise principles of the PNG Way which reinforce the traditional way of life, diverse cultures, languages and environment, and use of bilingual education. They also emphasises Integral Human Development through various facilitation processes that encourage rights to healthy living, nation building, and the roles and responsibilities of citizens to achieve sustainability through equal participation in catering for people with different needs. The third emphasis is on Teaching and Learning processes through an inclusive curriculum to meet the needs of different learning abilities of students, which are not only relevant but also student centred. In addition, they also emphasise the need to develop and maintain lifelong skills throughout an individual's lifetime. The beliefs and values of the Curriculum clearly encourage dissemination and promotion of various aspects of traditional knowledge and practices such as TEK.

The Curriculum Overview in Section 6 outlines various subjects and learning areas to be taught from elementary to primary and secondary education in PNG. There are five core learning areas that each of the subjects from Elementary to Upper Secondary are categorised as - Culture and Community, Language, Mathematics, Personal Development and Science. The learning area that reinforces the PNG way and may be most appropriate for TEK is Culture and Community as noted in the following statement:

This learning area reflects and will support the development of Papua New Guinea's unique national identity, the important place its many cultures and communities have in daily life and in nation building. A study of the subjects in this learning area will enable students to appreciate and understand Papua New Guinea's values, cultures, traditions, and provide students with many practical skills. (ibid., p. 23)

Acknowledging PNG's traditional knowledge, culture and identity in the Curriculum Statement indicates that there is a space for significant locally

relevant topics and issues to be incorporated into the curriculum. An example of a locally relevant but significant effort of this was reported by Tiu and Mirisa (2014) on a bio-culture project in Papua New Guinea, where primary school children were taught culturally-relevant skills of construction, weaving and painting by local instructors to complement the Culture and Community learning area. This can also be seen from the directives for the Elementary Curriculum in Section 4 that support the notion of community curriculum and allow flexibility for learning applicable locally-relevant knowledge and skills. While there is no direct mention of TEK in the Curriculum Statement Overview, there are very clear references implying its applicability. One of the limitations of the Statement is that those implementing the curriculum, particularly teachers and educators, can overlook the teaching of TEK for natural resource management. This indicates the need for clearer directives for teachers and educators to ensure topics of value and relevance such as TEK are taught. It should also require increased collaboration from different State agencies involved in natural resources and education to ensure TEK for natural resource management is reinforced through the curriculum. In addition, the elementary curriculum in particular, reinforces the notion of community involvement in the children's learning as compared to primary and secondary levels. This provides opportunities for teachers to involve community members to participate in teaching or instructing the children on specific topics, and natural resource management using TEK could be one possibility.

The final Section 7 of the Statement specifically provides directions for Assessment and Reporting. A core directive of this section is that assessment and reporting has to be culturally appropriate and balanced and should use a variety of ways to gather evidence about students' learning. There is "a great deal of attention on students' academic abilities in the national system of assessment with little focus on the other attributes that also needed to be considered, developed, enhanced and included in the assessment process" (Mel, 2007, p. 227). These attributes could infer those that are of personal, community and national benefit as it may enable a student to be assessed on the basis of their practical interactions and competencies, an area TEK practices would complement. The section also emphasises the importance of parents and community involvement in the

assessment process, a factor also identified as significant in TEK education as indicated in the findings of Chapter 6.

The National Curriculum Statement is guided by the Ministerial Committee Report and the National Goals and Directive Principles of PNG's Constitution. An analysis of this document reveals that the Statement intends the curriculum to:

- be consistent, stable, and reflective of cultural values and principles built on traditional knowledge, values and attitudes;
- support the development of relevant knowledge, skills and attitudes that promote and encourage sustainable use of natural resources;
- guide students to further appreciate their environment and rich cultural diversity so they could develop pride in their own cultures and those of others;
- be a community curriculum to maintain students' interest in community values, beliefs and practices while introducing specialised subjects for academic achievement;
- improve interpersonal and lifelong skills based on cultural and social values and beliefs that promote bilingual education, citizenship, law and order, and lifelong learning; and
- have an assessment and reporting system that is culturally appropriate and balanced.

Although these expectations do not make a direct mention of TEK, the references make clear the possibility and flexibility for TEK to be incorporated into the curriculum. For this to happen there is a need for clear directives to be provided to teachers and educators on the teaching and learning of TEK for natural resource management.

8.5 Chapter summary

This chapter discussed the findings of the document analysis of five pieces of legislation associated with natural resources management. It explored the legislation to establish the absence or presence of traditional ecological knowledge and practices to find out if there were any gaps to be addressed. The

key findings of this analysis indicated that legislation on natural resources was founded on the Fourth National Goal of PNG's Constitution. This was also fundamental in the development of the Environment Act, Protected Areas Policy, National Forest Policy and the Mining Policy Draft. The fourth Goal encouraged implementation of traditional knowledge, cultural practices and sustainability values in natural resource Acts and policies. Other findings discussed were as follows.

The Environment Act reinforces laws and responsibilities for environmental protection and preservation. It was found to lack clear directives on how policies could incorporate TEK into environmental management, planning and implementation. It was also unclear on how to apply local TEK in the preservation and protection of social structures, biodiversity and ecosystems. There appears to be a need to ensure sections and Clauses in the Act provide specific directives for integration of traditional ecological knowledge and practices for sustainable natural resource management.

The Protected Areas Policy makes very clear references to the application of TEK in natural resource management. The Policy's directives for integration of TEK into education and awareness for natural resource management are not very clear. This could imply that policy directives are needed to come up with suggested strategies for implementing TEK through education for continuity and reinforcement in natural resource management.

The National Forest Policy supports management and protection of PNG's forest resources as a renewable natural asset. It acknowledges the existence of customary landowners and their rights to resources but fails to acknowledge existence of local forest knowledge used to access these resources. Policy directives would need to clearly demonstrate linkages between local TEK and sustainable forest management, incorporate research on local TEK practices associated with understanding and managing the forest resources, and develop strategies for education and awareness for customary resource owners about forest products.

The Mining Policy was found to reinforce the goals of economic growth through employment creation and benefit sharing. The Policy focused on equality and participation but overlooked issues pertaining to ownership of mineral resources, community based awareness and education programmes, and application of locally relevant baseline techniques using indigenous knowledge for social mapping and landholder identification. The Policy would need to develop strategies to address concerns about collective resource ownership, and reinforce TEK values.

The National Curriculum Statement encourages culturally-relevant and inclusive education that embraces traditional knowledge, values and attitudes. These were found to emphasise use of students' prior cultural and local knowledge, development of interpersonal and lifelong skills, and students' positive attitudes towards sustainable use and management of natural resources. It also encourages community curriculum at the elementary level as essential for maintaining students' community values, beliefs and practices. There was no direct mention of TEK, although references to other aspects of traditional knowledge and culture were implied. There is a need for clear policy directives to direct teaching and learning of TEK for natural resource management in the curriculum.

In sum, the Fourth National Goal of PNG's Constitution recognised the value of traditional knowledge and practices in achieving sustainable natural resource management. Reinforcement of this goal in natural resources and environmental legislations would be an indication of the State's commitment to safeguard the environment and natural resources for the benefit of the present and future generations. Ensuring reinforcement of these values in the pieces of natural resources legislation is crucial as it requires clear directives in the Acts and Policies.

The next chapter provides discussion of the findings, and makes conclusions and recommendations from this study.

Chapter Nine

Discussion and Conclusion

9.1 Chapter Overview

This final chapter presents the discussions of the findings, conclusions, implications and recommendations for further research. The chapter draws from the responses of the findings discussed in Chapters 5, 6 and 7. These discussions were also informed by natural resource and education policies analysed in Chapter 8 and the literature.

The findings highlighted broad themes on the perceptions of TEK, sustainable natural resource management, and the role of education and policy in achieving this. Discussions of the findings are presented in three sections according to the main research questions. Each of these is answered in detail in the subsequent sections. The questions are:

1. What are Papua New Guineans perceptions of the relationship between traditional ecological knowledge and sustainability?
2. What are Papua New Guineans' perceptions of the role that education and policy can play in the use of TEK in sustainable resource management?
3. To what extent do existing policies related to sustainable resource management include an emphasis on TEK in PNG?

9.2 What are Papua New Guineans' perceptions of a relationship between TEK and sustainability?

This question explored whether Papua New Guineans perceive if there existed a relationship between TEK and the western concept of sustainability, and if they do, what aspects of TEK they perceive as related to sustainability. It was also intended to consider ways that these relationships could be understood, maintained and developed. The findings related to this question were gathered mainly from the stakeholder interviews in phase one of my field work.

