Good soils have names:

Local soil classification and management in Kae, Papua New Guinea

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Abstract

In Papua New Guinea (PNG) most rural people are semi-subsistence farmers who produce food and cash crops, such as oil palm, from their land. This study investigated local perceptions of soil fertility and soil management in the context of the two major socio-economic land uses in PNG: food gardening and oil palm plantations. The research took place on the north coast of the island province of West New Britain (PNG) where oil palm plantations occupy a significant portion of the land use and contribute to the majority of household income. The main objective of the research project was to determine local understandings of soil knowledge in Kae Village, West New Britain Province (WNB), in PNG; and to understand how this knowledge shapes the management of soil for food cropping and oil palm.

Soil knowledge was found to be interwoven in the daily practices and skills associated with food cultivation. The research uncovered that the process for passing down agricultural and ecological practices was characterised by oral transmission and a culture of learning through experience and repetition. There was strong evidence in the local soil classifications, of a dominant discourse on soils and their relationship with particular crops. In particular the local soil classification was dependent on taro, and the soil's ability to continue to yield adequate produce. If the soil ceased to produce adequate taro, then it was not considered soil, it was *kama ko kora magassa* translated literally as 'no good ground', and it would be fallowed until regarded as fertile again. The simplicity of this system supports its inherent sustainability, and ensures the biophysical limits of the soil are never depleted to a point of no return, making the fallow sequence successful and beneficial for future generations. Variations in the local soil knowledge, were found in examples of aging and gender roles, and provide insights into the possible resilience of local soil knowledge to broader environmental and economic changes. This research suggests the need for further efforts by the PNG oil palm industry to develop effective ways to engage with local soil knowledge/practices and incorporate this knowledge into their production model.

Keywords: Ethnopedology, soil knowledge, soil fertility, soil management, Papua New Guinea, West New Britain, agriculture, Oil Palm, aging, gender, sustainability.

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Introduction

1.3 Significance

In Papua New Guinea (PNG) most rural people are semi-subsistence farmers who produce food and cash crops, such as oil palm, from their land. Eighty per cent of the daily nutritional needs of Papua New Guineans are provided by local agriculture, highlighting the importance of soil as a resource in this production system (Hanson, Allen, Bourke & McCarthy, 2001. p11). This research took place on the north coast of the island province of West New Britain (WNB) in PNG where oil palm plantations occupy a significant portion of the land use and contribute to the majority of household income (Hanson et al., 2001; Nelson et al., 2010; Koczberski, 2012). For the supply of daily staple foods such as taro and sweet potato, however, the majority of people still rely on their food gardens and edible greens (such as juvenile fern tips) which are part of the naturally occurring vegetation in the remaining forest environs (Burke and Harwood, 2009; Hanson et al., 2001).

This research project set out to investigate local perceptions of soil fertility and soil management in the context of the two major socio-economic land uses in WNB: food gardening and oil palm plantations. Local soil knowledge is important to investigate in PNG for several reasons: (a) to explore the depth of such knowledge, and its interconnectivity with the people and place in which it is situated; (b) it offers a different temporal and geographic scale with regard to land use, which has important implications for sustainable agriculture (Sandor and Furbee, 1996); (c) Local soil knowledge provides important long-term insights about human responses to environmental change, and is therefore relevant to global environmental change (Sandor and Furbee, 1996) ; and (d) while soil use differs between cultures in terms of technology, fundamental soil processes, and changes involved are similar, therefore information from historic and contemporary cultures are relevant to present day land management.

1.4 Aims and objectives

The main objective of the research project was to determine local understandings of soil knowledge in Kae Village - West New Britain Province (WNB), Papua New Guinea (PNG); and to understand how this knowledge shapes the management of soil in the context of the two major economic land uses in the province: food cropping and oil palm.

According to Paul Sillitoe, indigenous soil knowledge is embedded in the 'heritage of practical everyday life' (Sillitoe, 1998. p89). The research aims were modelled on this premise. The initial aim

was to determine the ecological and cultural context in which soil knowledge/practice is constituted and subsequently, to interrogate any factors contributing to variation in this knowledge/practice.

This research will investigate if local soil knowledge, indigenous to a place and people, exists in the practices of everyday life associated with food gardening and with agriculture more broadly. It will also review if local soil knowledge provides the basis for a sustainable agricultural sequence by incorporating practices which do not jeopardise the ability of the soil to rejuvenate in a time-frame of benefit to the humans who rely upon it. This study argues that variances in local soil knowledge may provide insights into how and why local people adapt to predicted changes in the local environment, and attempts to find economically important avenues within the oil palm industry for the involvement and application of local soil knowledge.

1.5 Background

Oil palm is an attractive crop for West New Britain (WNB) farmers for a variety of reasons. Income is earned regularly and profits are high compared to other national cash crops (Nelson et al, 2010, p.15). Another benefit of the crop is that it does not need a high level of management to achieve reasonable productivity (Nelson et al., 2010). This presents a considerable advantage to the grower who is able to attend to other endeavours while their oil palm continues to be productive (Nelson et al., 2010 and Koczberski and Curry 2003, 2005). Oil palm has led to considerable benefits for WNB communities, but also problems, such as the immigration of people from other provinces in PNG, resulting in population pressure on limited land, food security issues and social disharmony (Koczberski 2007 and Koczberski et al., 2012). This multitude of socio-economic pressures has manifested in changes to soil management in some WNB communities (such as reduced fallow periods) and changes in soil fertility (such as a decline in soil nutrients from continuous planting) (Koczberski et al., 2012; and Koczberski and Curry, 2007).

This research addresses one aspect of this intricate socio-ecological system: the existence and practice of local soil knowledge as it relates to economically important land uses. In particular, the research examines how one village in WNB understands and manages their soil for food gardening and oil palm plantations. The focus on knowledge from a particular village reflects WinklerPrins' (1999, p. 151) definition of local soil knowledge as, '…the knowledge of soil properties and management possessed by people living in a particular environment for some period of time.' Field research was undertaken in Kae Village, on the Kimbe to Bialla Highway, in WNB (see Figure 2 and 3).

Kae Village has customary[1] land ownership, with residents utilising their land for oil palm blocks, food gardens and housing (including community structures such as 'haus win' – building for community gatherings without walls and 'haus lotu' - church).

Figure 1: Map of Papua New Guinea

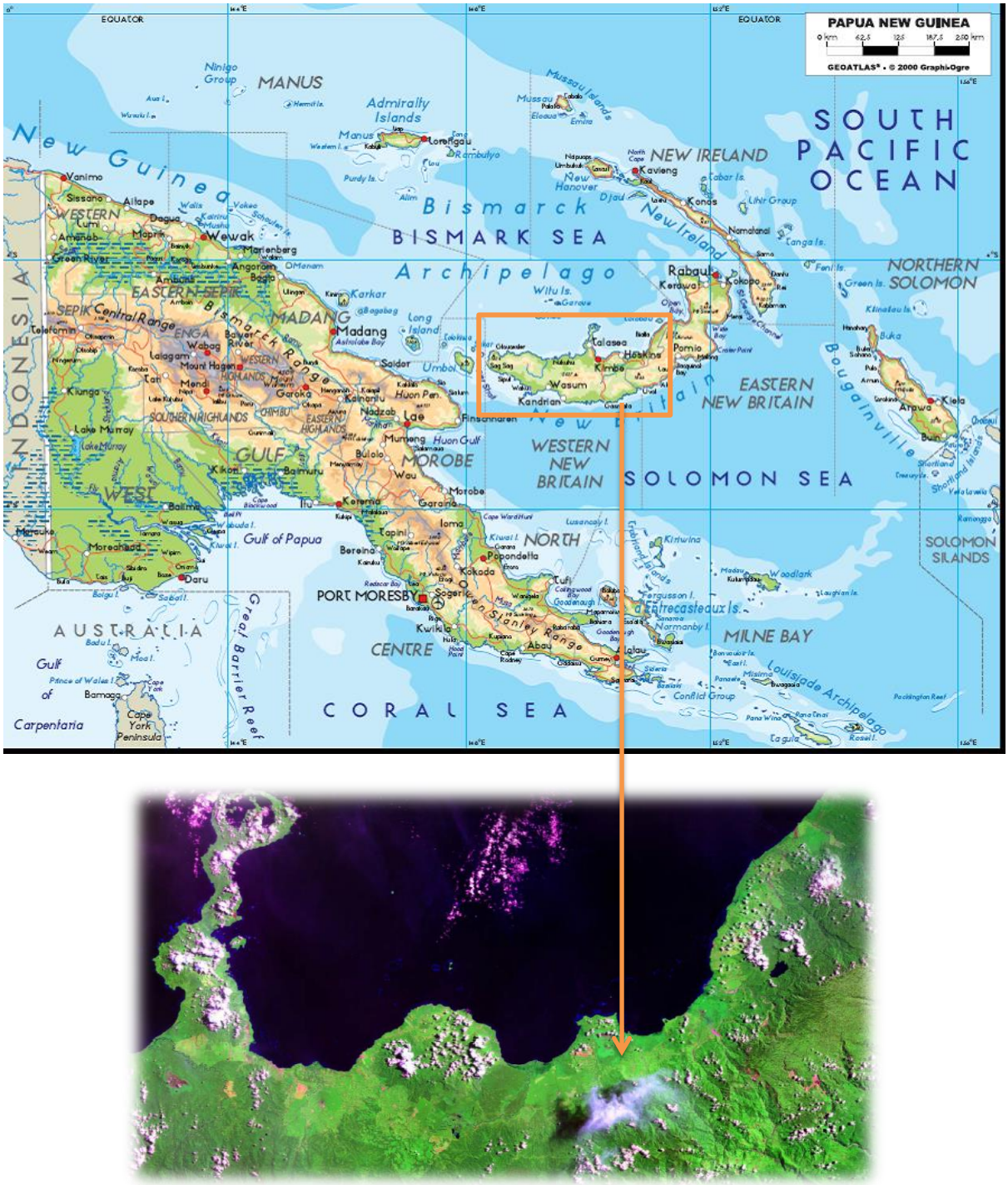


Figure 2: Arrow indicates the section of the North coast of West New Britain where research took place.