The participants' responses showed the term sustainability to not be easily defined in words, and that equivalent terms were not easy to find in the participants' local languages, but that the general ideas of sustainability were demonstrated through the application of TEK practices, as discussed in Chapter 5. This suggests that sustainability as a concept is a complex term created within a Western perspective that focuses on components of a whole that often alters or weakens their meaning. As Hall (2008) pointed out, "the English language tends to cut into segment parts of a whole, making sustainability from this perspective too small a term" (p. 100). Based on the findings, sustainability from an indigenous Papua New Guinean perspective is a way of life and comprised TEK practices and beliefs that guided and directed their way of life. These TEK practices reinforced human dependency on other environmental components, limitations on environmental resources, concerns for future generations and equitable access to resources, ideas that are connected to the Brundtland Commission Report (WCED, 1987) and other literature on sustainability (see, for example, O'Riordan, 1988; Power, 2011; Rao, 2000; Seghezze, 2009; Vos, 2007). The findings then portrayed sustainability in an indigenous context through TEK practices of holism, collaboration and access to resources. These are discussed as follows.

9.2.1 Perceptions of Holism

The findings indicate that TEK reinforces holistic connections. Connections between TEK users and their place in the environment were found to be holistic. This emphasis on holism which was also noted in TEK and ecology literature (see, for example, Berkes & Berkes, 2009; Dudgeon & Berkes, 2003; Oshry, 2008) had its own implications. For instance, holism is about parts of a whole system working in unity towards the function of that whole (Smuts, 1936). Understanding how that whole functions provides an understanding of the complexities of one's ecosystems (Berkes & Berkes, 2009) and the "general patterns of relationship between societies and their ecological circumstances" (Dudgeon & Berkes, 2003, p.80). The findings also showed that participants saw the environment and natural resources as parts of a whole system that is inclusive of humans and their places. This holistic connection to one's place (McGavin, 2016) enables a deeper understanding of interdependence between humans and non-human entities within their ecosystems. This perspective of reinforcing

importance of non-human entities may not sit well within the Western oriented views of sustainability, where human needs to achieve economic wellbeing often override the needs of other non-humans. A decline in environmental and communal wellbeing implies loss of understanding of, and connections that one has with, the land and the broader environment. The findings indicated that this loss was associated with minimal use of holistic knowledge and practices.

TEK comprises various knowledge systems, each operating interdependently with others. The findings portrayed TEK as consisting of several systems of knowledge as discussed in Chapter 5. Each of these knowledge types was found to have a specific function such as family or forest knowledge (Tiu, 2007), yet all were targeted at achieving human and environmental wellbeing. In both circumstances, these knowledges are linked to a 'place' and establishing one's connections to this place reinforces one's rights to access resources (Eaton, 1997; Hviding, 2003; McGavin, 2016). These rights are associated with one's responsibilities as guardians and protectors of tribal resources, a notion similar to the New Zealand Māori concept of Kaitiakitanga or guardianship (Miller, 2014). This has connotations for sustainable natural resource management, and defines those "with rights to ancestral lands and [who] are recognised as having special knowledge for managing resources within that land" (Morad & Jay, 2000, p. 201).

The decline in the use of these knowledges and practices could impact on the general wellbeing of the environment. The findings indicated concerns about the decline in the application of these knowledges and practices and the impact this could have on the environment. These concerns are also associated with increased resource extraction (Macintyre & Foale, 2007), emphasising the cash economy that triggers loss of TEK values and practices. In this thinking, ensuring a healthy environment is not just a need but also an inherited right of the local people. Thus the loss of ability to protect the environment for the benefit of the present and future generations becomes an issue of social justice.

TEK connects the understanding of physical environmental conditions with resource availability. The findings highlighted this knowledge as crucial for planning collective activities, as well as being applied in land use plans, a strategy

for contemporary resource management (Stevens, 1997). This knowledge acted as a control measure for harvest when used to determine abundance or scarcity of a particular species. TEK was also described as a living and dynamic knowledge that is able to “adapt to changes and incorporate contemporary information and technology, including other forms of knowledge” (Menzies & Butler, 2006, p. 7) to ensure continuity. Continuity in this sense is a matter of survival; hence any decline of these knowledges and practices becomes a concern for both human and environmental wellbeing, reinforcing again how this impacts on social justice, and on environmental justice between species.

Based on the findings, holism in TEK is about possessing a deeper understanding of the ecological functions and interactions at play in the environment, recognising the mechanisms that entitle rights to resource access and utilising a variety of knowledge types to access resources. Holism in TEK is about survival and reconnection to a sustainable livelihood.

These holistic perceptions of TEK are reinforced by collaborative practices as discussed next.

9.2.2 Perceptions of Collaboration

Collaboration is about coming together and supporting one another to ensure every kin member has access to resources. The findings implied that TEK practices were already reinforcing collaborative efforts such as clan-based natural resource management practices to control resource use and access. These practices utilised clan boundaries to control resource use and ensured common resources were carefully harvested. The notion of collective or common resources is associated with traditional resource management systems of indigenous and tribal communities of the world and is part of the communities’ common property resources (Berkes, 1989a; Ostrom, 1990). Such collaborative efforts were found to be guided by the TEK values of respect, responsibility and reciprocity. Respect for others and the environment meant being responsible for maintaining a sound relationship with all. The value of reciprocity is demonstrated in the actual act of caring which is reciprocated when the environment continues to provide resources and people care for each other and their environment in different ways.

Collaboration between TEK users in the harvesting and sharing of resources ensured continuity of access by all kin members. This was noted by Berkes (1989b) as “cooperation among the users of a resource towards sustainable management” (p. 84). However, concerns about lack of proper consultation involving traditional landowners by resource developers were expressed by both corporate and community participants in Chapter 5. Lack of meaningful consultation leads to lack of participation by traditional resource owners which results in resource companies having more say, while local people’s voices are less heard. This is a case of an unequal power relationship (Freire, 1996) which in turn affects local people’s decision-making abilities (Geuss, 1981) and may lead to an unjust society.

Imported individualistic ideas and practices promoting individual needs were found to threaten collaborative practices. Individualism, especially when it comes at the expense of the collective good, is a value and practice that does not sit well within the indigenous worldview where every kin member has the right to access resources. The inability of any member to access resources freely is a case of injustice and needs to be re-addressed.

Based on the findings, collaboration in kin groups is about controlling and accessing resources. Exercising of resource control is an approach practiced by indigenous communities to ensure continuity. Continuity in return ensures availability of resources that can be accessed within kin groups. The implication is that collaboration reinforces environmental and social wellbeing among kin groups, and that ensuring access to resources, is a collaborative effort. Other aspects of TEK promoting access to resources are discussed next.

9.2.3 Perceptions of Access

Access to resources was a core need for all kin groups yet accessing these resources was found to be meeting the community’s different needs. The findings emphasised that communities accessed resources to meet the cultural, social and physical needs. Both cultural and social needs are associated with Maslow’s needs for belongingness, while physical needs is linked to Maslow’s physiological

(survival) needs (Koltko-Rivera, 2006). The findings showed that TEK enabled communities to access resources to meet these needs through the social act of exchanging and sharing of surplus and culturally -valuable resources which continued throughout generations. These actions were promoted through reciprocal relationship building and strengthening. The value of these reciprocal relationships could be seen in various indigenous practices as described in Chapter 5 and the literature on anthropological studies of PNG tribal groups (see for example Healey, 1985; Kuehling, 2005; Poser, 2013; Sillitoe, 1993).

9.2.3.1 Access as a Cultural need

Accessing resources of cultural value was a community need for belongingness. The findings showed that access to culturally-valuable resources was achieved in two ways. Firstly, sharing of seasonal and surplus resources ensured all kin groups had access as discussed in Chapter 5. Secondly, the act of giving and receiving of resources in the exchange process reinforced cultural values of respect, responsibility and reciprocity. This created long term mutual reciprocal bonds and friendship built on a “shared sense of responsibility” (Stewart & Allan, 2012, p. 3). Such reciprocal relationship building is a common practice in many parts of contemporary PNG (Sillitoe, 1998).

The practice of accessing culturally-significant resources through exchange has decreased. The findings indicated two reasons for this declining practice. Firstly, the cash economy is encouraging selling of seasonal and surplus resources instead of sharing between kin members. Secondly, a focus on meeting individual and immediate family needs has increased over the collective needs of extended kin members and community. The findings also indicated that decline in this practice would lead to decline in the accessibility of much needed resources resulting in some groups and individuals having more resources than others. Such situations become a concern for inequality as an unequal society is an unjust society, which works against achieving a sustainable society.

9.2.3.2 Access as a Social need

Access to resources is a social need. The findings showed that indigenous Papua New Guineans accessed resources collectively and ensured their kin members also had access to these resources. This collective act is a social need for affiliation which is described by Maslow as a need for belongingness (Koltko-Rivera, 2006). The Papua New Guinean context is reinforced by tribal affiliations (Banks, 2008; Macintyre & Foale, 2007; Oates, 2011) through genealogical inheritance. This also enables access to tribal resources and enhances social wellbeing

Social need for access to resources is threatened by the focus on economic development. The findings indicated that despite resource developers having in place corporate social responsibility (CSR) guidelines (Weiss, 1989) , they were designed to achieve economic development more so than community social needs. The findings suggest the need for CSR guidelines to capture social needs holistically as social needs meet other deeper needs associated with physical and spiritual wellbeing and connections.