[1] Customary land in PNG is land which is owned by Indigenous communities and administered in accordance with their customs. Customary land holdings in PNG are protected under the Constitution (s.53).

1.6 Study area

1.6.1 Location and soils

Field research was undertaken in Kae Village, on the Kimbe to Bialla Highway, close to the north coastline of West New Britain, PNG (see Figure 3). The area has young volcanic ash soils (Zijsvelt and Torlach, 1975) classified as Andisols in Soil Taxonomy (Soil Survey Staff 2010). In the national soil map of PNG (Bleeker, 1983) the soils are classified as Entisols and Inceptisols (Soil Survey Staff, 1975) because the Andisol order had not yet been created. The soil map units in which the study sites were located are described in Appendix 7. The tephra in which the current soils are formed originated from the Witori complex to the west. The thick (~0.5-1.0 m) pumice gravel layer ubiquitous across the study area was deposited approximately 1200 years ago (Machida et al., 1996). Zijsvelt and Torlach (1975) noted that the soils had generally high chemical fertility and porosity but that food gardening had made the organic-rich A horizons thinner.

Figure 3: Topographic map showing smallholder oil palm blocks in the study site

1.6.2 Climate

West New Britain is classified as an 'extreme rainfall area' within PNG, with the annual rainfall in the study region averaging between 3500 to 4400 mm (Bourke and Harwood, (Eds.), 2009, pp. 56-67). The people of Kae define their seasons into two major categories: 'ren taim' (wet season) from late May to December, though in recent years (2010 to 2013) heavy rainfall and a rise in humidity have commenced as early as late March; and the 'dri taim' (dry season) usually occurring between December and late May with milder temperatures and infrequent light rainfall (Bourke and Harwood, (Eds.), 2009, pp. 68-70). The people of Kae also identify two intermittent mini seasons, which are connected to intermittent ecological events which affect livelihoods in the village. The first is large scale flooding which follows a heavy rain cycle and affects access to the village by road, destroys vulnerable crops, and reduces drinkable water sources. The second is high speed winds (winim taim in Tok Pisin or roro-ve in the Vere dialect), which mainly affects juvenile crops, but can destroy dwellings and block access to the village by way of fallen trees. The mini seasons can occur concurrently with the major seasons, and/or as a single force.

1.6.3 People and language

The people of Kae village are part of the Central Nakanai language group, otherwise known as a Tok Ples. Tok Ples is a general term (in Tok Pisin) used for the language of a specific clan or people. The Nakanai Tok Ples has had some orthographic work undertaken in the past on supra-segmentals, phonological and orthographic conventions, and syllable patterns (Johnston, 1978) (see Appendix 5). The dialect of Nakanai which is spoken in Kae is known as 'Vere'. The people of Kae believe their language to be oral only. Investigations during background research found no evidence of a written version of Vere (e.g. The Lord's Prayer), nor were any Vere texts found during field work in the village.

As a second language, most people in Kae also spoke the lingua franca of PNG: Tok Pisin. Tok Pisin has extensive orthographic work attributed to it. Interviews and conversations were held in a mixture of Vere, Tok Pisin and English. Assistance in translating was provided by two local men who the village elders (the magistrate, three retired teachers, two OPIC officers, and the church leader) considered had the best comprehension of all three languages. The local translator's level of English language comprehension and fluency was of a similar standard to my Tok Pisin: intermediate at best. We worked diligently to communicate our meaning to one another. The local translators were crucial to the quality of data collected, as they were the access point to local food gardeners and oil palm block owners. The translators also provided a point of comparison on soil knowledge/practice in the village, as information from participants changed, depending on their presence or absence during field work interactions.

1.6 Thesis structure

This thesis is organised into six chapters. Chapter 2 is a literature review and conceptual framework that sets the research out against the literature on ethnopedology and details two key concept areas with affiliations with local soil knowledge in WNB: swidden agriculture and oil palm as part of the agricultural system. The literature review establishes how previous research contributes to the study and which aspects require further investigation. Chapter 3 details the interdisciplinary methodology used for both field work and desk based research. Chapter 3 also stresses the importance of discourse analysis as an underlying theoretical model for qualitative research and as a practical tool in deconstructing and interrogating meaning from unstructured information. Chapter 4 discusses the findings of the research and provides locally articulated categories for the reader to understand soil knowledge which is embedded in broader agricultural practices and gender roles. Chapter 4 also details the absence of in-depth soil knowledge affiliated with oil palm cultivation compared to soil knowledge associated with food gardening, and the reasons behind this knowledge deficit. Chapter 5 builds on the results in Chapter 4 by investigating the inconsistencies and variances in the soil knowledge and what this means for the resilience of such knowledge in Kae. Chapter 6 summarises the major themes which emerged from field work and concludes the research by arguing the validity and application of local soil knowledge to the oil palm industry in West New Britain, PNG.

Chapter 2: Literature Review and Conceptual Framework

The literature review detailed below helped shape the research boundaries. Previous research has already established that local people are well qualified to define problems, and will be 'experts on their soils, climate, pests and so on' (Sillitoe, 1994, p.189; see also Sillitoe, 1994; Barrera-Bassols and Zinck, 2002; and Sandor and Furbee, 1996). Much of the information for analysis therefore came from the people of Kae and not from literature per se. Nonetheless, local soil knowledge is a hybrid discipline 'at the interface between natural and social science' (Barrera-Bassols, et al., 2005, p.118). Therefore the literature on indigenous soil knowledge, otherwise termed 'ethnopedology', provided an interdisciplinary framework for interrogating local soil knowledge within a distinct cultural system.

The literature review also investigates where and how local soil knowledge may be expressed in a specific place and cultural context, as well as the difficulties involved in recording such knowledge

(see Sillitoe 1998; Brookfield and Padoch 1994; and Sandor & Furbee 1996). According to Barrera-Bassols, Zinck and Ranst (2005), local soil knowledge is a fusion of knowledge and practice, and the two are frequently difficult to separate. Previous research has expanded on the issue of 'outsiders' uncovering and representing indigenous knowledge (see Sillitoe, 1998) This was relevant for my own positionality as a researcher and as an 'outsider' to Kae village. In contrast to previous findings in ethnopedology on the impediments of being an 'outsider', I found my position brought benefits to the research: people made an effort to clearly articulate their knowledge, meaning and circumstances to me. However Sillitoe (1998) notes there are impediments to 'others' reproducing knowledge outside of the context in which it was created, and argues such de-contextualisation of knowledge contributes to distortions in understanding: 'The separation of knowledge from the humans who create, reproduce and manipulate it is questionable. When decoupled from its socio-cultural context, it can fall prey to ambiguous science-like representation' (Sillitoe, 1998, p.189). In consideration of the epistemological disconnect highlighted by SIllitoe, it was important to review ethnopedology literature which discussed attempts to developed methods for recording and reproducing indigenous and localised ways of knowing about the soil (see Birmingham, 1998 for discussion on alternative methodologies; and Sandor & Furbee, 1996; and Sillitoe et al., 2006).

As field work progressed and soil knowledge emerged, relevant literature was re-visited and new literature was interrogated to assist in contextualising the information being gathered. Local soil knowledge in Kae was described most frequently through conversations and actions associated with staple food crops and gardening practices. And it is for food and income that the people of Kae are most interested in preserving soil knowledge. Therefore literature demonstrating the importance of agriculture at a local and household level in PNG was reviewed to contextualise the soil knowledge examined.

2.1 How people relate to their soil: 'Local soil knowledge'.

The primary body of knowledge which underpins this research is that of indigenous agricultural knowledge (see Brookfield and Padoch, 1994; and Toledo, 2000). More explicitly it is the previous work on 'ethnopedology' otherwise known as indigenous and/or local soil knowledge. The term 'indigenous knowledge' is by no means well-defined. According to Sillitoe, it applies '…to knowledge which is local in extent and embedded in parochial cultural traditions…It is the heritage of practical everyday life' (Sillitoe, 1998, p.190). Ethnopedology has also been described as the investigation and documentation of local approaches to 'soil perception, classification, appraisal, use and management' (Barrera-Bassols and Zink, 2000, p.172, see also Birmingham, 1998; Lamers and Feil,

1995; Sandor and Furbee, 1996; Sillitoe 1995 and 1998; and Tabor, 1992). The term derives from accepted ethnoscientific practices published by Williams and Ortiz-Solorio (1981); Tabor (1992); and Sillitoe, (1996 and 1998). Barrera-Bassols and Zinck (2000), describe it as a 'hybrid discipline' structured from the combination of natural and social sciences, such as 'soil science and geopedological survey, social anthropology, rural geography, agronomy and agro-ecology'. There are some themes which recur throughout ethnopedology literature. For example key soil morphological properties such as colour and texture are recognised by most cultures (see Sandor and Furbee, 1996; and Barrera-Bassols and Zinck, 2000). It is also noted that topsoil properties are frequently described in detail by participants in ethnopedological research, whereas subsoils tend to be ignored. In addition many cultural groups recognise geomorphological processes which form soil, for example volcanic ash deposits, erosion and sedimentation (e.g. Warren, et al., (Eds.), 1995). There is also wide-spread recognition of certain soil properties and processes which reflect the application of local soil knowledge to the function of soil in land use, for example, the function of soil in meeting crop needs for water (e.g. Ostberg and Reij, 1998).