Balancing economic development with social needs of indigenous communities is crucial to achieve a sustainable society. The findings indicated inadequate consultation by resource developers with local people. This results in less local voices being heard and a decline in their participation. Such situations become a concern for inequality and power imbalance (Freire, 1996) as developers continue to have the upper hand.

9.2.3.3 Access as a Physical need

Access to resources is a physical need for survival. The findings indicated that recognition of human dependency on their environment, and limitations of natural resources evoked concerns for accessibility and availability of food and other resources. This recognition that resources have limitations also meant that measures were taken to ensure continuity. The findings showed application of traditional resource management strategies (Berkes, 1989a; Foale, 1998) as crucial for equitable resource access for all as these were founded on the values of respect, responsibility and reciprocity.

Views about access to resources for physical needs were held strongly by those from remote rural communities. The findings indicated that rural communities, such as the focus group in this study, expressed great concern for declining practices of accessing physical resources. Dependence on the environment for accessing food and other resources is found to be associated with the isolation of these communities from the outside pressures and where the environment is the only place to access the much needed resources. Declining practices of traditional resource management in non-rural communities was a concern also expressed by participants. Dependence on imported goods causes loss of their own ability to access resources and leads to the loss of human values of respect, responsibility and reciprocity. This could also lead to issues of social disintegration when those without sufficient resources are forced to use other means to access them, thus becoming a concern for social justice.

9.2.4 Significance

The findings illustrated a strong connection between sustainability and TEK. TEK is a way of life that uses holistic approaches to maintain connection to land and resources and reinforces sustainability. TEK ensures resources are accessible to meet social, cultural and physical human needs and this is achieved through collaboration using the principles of respect, responsibility and reciprocity. This emphasis of sustainability through TEK values and practices is aimed at ensuring access to resources and needs to be reinforced among its users. Empowering communities through reinforcing these TEK values would enable them to recognise its significance and strengthen their ability to practice these values and principles of living in the environment. This contributes to sustainability through transforming their way of thinking and empowering them to participate in decision making about the use of their natural resources.

In answering question one, the perceptions of a relationship between TEK and sustainability is that sustainability is embedded in every social and environmental aspect of TEK.

The next section discusses the findings of the second research question.

9.3 What are Papua New Guineans' perceptions of the role that education and policy can play in the use of TEK in sustainable resource management?

This question intended to explore the role of education in the use of TEK in sustainable natural resource management and ways in which this could be reinforced. The findings related to this question were gathered from the stakeholder interviews during phase one of my field work. Based on the interviews, responses from the participants highlighted education as vital for ensuring continuity and understanding of sustainable values embedded in TEK, a notion that reinforces education as a strategy for understanding, issues of acceptance and wellbeing (Baker et al., 2004). Participants' responses implied that education was a process of disseminating and receiving instructions in a number of ways, and "the cultivation of hopeful environments and relationships for learning" (Smith, 2015, p.3). This reinforces TEK values and practices that promote sustainability.

The findings reiterated education as a medium through which TEK principles promoting sustainability are reinforced. TEK in the indigenous Papua New Guinean context has been a way of life, and teaching and learning about TEK principles was one way through which education about life (and sustainability) was reinforced. The findings also showed that for continuity to be maintained, flexible approaches drawn from familiar indigenous education practices discussed in Chapter 6 would be required to facilitate changes taking place and at the same time, uphold valuable knowledge and practices promoting TEK for sustainability. Two roles of education described by participants that could ensure these happened were education as empowerment and education as reflective learning. These are discussed below.

9.3.1 Education as Empowerment

Education is empowering. The findings described one role of education as a medium through which teaching and learning about TEK values of respect, responsibility and reciprocity could be enhanced. These TEK values reinforce interconnectedness (Morse, 2010; Paehkle, 2012) exhibited by both the natural and physical environment as well as the concerns for future generations (WCED,

1987) and the need to ensure resources are managed for the good of these generations. The findings indicated reinforcement of these core values through education as empowering, particularly for youth as it equips them with critical thinking skills, planning and decision making skills, and respectful and responsible behaviour (Tilbury & Wortman, 2008).

TEK values can be reinforced through both formal curriculum and non-formal community education. The findings indicated that current education practices, including the curriculum, have a lack of emphasis on the teaching and learning about TEK. Thus aspects of TEK values need to be integrated into both formal curriculum and non-formal community education.

TEK values can be disseminated using indigenous education approaches. The findings deliberated on the vital role of education in utilising locally relevant methods of dissemination associated with indigenous education approaches discussed in Chapters 5 and 6. Familiar indigenous approaches are significant to local people as these encourage flexibility and spontaneity (Jeffs & Smith, 2011) and create a conducive learning environment for interaction. In addition, documentation of TEK values for teaching and learning in formal and community education was also viewed as vital because the loss of TEK was increasing. The findings indicated that as people get older and pass on in life, some of them do not impart their TEK. Similarly, some TEK is sacred and protectors of this knowledge do not pass it onto people who are not anointed into that sacred knowledge or system (McCarter & Gavin, 2011). This challenges the process of learning TEK formally as it requires young people to understudy elders or spend more time with them (Reta, 2010). In addition, learning sacred TEK requires one to be initiated into the sacred society or knowledge protectors' group to be deemed eligible. Both of these cases indicate the need for teachers of TEK to have acquired TEK either through being taught by an elder or being initiated into a sacred knowledge society. The findings also indicated that such challenge could be addressed through a collaborated effort from teachers and elders in the community using an integrated approach. This would ensure TEK values for sustainability are taught through non-formal community education programmes and the formal school curriculum for impacting on natural resource management.

Education can change people's values and understanding of the environment. The findings indicated that people's values and understanding about the environment could be changed by empowering them through education. As a catalyst for change, education could foster respectful and responsible behaviour and influence positive environmental attitudes particularly among the youth (Tilbury & Wortman, 2008), a generation that was seen to be more at a loss without their traditional knowledge and practices. Change in this context is about recognising the importance of local knowledge and practices and taking measures to ensure it continues to be maintained.

Integration of TEK into formal curriculum is challenging. Teaching and learning about TEK is quite informal in nature and poses a challenge for formal curriculum which is generally quite structured in its content and delivery approaches. Ensuring appropriate teaching and learning strategies discussed in Chapter 6 were incorporated into the formal curriculum would enhance the dissemination of TEK. In addition, integration of TEK into the non-formal community education programmes require use of appropriate or familiar languages. This could be addressed through ensuring the teacher/instructor is able to communicate in the local dialect or Pidgin.

In sum, education is seen to empower TEK usage through dissemination of TEK values either through teaching approaches or materials. Education is also perceived as having the ability to change people's understanding of the environment through teaching and learning of TEK values.

9.3.2 Education as Reflective Learning

Education is a reflective process. Another role of education was viewed as a reflective process that enables TEK users to learn from the past to develop plans and strategies to move forward into the future. Reflective learning strategies enable communities to learn about sustainable beliefs, values and practices of TEK that are applicable for achieving sustainable livelihoods, an outcome seen in community education as crucial (Tilbury & Wortman, 2008). Using reflective thoughts founded on TEK beliefs was seen as important as they develop into conscious reflections of nature and implications for useful practices (Dewey, 1910)

that result in reflective actions (Smyth, 1989). Fien and Rawling (1996) added that reflecting on these actions enables a person to “combine theory and practice or knowing and doing to understand the reasons for their actions” (p. 14) so that they can take measures to address immediate problems. The role of education as a reflective process is crucial for continuity of sustainable TEK values and practices.

The process of reflective learning is an enlightening process for those who use TEK as their confidence in the application of TEK in natural resource management alongside scientific knowledge increases. Such a process is described by Geuss (1981) as the stage of self-reflection and enlightenment, whereby a realisation of the importance of TEK is acknowledged, leading to an explicit understanding and acceptance of TEK as a strategy for contemporary natural resource management in PNG (see Figure 9.1). Emphasis on these in the formal education curriculum would also reinforce the significance of these TEK values among the younger generation and build their confidence to accept and apply these in their lives.

One of the challenges indicated in the findings is that the application of TEK in contemporary PNG is decreasing as the present generation continues to be alienated from the use of their traditional knowledge and practices. This has led to loss of useful sustainable knowledge. The findings implied that education as a reflective learning process would enable such people to critically reflect on their actions to ensure values of significance are reinforced and embraced to achieve the goal of sustainable livelihoods.

9.3.3 Significance

TEK has a crucial role in education about sustainable resource management. Through empowerment using reflective learning processes, significant TEK values of respect, responsibility and reciprocity can be reinforced. Using self-reflection processes, TEK users come to recognise the value of TEK principles in sustainable resource management. Reinforcement of these values through education could keep TEK alive and strengthen sustainable resource management practices to achieve a sustainable society (Refer to Figure 9.1 for a summary of this).