In 2006 Barrera-Bassols, Zinck and Ranst, published their work on approaching ethnopedology in a 'multi-scalar perspective' from global to regional to local. This addition to the literature brought together a holistic approach to analysing soil knowledge systems, based on three main social theories of soil and land resources, being the 'symbolic (Kosmos), cognitive (Corpus) and management (Praxis)', forming the 'K-C-P ethnoecological model' (Barrera-Bassols and Zinck, 2006, p. 119). Their main goal was to unfold and interpret the many relationships of soil and land resources with other ecological and agronomic features, as perceived by the local population. This information was applicable to this research project as it suggested that ethnopedological information should include local knowledge on soil components, soil profile description, soil nomenclature, spatial distribution of soil classes, soil behaviour, soil erosion recognition, knowledge about land-use potentials and restrictions, land crop suitability and limitation, and land management techniques (Barrera-Bassols, Zinck and Ranst, 2006, p.124).

The literature shows that ethnopedology may be fragmentary and is often shared more frequently and broadly on a local level, than specialised scientific 'best practice'. Previous studies of indigenous soil knowledge in Papua New Guinea (Bourke and Harwood, 2009; Hanson et al., 2001; Olliver et al., 1971; Sillitoe, 1998; Sillitoe, 1995; Sillitoe, 1993) have found that soil knowledge is usually not held by one authority but in the 'clustering' of particular knowledge within populations, for example by gender or age, or according to a specialist status (Sillitoe, 1998). There are also often power differentials based on common perceptions within the cultural group on race or clan, gender, age,

educational background, etc. that result in 'translation' and discourse differences and complications (e.g. Birmingham, 1998 on age and Koczberski, 2005 and 2007 on gender differences).

2.2 Swidden agriculture systems in PNG

The practice of shifting cultivation, or Swidden agriculture, has been present in the PNG landscape beginning from between 5,000 and 9,000 years ago (Golson, J. 1982, May and Nelson (Eds.), p.297-307). The people of Kae village practise a swidden agriculture system, which includes practices in use for generations, and also recently developed ones. The shifting agricultural sequences, and slash and burn regimes, are primarily used to enhance food cultivation, and therefore household health and security. However, swidden practices do not apply to oil palm blocks in Kae village. The long term-nature of oil palm (30 year growth cycle) as a cash crop means blocks are not rotated or fallowed often enough to be considered as 'shifting'.

Paul Sillitoe (1995) has recorded the swidden agriculture practices of a linguistic and cultural group in PNG, known as the Wola people of Nipa District in the Southern Highlands Province of PNG. The article: 'Fallow and fertility under subsistence cultivation in the Papua New Guinea Highlands: I. Fallow Successions' discusses the fallow and soil fertility practices of the Wola people, who Sillitoe characterises as both 'subsistence' producers and practitioners of swidden agriculture, which incorporates a sequence of shifting cultivation and burning for land-clearing purposes (Sillitoe, 1995, 82-100). The majority of Sillitoe's information on vegetation and fallow stages is presented in tables with adjoining discussion. 'Stages' of vegetative regrowth are also incorporated in the table in the Wola language. The use of the local lexicon as a divisive part of a data table, is made possible by a brief English interpretation of what the particular Wola term may represent, for example, 'Mokomba' meaning 'Coarse Grassland Regrowth' (Sillitoe, 1995, 85).

Sillitoes' article is an account of the author's perception of traditional knowledge, and knowledge which is indigenous to a people. Here the distinction is made between traditional and indigenous. Sillitoe is presenting information which is a mixture of practical techniques, names and uses of plants, and certain ecological data. There is no discussion as to whether this is knowledge which is considered as traditional, by the culture who proliferates it. Knowledge which is considered as traditional by the indigenous people who acquire it, may not be based on techniques or a nomenclature, but on a unique character, such as an underlying cosmology (Overing, 1989 and Brookfield and Padoch, 1994, p.9).

Sillitoe's article makes a number of distinctive findings, which are relevant for the results of the thesis, as both the Wola, and the people of Kae are practitioners of shifting agriculture. The following is a brief discussion of aspects of the Wola's soil management regime which are relevant:

Food gardens and encroaching vegetation:

The Wola encourage the emergence of small trees (such as banana trees) towards the end of the cultivation period, as these are an ecological cue that it is time to fallow the soil. These saplings form part of the 'secondary' regrowth stage that 'will restore the site's fertility during the fallow period' (Sillitoe, 1995, p.83). Rappaport (1968) argues that this practice protects the soil from serious depletion by making harvesting more labour intensive as crop returns decline. However, Sillitoe notes that the Wola are unlikely to relinquish their garden to regeneration while crops are still 'yielding an adequate return'. The equilibrium for the Wola to abandon a garden is when crop yield is in decline, and sapling growth is robust. Sillitoe speculates from this practice that the Wola '…are not attempting to manage their land resources to maximum effect; instead, they casually exploit and abandon locations to chance spontaneous natural colonisation and regeneration, risking possible degradation.' (Sillitoe, 1995, p.83). The Wola, like the people of Kae village, are well aware of the importance of fallow vegetation but make little effort to manage it intensively. Instead their approach is a function of the surrounding vegetation and what seeds it supplies to a site.

Regrowth or fallow management:

Once left to fallow, the uncultivated garden may pass through a series of successional changes until a sufficient period of time has elapsed. For the Wola, Sillitoe writes that the time which must elapse is the eventual passing away of all the people who had knowledge of that garden's existence. The living, then recognise the vegetation as 'virgin' and are able to return to cultivate it. The important finding here is that culturally and ecologically there is a broad sequence of regeneration which is well known to its custodians. While the transitions between the gradual changes in vegetation are not clear, the Wola can make the distinction and know which changes must occur before a fallow period can end.

Sillitoe also discusses the human influence of the non-management of 'natural regeneration' by indigenous people. 'Regardless of Wola claims that they exert little control over the sequence of natural regeneration on any site… their actions as gardeners may nonetheless influence it to some extent.' (Sillitoe, 1995, p.93). Meaning that, the length of time which the site was cultivated for, and the extent to which natural vegetation was cleared, may affect the species composition of subsequent regeneration. This also depends largely on the

individual choices of gardeners as to how thoroughly they use common practices on their garden, like burning to clear vegetation or weeding during cultivation periods.

Soil fertility management

A feature of the Wola's farming system is that all nutrient inputs for the garden's soil fertility are internally derived; nothing is added to the site from outside, apart from planting material to stock the gardens. Sillitoe characterises his approach with a more scientific explanation of the local fallow practices by explaining the nutrient cycle of regrowth (Sillitoe, 1995, pp.94-96). The secondary regrowth on abandoned gardens brings back to the surface minerals which have leached down the profile while the soil was exposed under 'shallower rooting crop plants' (Sillitoe, 1995, p.82). Thus allowing a garden to naturally regenerate improves, or at the least, maintains, soil fertility for successive crops.

Sillitoe investigated soil fertility changes which occurred after cultivation. Though he himself notes that from a local perspective, '…they have relatively little interest in it [soil fertility]' (Sillitoe, 1995, p.93). Soil management is not a deliberate action of the Wola, according to Sillitoe, but rather a beneficial consequence of the fallow sequence.

The importance of a 'central' crop.

The sweet potato (kau kau) occupies the majority of Wola food gardens (Sillitoe, 1995,p. 97). This crop also comprises approximately 75 per cent of all food consumed by weight according to Sillitoe (Waddell, 1972, in Sillitoe 1995,p.97). Notably, the Wola's agricultural regime depends on this crops ability to continue to yield 'adequately', as Sillitoe states, 'regardless of changes in soil fertility status with time under cultivation' (Sillitoe, 1995, p.97). Therefore the most influential factor causing change in the Wola agricultural system is the size and yield of their central crop.

Sillitoe's article on the Wola people is a good example of how indigenous soil knowledge can be embedded in the everyday practices of subsistence food produces in PNG.

2.3 Oil palm and the relationship with agriculture in West New Britain.

In West New Britain province the primary source of income is oil palm plantations, followed by food gardens. The literature covering WNB agriculture (Koczberski and Curry, 2005; Koczberski and Curry, 2007; and Koczberski et al., 2012; Hanson et al., 2001; and Bourke and Harwood, 2009) unavoidably intersects with oil palm on numerous levels, such as socio-economic developments, ecological

changes and food security. The repeated connection in the literature, between a geographic place and crop, characterised the way this research was approached.

The major contributor to socio-agricultural literature on the oil palm-growing areas of WNB is Gina Koczberski of the School of Social Sciences and Asian Languages at Curtin University, Australia. Koczberski has been researching and recording socio-agricultural issues in WNB for over two decades. Her work encompasses the influences of oil palm on environment and community, cropping systems, food security and gender roles in agriculture (Koczberski and Curry, 2007; and Koczberski et al., 2012). Koczberski also reiterates certain themes in her work, often described as 'socio-economic pressures', which have manifested in WNB from oil palm including, but not limited to: rapid population increase, decline in available arable land, food shortages, and reduced fallow periods (Curry and Koczberski, 1999; Koczberski et al., 2001; Koczberski and Curry, 2005; Curry and Koczberski, 2007; Koczberski, 2010; and Koczberski et al., 2012).

Koczberski focuses on a particular socio-economic group of oil palm growers, the 'Land Settlement Scheme' (LSS) smallholders (see Curry and Koczberski, 2007; and Koczberski 2010). Koczberski notes that the characteristics of this group make them highly vulnerable to rapid environmental and socio-economic change (see Appendix 6 for information on oil palm stakeholders). Koczberski and Curry argue that while smallholder oil palm growers in WNB have demonstrated a persistent ability to adapt to change, the swift expansion of the oil palm industry has seen land use intensify, cultivation systems change, and the expansion of food crops into less than suitable areas (Curry and Koczberski, 2007; Koczberski and Curry, 2012).

The article by Koczberski entitled 'Loose Fruit Mamas: Creating Incentives for Smallholder Women in Oil Palm Production in Papua New Guinea' (2007), presents a relevant case study on gender roles in smallholder oil palm communities. Koczberski investigates opportunities to expand gender and labour relations on oil palm blocks for a more 'gender equitable payment scheme'. Koczberski notes:

'…clear division of labour by gender and age. The heavy task of harvesting fresh fruit bunches (FFB)…is the work of men, with elderly males relying on their sons or other male relatives to harvest tall palms. The collection of loose fruit during harvesting is culturally and institutionally defined as women's work' (Koczberski, 2007, p.1176).