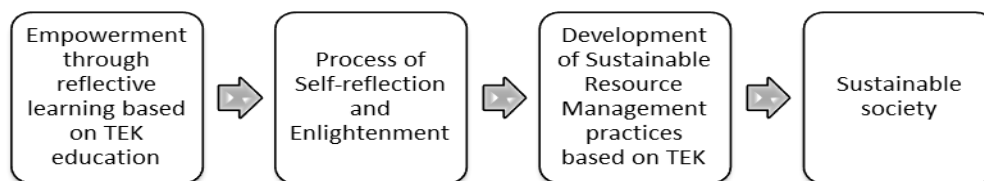


Figure 9.1 Sustainable society model through education

In answering question two, education can engage and involve TEK users and learners to reflect on their beliefs and practices, develop positive attitudes and approaches towards sustainable resource management and keep TEK knowledge alive.

The next section discusses the findings of the third research question.

9.4 To what extent do existing policies related to sustainable resource management include an emphasis on TEK in PNG?

This question intended to explore the extent to which existing policies related to sustainable resource management emphasise TEK. The findings related to this question were gathered during the interviews and feedback workshop in the field work in both phases one and two and are discussed partly in Chapter 6 and in Chapter 7. These findings were also informed by the analysis of various natural resource and education policies presented in Chapter 8. Based on these information, policies were viewed as having a significant role in strengthening the integration of TEK values of sustainability in both formal and community education. The workshop feedback also supported the view that TEK is an important strategy for natural resource management and needs to be reinforced by policy through education. The analysis of Chapter 8 indicated the absence of TEK principles in some of the core policies and needed to be addressed.

For policy to be developed using TEK for sustainable natural resource management, the findings indicated that it needed to firstly, be incorporated into natural resource management strategies and practices, and secondly, be integrated

with formal school curriculum and non-formal natural resource education and awareness programmes. These are discussed below.

9.4.1 TEK for Natural Resource Policy

The findings indicated that core TEK values emphasising sustainable natural resource management are useful for policy development. This includes values concerned with environmental sustainability and embraces respect, responsibility and reciprocal relationship building essential for resource access. An analysis of natural resource policy documents indicated that the Environment Act 2000, National Forest Policy 1991 and Mining Policy 2012 clearly lack any emphasis on TEK or the role of TEK in natural resource management, while the Protected Area Policy 2014 does acknowledge the existence of TEK and clearly deliberate on its role in natural resource management. The gaps in some of these policy documents, and the recognition of local people as important stakeholders in the management of biodiversity (Mauro & Preston, 2000), imply that application of familiar knowledge and practices are vital for setting the basis for negotiation of natural resource management. Familiarity in this context is associated with human need for connection drawn from previous experiences (Mandler, 2008), thus enabling a self-reflective process (Guess, 1981) leading to reflective actions (Smyth, 2000) for sustainable resource management.

The findings indicated that extrapolating core values of collective and consultative decision-making practices from traditional management systems were essential for informing sustainable natural resource policy ideas. Those drawn from western models do not always work in indigenous contexts (Gadgil & Berkes, 1991; Mantjoro, 1996) as they are designed using scientific knowledge (Odum, 1971; Rao, 2000) and often do not produce sustainable or just outcomes. Application of collaborative, consultative approaches in traditional resource management processes were viewed as essential for reinforcing equitable participation and promoting positive efforts towards sustainable societies. This reinforces the need for state agencies in natural resource sector to improve communication and networking between all stakeholder groups to strengthen policy considerations and develop specific criteria based on Papua New Guinean value systems for sustainable management and development.

Communal decision-making was emphasised by TEK as useful for natural resource management. The findings highlighted this as a process that engages all members of a community and encourages equal participation. However, these practices were found to be declining and that a lot of the current policies had been borrowed from the previous colonial administration without a good representation of TEK. This was indicative of the Environment Act 2000 and the National Forest Policy 1991, which had less emphasis on TEK when they were responsible for dealing with natural resource management of PNG. There is a need for natural resources policies to incorporate values and principles of traditional decision making processes and structures to encourage community involvement and participation.

TEK is concerned with reinforcing relationship and partnership. The findings described TEK as being about people and place (McGavin, 2016), which needs to be acknowledged through policies. Relationship building is a core value of PNG societies that demands mutual responsibilities and obligations and perceived as essential for developing sustainable natural resource management plans and strategies. The inclusion of these core values and principles in the implementation of natural resource policies would not only improve resource developers' perceptions of TEK but also promote environmental and social wellbeing through resource ownership, rights to participate in decision-making and having shared responsibilities. Inclusion of culturally-relevant policies founded on TEK values encourage collaboration and involvement, and reinforce ownership of resource management strategies and plans.

9.4.2 TEK for Education Policy

The findings indicate that incorporation of core TEK values in both formal curriculum and non-formal community natural resource education and awareness programs is significant. These findings support other writers' assertions that see people, their language, culture and environmental interactions (Berkes, 1993; Dudgeon & Berkes, 2003; McGregor, 2004a, 2009; Semali & Kincheloe, 1999) as the focus of TEK thus forming a familiar local knowledge base needed to be reinforced through education curriculum and policy. The findings indicated that incorporation of TEK in formal education would enhance young people's

perceptions of local and global issues (Tilbury, 1995) and enable them to make informed decisions and take responsible actions (Dresner, 2002) towards sustainability.

Both formal and community natural resource education need clearly defined policy ideas and statements to guide implementation of TEK values for sustainability. Analysis of policy documents indicated that the Protected Areas Policy (2014) lacks clear directions on how TEK could be utilised effectively in education to provide directions for teaching and learning about sustainable natural resource management. In addition, the analysis of the National Curriculum Statement also indicated non-clear directions on how and when TEK could be used to educate about sustainable natural resource management. These guidelines need to emphasise application of TEK values to strengthen the principles of fairness and equality (Daily & Ehrlich, 1996; Munasinghe, 1999), capture approaches and strategies that would safeguard and strengthen TEK, encourage collective participation and community involvement, reinforce collaborations and partnerships, and ensure parties involved in decision-making are held accountable for their actions.

Policy is needed to reinforce documentation and dissemination of TEK values through both community and formal education. The teaching of non-practical knowledge and skills for community living through formal education was seen as irrelevant to the local people and needed to be re-addressed, Reintroduction of TEK in the formal system may address this gap according to Mehta, Alter, Semali, & Maretzki (2013) as this is vital for enhancing understanding of traditional wisdom to help solve environmentally-related problems. Strengthening value building in young people and reintroducing family responsibilities towards TEK education were viewed as essential for natural resource education policy.

9.4.3 Significance

The findings illustrate that policy has a specific role in ensuring a sustainable society is achieved. This can be done through reinforcing policies for empowerment and reflective learning. This process would help communities to be

enlightened and empowered to participate in sustainable resource management decision making and implementation. This is summarised in Figure 9.2.

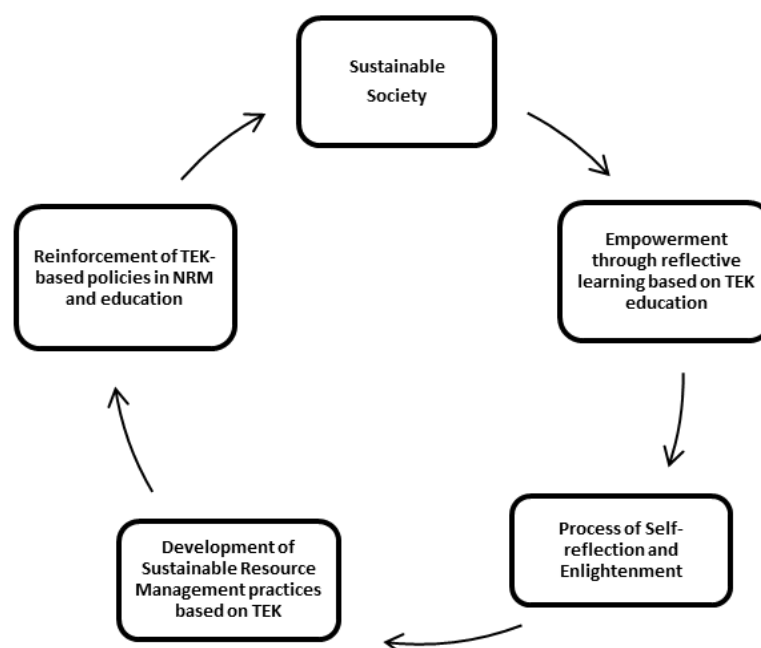


Figure 9.2 Sustainable society model through education and policy

Using this model, education curriculum statements need to reinforce core TEK values at all education levels and provide directives for implementing TEK in the school curriculum. Furthermore, policies reinforcing TEK need to embrace equality and justice, and encourage community involvement and participation.

In answering question three, existing policies related to sustainable resource management do not sufficiently include emphasis on TEK.

The next section discusses the conclusions of the study.