Chapter 3: Methodology

There is no one way to 'do' ethnopedology, as it is positioned at the intersection of the natural and social sciences. Therefore no single methodological approach was appropriate to cover the scope of this research project. 'Hybrid' methods and analysis tools were used to gain insight into and evaluate local soil knowledge and practices. Similar interdisciplinary or 'integrated' approaches have been undertaken on a wider scale by Birmingham (1998) and Barrera-Bassols and Zinck (2003). Birmingham, among others, has detailed the need to describe and analyse the approach and methodologies used in recovering local soil knowledge with a view to improving future research. The methods used during this research project are situated under the broad umbrella of discourse analysis. Discourse analysis has a malleable framework which best suits the 'learn as you go' approach taken to field work, and was also able to integrate an ongoing analysis of literature.

To collect primary data on the cultural and ecological contexts in which soil knowledge was integrated, a combination of well documented anthropological qualitative research techniques were employed. These include, but are not limited to: participant observation; field notes; coding; mapping; visual ethnography; and unstructured interviewing (Hay (Eds.), 2008). The material produced from these methods created a discourse distinct to a community on soil knowledge/practice which could be interrogated as part of the ongoing discourse analysis (For information on doing discourse analysis see Wait in Hay (Eds.), 2008). Basic soil science field observations were also conducted such as texture and colour.

3.1 Theoretical approach of study: previous approaches in PNG

Research rigour requires practitioners of qualitative research to discuss their methodologies, (Edwards, 2003). In line with this requirement, the 'skill' approach of 'Discourse Analysis' (Waitt, 2008, in Hay ed., 2008, p.179) was the most appropriate methodological framework for addressing the research objectives, in a 'hybrid discipline' (Barrera-Bassols, et al., 2006), in the context of a different knowledge culture. Several texts for qualitative methods in social sciences have been hesitant to prescribe structured guidelines for what is known as 'Foucauldian Discourse Analysis' (see Hay, 2008; Phillips and Hardy, 2002; and Potter, 1996). Discourse analysis can be positioned as a 'craft skill' (Potter 1996, p.40); which is the researchers ability to customise 'rigorous scholarship' (Gill, 1996, p.144), or 'human intellect' (Duncan, 1987, p.147).

Discourse analysis is not widely known for its association with agricultural research, though there are some notable examples of how it can be used to produce meaning from complex human ecology

structures, such as gender identities in Australian and New Zealand farming. Ruth Liepens of the Department of Geography, University of Otago (New Zealand) has used discourse analysis to examine representations of masculinity in agricultural professions in Australia and New Zealand (Liepens, 2000). Liepen's work explores the discursive processes constructing gender relations and identities across a range of key agriculture-related masculinities. Examining masculinity in agriculture is a good example of how discourse analysis can be used to deconstruct long held beliefs, and the social process and behaviours which reinforce them.

Berit Brandth and Marit S. Haugen (2005), also use discourse analysis to look at gendering process in farm forestry. Brandth and Haugen analyse what they consider the 'main sites' of discourse in forestry being the Magazine of Forest Owners, and also at the physical site of forestry work (Brandth and Haugen, 2005, pp. 13-22). The work of Brandth and Haugen highlights a common tool in doing discourse analysis and that is to establish the text or sources of discourse upon which your analysis of 'truths' about a particular subject relies. This is also part of a discursive process, where as a researcher you must limit your scope in order to produce meaning about a particular topic. In other words, the researcher's perspective is important to examine as a 'source' of a discourse analysis approach.

This literature review introduces some sources which add to the discourse on soil used for agriculture in WNB, such as texts about WNB agriculture primarily by Gina Koczberski, George Curry, and Paul Nelson. Texts by Paul Sillitoe, Barrera-Bassols et al., Birmingham, Brookfield and Paddoch, and Sandor and Furbee also contribute to the discourse on local and/or indigenous soil knowledge. In addition to these sources, the majority of the discourse contributing to the representation of soil knowledge in Kae came from the people themselves. Therefore field notes, photographs, and recordings also form part of the discourse to be analysed.

To scrutinise the structure of 'sources' identified as forming the discourse on local soil knowledge, strategies were adapted from the work of Rose (2001):

1) **Suspend pre-existing categories: examine texts with fresh eyes and ears.**

   For example, pre-existing categories included soil maps of the study area by Zijsvelt and Torlach, (1975). Such soil maps and scientific resources established particular preconceptions about what is considered valid soil knowledge. While beneficial as a source of reference, attempts had to be made to suspend pre-existing scientific soil classifications to be able to record locally embedded categories which arose from field work.

2) **Familiarisation: absorb yourself in your text/sources.**

For example, preliminary research focused on work by Gina Koczberski and George Curry on environmental and socio-economic pressures associated with the oil palm industry in WNB. Further, field work was part of the familiarisation process, and the categories of knowledge used in the results arose from these interactions rather than being imposed from elsewhere.