9.5 Conclusions of the study

The study set out to explore indigenous Papua New Guineans' perceptions of sustainability and traditional ecological knowledge, the role education plays in using TEK in sustainable natural resource management and the extent at which existing policies emphasise TEK in PNG. There are six conclusions drawn from the study:

1. Rural communities still depend today on TEK as a form of sustainable resource management. The remoteness of these communities and the minimal impact they receive from outside influence their use of TEK. As people increasingly move from rural to urban areas, the knowledge of TEK appears to be lost, particularly as young people become disconnected from the land.
2. Application of TEK in an indigenous Papua New Guinean context reinforces social wellbeing and equal access to resources. TEK values of respect, responsibility and reciprocity encourage all kin groups to ensure their kin members have access to resources. However, the findings indicated a decline of resource accessibility by members of kin groups. This has increased concerns about inequality and social justice.
3. The findings indicated that TEK reflects a sustainable way of life and that this way is about being one with the natural, physical and spiritual worlds. Demonstrating care and respect for resources would mean that they could continue to be available for a very long time. However, the findings indicated an increase in resource extraction activities and decrease in the application of TEK practices. This calls for improved and broader approaches to educate and empower communities to take measures to harvest and use resources carefully. It also means resource developers have the responsibility to the communities to ensure their corporate social responsibility (CSR) guidelines take into consideration the local TEK values and practices.
4. TEK practices create sustainable decision-making when all stakeholders are involved in the decision making processes and resource sharing activities. The findings indicated there has been a lack of involvement of traditional landowners where development projects occur. This indicates a lack of proper consultation that does not follow traditional decision making protocols and institutions associated with resource harvest and management. Resource developers need to be aware of traditional

collective decision-making and consultation processes to engage communities appropriately.

5. Application of TEK values and practices among Papua New Guineans to promote sustainable ways of living could be achieved through informal, non-formal education within communities, and formal education through the school curriculum. To enhance natural resource management, there is a need to both document significant TEK values and practices using appropriate language as well as develop curriculum materials that could reinforce the teaching and learning of these values.
6. TEK was found to be inadequately emphasised in natural resource policies, although people and the use of their natural resources are the focus of many of these sectors. The findings indicated the need to review these policies to ensure aspects of TEK that are essential for sustainable natural resource management are included.

9.6 Recommendations

The conclusions in Section 9.5 raise some implications for the role of TEK in sustainable natural resource management. Some recommendations to address these and for further research follow in the final two subsections.

9.6.1 Recommendations for practice

Regular practice of TEK

Communities should be encouraged to recognise TEK as crucial to their sustainable futures. They should continue to practice TEK and document its key aspects in appropriate ways for perpetuity. Inclusion of TEK in education and natural resource policies by appropriate Government departments would enhance this encouragement.

Social application of TEK

Natural resource education and policy should acknowledge that equal access to resources is associated with TEK values of respect, responsibility and reciprocity. Education and natural resource policies

should be reviewed to reflect these Papua New Guinean values.

TEK is a way of life

Natural resource education and policy documents should acknowledge TEK as a way of life. TEK values associated with equity should be promoted through collaborative efforts.

Community partnership

State departments involved in natural resources should ensure community collaboration and partnership is encouraged in their policies. Local communities should be consulted throughout the project development and implementation stages.

TEK for the younger generation

Education and natural resource policies should reinforce involvement of youth and young people in promoting TEK values for sustainable natural resource management. Capacity building and empowerment training of youths and young people should be a collaborative effort from all stakeholders.

Natural resource policies

Natural resource policy documents should be reviewed to integrate TEK values for sustainability. Roles and responsibilities of all stakeholders should be clearly outlined in natural resource policy statements. Policy documents emphasizing TEK values for sustainability should be clearly linked to education curriculum.

9.6.2 Recommendations for further research

The findings of the study clearly indicated the need for further research both in the area of TEK in education and implications for TEK in Natural resource management policies in Papua New Guinea. The following are suggestions for further research.

TEK in education

- Further research is needed to investigate perceptions of youth and students about TEK and sustainability and how this could inform education about sustainability.
- Further research is needed to explore how TEK could be applied through wider participation from both youth and adult members of the community.
- Research is needed to explore possibilities of developing a sustainability education framework that is underpinned by core TEK values of respect, responsibility and reciprocity to inform teaching and learning about sustainable natural resource management.

TEK for Natural Resource Policies

- Additional research into the role of gender in decision-making in TEK and sustainable natural resource management.
- Research could explore the possibilities of developing a sustainability policy framework that incorporates TEK values and practices.
- Further research could investigate approaches of incorporating TEK in natural resource management policies.

9.7 Limitations of the study

This study focused on perceptions of indigenous people of PNG and it did not explore non-indigenous perceptions. The selection of participants for this study was limited to those who had some form of involvement with the natural resource sector in PNG.

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Appendix A: Ethical Approval

Centre for Science and Technology Education
Research
Faculty of Science & Engineering
Te Pūtiao me te Mātauranga Pūkaha
The University of Waikato
Private Bag 3105
Hamilton, New Zealand

Telephone 64-7-838 4357
Facsimile 64-7-838 4272
Email c.ames@waikato.ac.nz



THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

To: Sangion Tiu
Date: 10 October 2012
From: Dr Karsten Zegwaard
Subject: Ethics Sub-committee Report on Ethics Proposal

The Faculty of Science and Engineering Human Research ethics sub-committee has considered your proposal Indigenous Perceptions of Sustainability and Traditional Ecological Knowledge and the implications for developing policy framework in education for sustainability in Papua New Guinea

The proposal as attached is approved. If you wish to vary the terms of the approved application in any way, please contact me to request an amendment.

Good luck with your research!

Signed

Appendix B: Informed Consent Letter

C/- STER Center
University of Waikato
Private Bag 3105
Hamilton 3240
New Zealand

11th February 2013

Dear _____

I am writing to invite a representative from your organization/community to participate in a research study that I am conducting for my PhD at the University of Waikato, New Zealand. This study intends to find out the participants' views on important aspects of traditional ecological knowledge (TEK) that enabled past generations to live harmoniously with nature and how they drew from it to survive. It also intends to find out the participants' views on the key principles and practices that were useful to people in the past and are seen as applicable to the present to ensure that the environment continues to support life. The study also intends to find out the participants' views on how these TEK principles and practices could be used in education today. Your organization/community's participation will contribute towards the findings that will enable me to develop a tentative policy framework for education for sustainability. This framework will integrate vital aspects of TEK for wider education, training and awareness on sustainability issues in Papua New Guinea.

I would like to involve [name] from your organization/community in this study. If you agree to this, your representative will then be asked for their consent to be involved, and if they do, they would be involved in an interview that may take up to 60 minutes. The procedure will involve an explanation of the interview process including a discussion on the participants' rights and consent. This will then be followed by the interview that will include questions on examples of TEK people used for sustenance, the kinds of principles and practices used in the past that are applicable today and how the participants' think these could be used. I undertake to provide [name] with a summary transcript of their interview for them to check or amend and to verify that I can proceed to analyse the interview.

Data collected from your representative during the study may be used in writing my PhD thesis, reports, publications or in presentations. I will not use your representative's name, the name of your organization/community or the names of other participants in any publications or presentations. I will take care to ensure that any data that I use from your representative cannot be identified as coming from your organization/community. I will make sure that I store all the information gathered from your representative securely. Your representative can decline to be involved in the research, and can withdraw any or all data s(he) has provided if s(he) is unhappy with the conduct of the researcher, up to two weeks after receiving the interview transcript for checking. If there is a withdrawal, I will destroy any data gathered from your representative.

I would appreciate your consent for [name] to be involved as described. If you need any more details about the project, or issues arise for your representative during the project, please contact me on email: st125@waikato.ac.nz or phone: + 64 221556176 (New Zealand) or + 675 72196791 (PNG). If I am unable to resolve your concerns, you may contact my chief supervisor, Dr. Chris Eames on email: c.eames@waikato.ac.nz or phone: + 64 7 8384357. If you consent to [name] being involved in this study, please read the attached consent form, sign and return to me.

Yours sincerely

Sangion A. Tiu
Student Researcher

Appendix B1: Research Consent

I have read the attached letter of information.

I understand that:

1. My organisation's participation in the project is voluntary.
2. My organisation has the right to withdraw and then no data collected from my organisation will be used in the study and the data will be destroyed.
3. Data may be collected from my organisation in the ways specified in the accompanying letter. This data will be kept confidential and securely stored.
4. Data obtained during the research project may be used in the writing of a PhD thesis, reports or published papers and making presentations about the project. This data will be reported without use of my organisation's name or means to identify my organisation.

I give my consent to the following for the study to proceed.

I can direct any questions to Sangion Tiu on email: st125@waikato.ac.nz or stiu@rcf.org.pg Tel: + 64 221556176 or + 675 72196791.

For any unresolved issues I can contact the Chief Supervisor Dr. Chris Eames on + 64 7 8384357 or c.eames@waikato.ac.nz.

I give consent for my organisation to be involved in the project under the conditions set out above.

Name: _____

Signed: _____

Date: _____

Please return this form to the researcher by email to st125@waikato.ac.nz or stiu@rcf.org.pg or in person at the start of the interview.

Appendix C: Interview Protocol 1

Community /other stakeholders

(Note: all personal details will be recorded in the field notebook)

1. (a) What traditional knowledge do you and your people have about the natural world?
(b) How useful is that knowledge today?
(c) Why is it useful?
(d) How could it be used more?
2. (a) What ideas from your traditional knowledge about the natural world are important to you?
(b) Why do you think they are useful?
(c) Do you think these ideas influence the way your people live today? If so can you explain how?
(d) How do you think such ideas can be maintained?
3. (a) How have your people maintained their traditional knowledge about the natural world?
(b) Why did they maintain this knowledge in this way?
(c) How did they disseminate this knowledge? Can this be applied today? If so, in what ways?
4. (a) How do people use their traditional knowledge about the natural world to obtain resources that they need to live?
(b) Are these practices relevant today? Why/why not?
(c) How have these practices changed over time?
5. (a) What ideas from your traditional knowledge about the natural world do you use in thinking about resource use and management?
(b) Why are these ideas useful?
(c) Has it been a problem in any way—have traditional ideas on resource use stopped people from adapting to current constraints?
6. (a) How were decisions about natural resource use and management made in the past? Can you give me some examples?
(b) Are these decision-making processes still used and useful today?
7. (a) How were decisions about natural resource use made into traditional laws or practice that people abide by in the past?
(b) Is it appropriate or desirable to use similar decision making processes today? Why or why not?
(c) If it is, how can these processes be applied today?
8. (a) How do you think people should learn about natural resource use and management today?
(b) Why should they learn in this way?

9. (a) What are some key ideas and values from traditional knowledge about the natural world in resource use/management that can be learnt?
- (b) Why should these ideas and values be learnt?
- (c) How can these be emphasised in the learning process? Can you give me some examples?

Practitioners

- 1.(a) What does the term sustainability mean to you?
- (b) What does traditional knowledge of the natural world mean to you?
- (c) Do you think this knowledge is important in sustainability? Why/why not?

- 2.(a) What are your views about natural resource management and sustainability?
- (b) Do you see a place for traditional knowledge in this? If so, can you explain?
- (c) How can this place be enhanced or maintained?

- 3.(a) Do you see a role for each of the stakeholders (communities, practitioners, educators, industry, policy makers) in contributing to NRM? If so, can you state what these are? Who should have final say?
- (b) Do you think these stakeholders currently have a say in NRM? If so, how do you think this happens? If not, why do you think that is?

- 4.(a) Should traditional knowledge and/or sustainability principles be used by these stakeholders in NRM?
- (b) How do you see the role of national and local governments in supporting the use of traditional knowledge and/or sustainability principles in NRM?
- (c) Do you think this is important? If so, can you explain?

- 5.(a) What key values/principles should guide decisions about the use of traditional knowledge and/or sustainability principles in NRM?
- (b) Why are these values/principles important?
- (c) How important are these values/principles in developing sustainability policies? Can you explain?

- 6.(a) How do you think people should learn about natural resource use and management?
- (b) Why should they learn in this way?

- 7.(a) What are some key concepts and values from traditional knowledge and/or sustainability principles in natural resource use/management that can be learnt?
- (b) Why should these concepts and values be learnt?
- (c) How can these be emphasised in the learning process? Can you give me some examples?

Educators

1. (a) What does the term sustainability mean to you?
- (b) Do you think it is important? Can you explain why?

(c) Do you think it is important that students learn about sustainability? Why/why not?

2. (a) What does traditional knowledge of the natural world mean to you?

Do you think this knowledge is important today? Why/why not?

Should people/students learn about it? If so, how should they learn about it?

(b) Do you think traditional knowledge of the natural world can be used in building a sustainable future for PNG? Why/why not?

(c) If so, how can traditional knowledge of the natural world influence decision making? i.e. curriculum, lesson planning or education policy

(d) How do you think this will work? Can you explain?

3. (a) Do you see a role for each of the stakeholders (communities, practitioners, educators, industry, policy makers) in implementing TEK and sustainability in contributing to NRM? If so, can you state what these are? Who should have final say?

(b) Do you think these stakeholders currently have a say in NRM? If so, how do you think this happens? If not, why do you think that is?

4. (a) How do you think people should learn about natural resource use and management?

(b) Why should they learn in this way?

5. (a) What are some key concepts and values from traditional knowledge and/or sustainability principles in natural resource use/management that can be learnt?

(b) Why should these concepts and values be learnt?

(c) How can these be emphasised in the learning process? Can you give me some examples?

Appendix C1: Interview Protocol 2

Industry/corporation

1. (a) What does the term sustainability mean to you?
(b) What are your views about natural resource management and sustainability?
(d) Do you see a path for traditional knowledge of the natural world in this? If so, can you explain?
(e) How can this path be enhanced or maintained?
2. (a) Do you think there is a role for industry/corporation in supporting the implementation of traditional knowledge of the natural world and sustainability in natural resource management? Can you explain what this is?
(b) Do you see a role for each of the other stakeholders (communities, practitioners, educators, policy makers) in implementing traditional knowledge of the natural world and sustainability in contributing to natural resource management? If so, can you state what these are? Who should have final say?
(c) Do you think these stakeholders currently have a say in natural resource management? If so, how do you think this happens? If not, why do you think that is?
3. (a) What key values/principles of traditional knowledge of the natural world and sustainability in natural resource management would the industry/corporation support?
(b) Why would the industry/corporation support these values/principles?
(c) How can these values/principles be reinforced or enhanced?
4. (a) What key values/principles are needed when making decisions about use of traditional knowledge of the natural world and sustainability in natural resource management?
(b) Why are these values/principles important?
(c) How important are these values/principles in developing sustainability policies? Can you explain?
5. (a) How do you think people should learn about resource use and management?
(b) Why should they learn in this way?
6. (a) What are some key concepts/values from traditional knowledge of the natural world and sustainability in resource use/management that can be learnt?
(b) Why should these concepts and values be learnt?

Policy makers/officers

1. (a) What does the term sustainability mean to you?
(b) What are your views about natural resource management and sustainability?
(c) Do you see a path for traditional knowledge of the natural world in this? If so, can you explain?
(d) How can this path be enhanced or maintained?
2. (a) Do you see the value of promoting traditional knowledge of the natural world and sustainability in NRM/Education policy?
(b) If so, can you explain what values/principles of traditional knowledge of the natural world and sustainability are important?
(c) Why do you think this is important?
3. (a) What aspects of traditional knowledge of the natural world and sustainability can be reinforced through policy making?
(b) Should traditional knowledge of the natural world be involved in policy making? Why or why not?
(c) Do you think this will improve livelihoods and empower communities?
4. (a) Do you see a role for the government in supporting other stakeholders? If so, in what ways?
(b) How can this role inform policy development and dissemination?
(c) What does this mean for traditional knowledge of the natural world and sustainability?
5. (a) Do you see a role for each of the other stakeholders (communities, practitioners, educators, industry/corporation) in contributing to NRM? If so, can you state what these are? Who should have final say?
(b) Do you think these stakeholders currently have a say in NRM? If so, how do you think this happens? If not, why do you think that is?
6. (a) Do you think education has an important role in connecting key values/principles of traditional knowledge of the natural world and sustainability in policy development?
(b) Why do you think so?
(c) Can you explain how education can connect these key values/principles?
7. (a) How can the values of traditional knowledge of the natural world, sustainability and natural resource management practices be reinforced in policy development?
(b) What processes are involved in policy development?
(c) Should all stakeholders be involved in the process? Why or why not?
(d) What do you think is the role of national and local governments in this process?
(d) What are the roles of other stakeholders in this process?

Appendix D1: Workshop PowerPoint

“Equality through TEK in Education for Sustainability”



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Outline

- ❖ Background
- ❖ Research design & methodology
- ❖ Theoretical discussions
- ❖ Preliminary findings
- ❖ Recommendations for sustainability policy
- ❖ Comments and feedback

Background

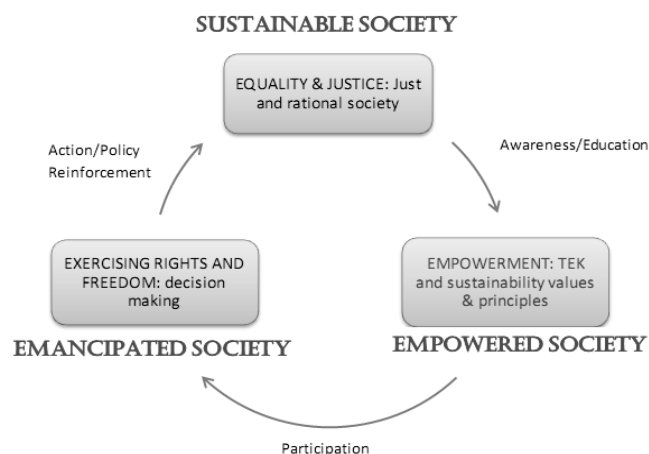
- ❖ PNG's high concentration of ecosystems
 - biological diversity & endemism
 - interplay between biodiversity & culture/language
- ❖ Highly rural population (over 80%)
 - Greater dependence on environment for subsistence lifestyle
 - Threats of extractive activities, increasing population & deforestation
- ❖ Personal experiences in conservation education
 - Dependence on TEK for resources daily (Paglau, 1982; Sillitoe, 1998)
 - Threats on loss of TEK & sustainable resource use
 - Need for sustainable development that draws from/strengthen by TEK
 - Need to understand perceptions of TEK and sustainability and role of education

Research design & methodology

- ❖ Qualitative study capturing data on perceptions and interactions (Miles & Huberman, 1994)
- ❖ Research questions:
 1. *Relationship between TEK and sustainability.*
 2. *Stakeholders' perceptions of this relationship and how these perceptions can inform development of a policy framework for sustainability in PNG*
 3. *How this policy framework for sustainability can be translated into education policies to inform practice in PNG*
- ❖ Study site: Eastern Highlands, Simbu, Morobe, Manus & NCD.
- ❖ Participants: 24 key stakeholders
- ❖ Methods: interviews (individual & focus group), storytelling, observations, questionnaires, document analysis.

Theoretical discussions

- ❖ TEK as a strategy in NRM (Berkes, 1999, 2008; Houde, 2007; Usher, 2000)
 - demand for alternative solutions to increasing environmental issues of degradation, poverty and inequality
 - changing phases in globalisation of science and citizenships
- ❖ TEK: emphasises relationships, interactions, and resource management (Usher, 2000; Reid et.al., 2002; Berkes, 2008; Johnson, 1992) linking it to sustainability.
- ❖ Sustainability:
 - multidisciplinary (Jabareen, 2008; Morse, 2010)
 - concerned with understanding complex systems of world economy, global society & physical environment and their political & cultural interconnectedness (Sachs, 2002; Barkin, 1998).
- ❖ concerned with economic wellbeing, social inclusiveness (e.g. equal participation), environmental sustainability and good governance (political)
- ❖ Sustainability is achievable e.g. see critical theory model



Preliminary findings

Theme	Code	Sub-code
Normative values of TEK	Understanding TEK	Survival and subsistence livelihoods Control of resource use and availability
	Application of TEK values (NRM)	Clan based resource harvest and management Stakeholder collaboration and partnership Traditional practices and techniques in resource harvest and management
	Interdependence	Understanding relationships between in environment and available resources Understanding finite resources
Sustainability	Sustainable growth	Understanding sustainability Economic well-being
	Sustainable Practices	Resource replacement programs Community actions
	Sustainable behaviour /attitude	Reinforce value building and environmental behaviour
Social responsibility and equity	Future generation	Meeting present and future needs Responsibility
	Social structures	Inheritance and ownership of resources Stakeholder collaboration for integration and reinforcement of community perceptions
	Equity	Access to resource and reciprocity to strengthen social relationships Community voice and participation
Aspects of decision making	Social responsibility	Corporate responsibilities
	Processes in decision making	Collective decisions Influences of TEK
	Institutions of power	Decision making & leadership
Policy development	Policy development	Incorporating existing systems i.e. TEK Stakeholder consultation Sustainable natural resource management policy
Education	Traditional education practices	Indigenous education structures Disseminating TEK
	Documenting and integrating TEK	Documenting TEK Integrating TEK in curriculum
	Role of education	Change understanding and values about environment Community empowerment

Some issues of sustainability
<ol style="list-style-type: none">1. Deteriorating values and principles<ul style="list-style-type: none">- Loss of TEK values (respect, responsibility, relationship, reciprocity)- Disconnections with TEK2. Unsustainable harvest and resource depletion<ul style="list-style-type: none">- Logging and timber- Mineral extraction- Energy production- Species loss- Land degradation3. Inequality and decision making<ul style="list-style-type: none">- No or limited community involvement- Unequal participation- Borrowed policies or policy ideas- Inadequate consultations- Poor communication4. Lack of awareness and education<ul style="list-style-type: none">- Limited knowledge of communities/stakeholders on relationship between TEK & sustainability- Lack of documentation on TEK values- No policy direction

Preliminary findings

Table 1.3: Summary of analysis of policy documents

POLICY	PROBLEM	CONCEPTUAL LOGICS	CONDITIONS	LIMITATIONS	EFFECTS	CHALLENGES
National Forest Policy (1990)	<ol style="list-style-type: none"> Unsustainable forest management Underutilisation of forest resources for economic growth Inadequate administration structures 	<ul style="list-style-type: none"> Customary resource ownership Forest classifications Sustainable harvest & yields Environmental protection Resource management Sustainable development Research, education & training Structural reform 	<ol style="list-style-type: none"> Responds to new Forestry Act (1991) Address corruption, malpractice and unsustainable harvesting of forest resources (Barnett Forest Industry Inquiry) 4th National Goal 	Demonstrating linkages between cultural and social issues	<p>No reinforcement of:</p> <ul style="list-style-type: none"> Communities' traditional knowledge of forests/forest resources Relationship between benefits of forest management and sustainable livelihoods 	Approaches to social forestry/reforestation through Community Education
National Climate Change & Development Policy (draft)	<ol style="list-style-type: none"> Threats associated with climate change Coping/ adapting to climate change 	<ul style="list-style-type: none"> Policy principles Thematic Area objectives and strategies Implementation framework 	<ol style="list-style-type: none"> Increase potential for climate resilient and carbon neutral society 4th National Goal PNG Vision 2050 PNG MTPD 2011-2015 	Defining linkages between socio-cultural and sustainable economic development	Linkages to existing climate related traditional knowledge & practices and environmental sustainability unclear	Approaches/strategies for community awareness/education
Protected Area Policy (draft discussion paper)	<ol style="list-style-type: none"> Failure of current approaches of priority setting, selection, establishment and management of PAs in PNG to meet Constitutional commitment as expressed in 4th National goal and international obligations under CBD 	<ul style="list-style-type: none"> Institutional settings New/amended legislation Role of NGOs Priority setting & selection of areas of national significance for inclusion in NPAS Establishment of PAs to form the NPAS Management of PAs that form the NPAS 	<ol style="list-style-type: none"> 4th National Goal PNG Vision 2050 National Parks Act Fauna (Protection & Control) Act Conservation Area Act 	Linking TEK, PAs/NPAS and sustainability	Relationship between PAs/NPAS establishment, TEK and sustainability unclear	Strategies/approaches for community awareness/education
Statement of Environment & Conservation Principles (1976)	<ol style="list-style-type: none"> Response to five National Goals and Directive Principles due to rapidly changing environment 	<ul style="list-style-type: none"> Ecological, social & culturally suitable development, Sustainability Environmental responsibilities Environmental education & awareness 	<ol style="list-style-type: none"> National Goals with focus on 4th Goal 	Incorporating TEK with EE and Sustainability	Emphasis on TEK not visible	Approaches/strategies to incorporate TEK in EE
Mineral development policies based on Mining Act (1992)	<ol style="list-style-type: none"> Generate government revenue for economic development 	<ul style="list-style-type: none"> State ownership of minerals Use of foreign investment to develop mineral deposits Extracting revenue for broader economic development 	<ol style="list-style-type: none"> Post-independence economic development goals National Goals & Directive Principles 	Establishing connections between resource extraction, its impact and sustainable livelihoods	Relationship between impact of resource extraction, values of TEK & sustainable livelihoods not visible	Approaches/strategies to incorporate TEK values to address impact of resource extraction through community awareness/education

Recommendations for sustainability education policy

Recommended policy	Objectives	Strategies
TEK Values and Practices	Incorporate significant local TEK values and practices into program/project activities.	<ul style="list-style-type: none"> • Revisit/identify local values and knowledge systems associated with sustainable living. • Explore existing traditional systems and build on what people already have. • Reinforce TEK values of respect, responsibility and relationships through community meetings/discussions. • Incorporate values of relationships and limited resources through stakeholder consultation. • Develop local policies through stakeholder consultation beginning with families and clans to wider community.
Sustainability Principles	Reinforce principles of equity, interdependence and responsible actions.	<ul style="list-style-type: none"> • Establish available natural resource stock base using local/traditional knowledge through community capacity building activities. • Engage dialogue between stakeholders on effects of unsustainable harvest on livelihoods. • Encourage community discussions and meetings on access to resources. • Reinforce wise use of resources through community awareness • Promote waste and pollution free environment
Natural Resource Management, TEK and Sustainability	Strengthen TEK values that emphasise sustainability in natural resource management practices.	<ul style="list-style-type: none"> • Utilise TEK to determine locally important natural resources, their sources and location. • Develop land-use plans (LUP) to reinforce resource availability, use and management. • Incorporate traditional practices of open and close seasons, rotational harvesting, and temporary bans through community and clan based meetings.
Land Ownership	Involve land owner consultation and participation.	<ul style="list-style-type: none"> • Reinforce traditional land ownership and leadership structures through community meetings. • Involve participation of landowners in decision making on resource extraction or management. • Develop local capacity for sustainable resource use and management. • Reinforce and improve local governance structures through capacity building.
Collaboration and networking (Partnership)	Develop and maintain collaboration between all stakeholders	<ul style="list-style-type: none"> • Promote stakeholder collaboration to formulate policy regulating sustainable management. • Improve communication and networking between all stakeholders • Develop wider consultation process to promote sustainability issues. • Engage all stakeholders in policy discussions or review • Support efforts to promote sustainable legislation and policies in consultation

		<i>with all stakeholders.</i>
Scientific research	Build, encourage and support scientific research	<ul style="list-style-type: none"> • <i>Encourage and support scientific research on environmental issues.</i> • <i>Develop data-base on TEK and scientific ecological knowledge about local resources.</i> • <i>Support scientific monitoring of resource use and management.</i> • <i>Provide scientific information about local resources in community meetings</i>
Formal and community education	Develop activities for formal and community awareness and education	<ul style="list-style-type: none"> • <i>Incorporate TEK values and practices in community awareness and school curriculum.</i> • <i>Develop and implement local or placed-base community education and awareness activities.</i> • <i>Encourage community participation in developing local materials for awareness and education.</i> • <i>Engage schools and communities in discussions/ debates on resource use and management</i> • <i>Document TEK about natural resource use and management practices through collaboration and consultation of all stakeholders.</i>
Policy Review	Promote local policies incorporating TEK and sustainability for natural resource management practices.	<ul style="list-style-type: none"> • <i>Develop locally relevant criteria and standards based on local/traditional system of values for sustainable management and development of natural resources.</i> • <i>Review existing institutional structures to cater for local issues of TEK and natural resource management.</i> • <i>Ensure development of locally relevant and implementable NRM policies through community consultation.</i> • <i>Put in place mechanisms for community consultation, awareness and education on policy changes or reviews.</i> • <i>Ensure policy reviews and amendments are translated for effective deliberation or dissemination through community consultation and awareness.</i>

Comments /Questions

1. Would incorporating significant TEK values and practices into policies be beneficial? Why would you think so? How can policy connect this to sustainability principles?
2. How can education be supported by policy to reinforce principles of equity, interdependence and responsible actions? Why do you think education has an important part in this?
3. What would be the effect of policies that incorporate TEK and sustainability on natural resource management? How can these be strengthened?

Appendix D2: Workshop Feedback Form

Theme: “Equality through TEK in Education for Sustainability”

Consultation Workshop

Port Moresby/Goroka, Papua New Guinea

6th & 12th March, 2014

9:30 a.m. – 12:30 PM

FEEDBACK FORM

1. (a) Would incorporating significant TEK values and practices into policies be beneficial?

(b) Why would you think so?

(c) How can policy connect this to sustainability principles?

2. (a) How can education be supported by policy to reinforce principles of equity, interdependence and responsible actions?

(b) Why do you think education has an important part in this?

3. (a) What would be the effect of policies that incorporate TEK and sustainability on natural resource management?

(b) How can these be strengthened?

Appendix E: Simple Theme Codebook

Respondent: COM 2

Sequence #	Participant name	Research Question/Participant Response	Codes/sub codes	THEME or CATEGORY
49	researcher	What traditional knowledge of the natural world do you and your people have?		
50	COM 2	The knowledge of the forests, rivers/streams, and wild animals in terms of hunting, which was practiced when people went as a team (not in individuals or small groups) to hunt in a particular forest chosen for that purpose.	TEK SYSTEMS <ul style="list-style-type: none"> forest knowledge communal harvests 	TEK
53	researcher	Do you think this traditional knowledge of the natural world is important to be disseminated to children and young people today?		
54	COM 2	Yes, children and young generation need to be taught this knowledge and skills because not only was it our ancestors' knowledge but it is the knowledge we use to survive in the forest environment we live in.	SOCIAL ASPECTS <ul style="list-style-type: none"> knowledge about survival and livelihood 	SUSTAINABILITY & NRM EDUCATION
55	researcher	How can dissemination and learning of this traditional knowledge be strengthened or enhanced?		
56	COM 2	Children when they go to school, they too must learn these knowledge and skills and then be able to see and relate to it when they return to the village. They must learn both in theory and practice. If they learn only theory in school and do not practice in the village, it won't be good because they will forget. Also, the information and pictorial illustrations of TK need to be used to help us educate our children so that they do not lose our TK.	FORMAL APPROACHES <ul style="list-style-type: none"> apply knowledge and skills learnt integrate theory and practice through curriculum 	EDUCATION
57	researcher	Do you think many of your people are still practicing this traditional knowledge and practices?		
58	COM 2	In my view, this knowledge is still practiced although some of us are slowly losing some of it. In fact, we are fortunate because our traditional practices of managing resources are in line with conservation ideas so we partnered with conservation organisations to ensure that we continue to maintain these traditional knowledge and practices of natural resource management.	TEK PRACTICE <ul style="list-style-type: none"> TK consistent with conservation practices Create partnerships to maintain TK of NRM 	TEK
59	researcher	How were decisions about resource use and management made traditionally?		
60	COM 2	No individual makes decisions on his or her own. Everyone sits down together and agree or disagree to harvest resources in a particular site.	DECISION MAKING SYSTEMS <ul style="list-style-type: none"> consensual decision making 	DECISION MAKING
63	researcher	Do you have traditional rules or laws to guide the way your people use resources?		

64	COM 2	In the past there were laws guiding the way we live and do things. Also, there were laws restricting certain age groups (e.g. new born to mid-teens) from eating certain meat such as bandicoot, snake (python), echidna, freshwater eel, monitor lizard and some insects. For example, it is believed that if children between these age groups eat such meat, they will not grow quickly, have problems with their sight and not be able to see things well, or maybe they will have a disability.	NRM PRACTICE <ul style="list-style-type: none"> • simple rules/laws guiding NRM • spiritual beliefs/taboo associated with food and resource harvesting 	SUSTAINABILITY & NRM
69	researcher	In NRM, there are many stakeholders like village communities, practitioners like conservation NGOs, the government and policymakers, educators, and the extractive companies. How do you see the role of each of these stakeholders?		
70	COM 2	In our opinion, if the company came into our area, we would have lost a lot of our traditional customs and practices. The conservation practitioners on the other hand, seem to reinforce our traditional knowledge and practices and we believe this will help us to continue for many more years because we live in the village where we continue to use the resources from the forest.	ROLES <ul style="list-style-type: none"> • company could cause loss of TK and practices • Conservationists reinforce TEK and sustainable practices 	KEY ACTORS
71	researcher	<i>Do you think the government has a role to reinforce traditional knowledge and practices about resource use and management?</i>		
72	COM 2	If we take the initiative to document this knowledge and practices and present to the government, I believe they can reinforce this in the policies.	ROLES <ul style="list-style-type: none"> • Government can reinforce policies 	KEY ACTORS POLICY MAKING
73	researcher	<i>How do you see the role of educators in natural resource use and management?</i>		
74	COM 2	If traditional knowledge of the environment and practices of resource management based on this is documented, the teachers and educators can use this to teach our children so they can know about the way our ancestors lived in the past. This will also help the children to see what changes have occurred and how this has affected or enhanced the way we live today. In a way the children, as next generation of adults, will be able to make informed decisions on what to do or not to do.	FORMAL APPROACHES <ul style="list-style-type: none"> • document TK and NRM practices • teachers teach TK to inform next generation 	EDUCATION
75	researcher	<i>Which of these stakeholders should have a last say to how resources are harvested or used?</i>		
76	COM 2	The stakeholder who should make the last decision is the resource or land owner. This is his <i>customary land and his belly button is buried on this land</i> . He also has customary rights to these resources	DECISION MAKING SYSTEMS <ul style="list-style-type: none"> • reinforce customary ownership and rights 	DECISION MAKING
77	researcher	<i>Do all these stakeholders have a say in decision making about resource use and management?</i>		

78	COM 2	Many times, other stakeholders are not given time to have a say in such decision making processes. For instance, sometimes resource owners are surprised when resource developers show up in the community to conduct exploratory activities to establish the extent of a resource. This is not fair to the resource owners because this is our ancestral lands and we have to be informed or consulted first before such activities are carried out.	POWER RELATIONS <ul style="list-style-type: none"> unequal power of decision making consult landowners' approval 	DECISION MAKING
79	researcher	Do you see the role of education in enhancing traditional natural resource use and management?		
80	COM 2	There is a need for education to ensure that traditional knowledge and practices of resource use and management is enhanced through teaching and learning. We see the need to document all that we have while some of our older people are still alive. If they go, then we would lose this knowledge and practices forever. This will enable teachers to educate our children in school.	FORMAL APPROACHES <ul style="list-style-type: none"> document TK and practices teachers to educate children on TK 	EDUCATION
81	researcher	What are some key values about TK and practices of resource use and management that can be incorporated into education for dissemination?		
82	COM 2	Some of these key ideas include the ways of managing and using resources. Also one key value that our way of life depended on is <i>continuity</i> . i.e. resources should continue to be available for a very long time so <i>future generations</i> can be able to use it. A practical output of this belief is the declaration of the wildlife management area for conservation purposes. It is <i>our action to demonstrate our belief</i> in how our ancestors lived in the past and the need to <i>conserve</i> for the present and future generations. Our society promoted <i>communal decision making and harvesting, and sharing of resources</i> .	NRM PRACTICE <ul style="list-style-type: none"> value of continuity resource availability for future generations practical action to demonstrate beliefs and values e.g. WMA conserve for present and future generation promote <u>communal property</u> values 	SUSTAINABILITY & NRM