3) **Coding: identify key themes to reveal how the producer is embedded within particular discursive structures.**

For example, garden practices continually reiterated during field work were connected to growing taro, and this relation shaped soil knowledge and identified the purpose of the knowledge.

4) **Persuasion: investigate within texts/sources for effects of 'truth'.**

For example, while investigating **how** particular soil knowledge is produced I also assessed **why** the discourse is considered to be valid and true. Devices such as repetition and connection to what your 'parents' taught you acted to perpetuate soil knowledge and practices which were accepted by most people as common sense.

5) **Incoherence: take notice of inconsistencies within text/sources.**

For example, there were points of difference between Koczberski's findings on gender roles and socio-economic pressures within the smallholder oil palm growing community in WNB and the oil palm community in Kae village. Further inconsistencies included notable differences in soil knowledge between men and women in Kae, and between people of different ages.

6) **Active presence of the invisible: look for mechanisms that silence.**

In other words the active presence of absent items in the texts: 'absences can be as productive as explicit naming: invisibility can have just as powerful effect as visibility' (Rose, 2001, p.157). In this instance previous work on the WNB oil palm industry had not included the experiences of customary land owners and their agricultural regime as they were not considered 'vulnerable'. Therefore the presence of indigenous people was not widely included in the geographical knowledge of the area.

7) **Focus on details**

All of the above.

(Adapted from Rose, 2001, p.158)

3.2 Experience of the researcher

Discourse analysis requires a certain level of self-analysis on the part of the researcher, or at the very least an 'identification of the subject position of the author' (Waitt, G. 2008. p. 185). It is therefore relevant to the theoretical approach that my experience as a researcher be listed as a 'source' on which meaning can be gained.

For an honours project it is appropriate that the undergraduate background of the researcher be acknowledged as this is the immediate tertiary influence upon an individual's world view. I have a bachelor's degree in Interdisciplinary Studies (Environment and Sustainability), which arguably fosters distinct ways of perceiving the world and unique ways of framing a 'problem'. Other obvious and inexorable influences such as my gender, also contributed to how meaning was established during field work interactions, and therefore the perspective of the authorship. Gender is important as we often ascribe characteristics to people on the basis of gender. Further, personal interactions vary with the gender dynamics between the participant and researcher; we tend to react differently to men and women, regardless of cross-cultural settings (Dowling, in Hay (ed), 2008).

The human geographer, Robyn Dowling (2008) suggests: we are never able to simply be either an 'insider' or an 'outsider' during qualitative research. We have overlapping gender, racial, ethnic and socio-economic characteristics. Both researcher and informant have multiple social qualities and roles producing many points of similarity and dissimilarity between each other. The researcher's ability to interpret situations also depends on these characteristics. In terms of my experiences in Kae, gender and possibly my age contributed to power dynamics between myself and informants. It was possible to establish rapport and points of similarity with certain segments of the Kae community, which provided an opportunity for in-depth soil knowledge to be clearly articulated to me. As a female researcher, younger than most of the Kae food gardeners, and an 'outsider' to the village, I found it comfortable and practical for the collection of information to adopt a teacher-student (myself) relationship with the women gardeners. Further, when interacting with men of different ages during research, my female persona also changed, to a more conservative approach, to facilitate communication. Similarly, Hilary Winchester found that she adopted a 'typically

feminine role' when interviewing single fathers, and this facilitated conversation and aided her research in gathering the men's stories (Winchester, 1996).

3.3 Desk based research

Throughout the project collation and analysis of relevant published work was carried out. Initially literature provided introductory and background information on agricultural and the oil palm industry in PNG. Concurrent with field work, the reviewed literature reflected major themes in WNB which intersected with agriculture, such as food security. Finally, literature (e.g. Sillitoe; Barrera-Bassols & Zinck; Birmingham; Sandor & Furbee; and Ollier) was used during analysis of findings as part of the discourse on local soil knowledge.

Previous soil survey work (see Zijsvelt and Torlach, 1975; Bleeker, 1983; and Machida et al., 1996) established a history of recorded soil knowledge in WNB. Zijsvelt and Torlach (1975) produced a comprehensive map (1:50,000 scale) of the coastal plains and hills on the north coast of WNB, between the Ala and Kapiura rivers, the region in which the study site was situated. These soil sources were fundamental in understanding the soil distribution and soil properties of WNB. However they are considered to be a technical science text which is evident by the discourse used, and by the medium it was published and distributed in. The expected audience of this text is primarily considered to be the government and technical advisory community. The WNB soil texts do not include the perspective of indigenous and local peoples.

3.4 Specific field work methods

A range of qualitative methods, common to cultural anthropology, were used during field work. Details of how techniques were utilised to illicit culturally relevant information on soil are listed here. These methods were not undertaken in any set format and occurred when necessary and practical to the context.

3.4.1 Timing

Field work was undertaken in three separate research trips to WNB between February and July 2013. The trips comprised of approximately eleven days in Kae village, and four days at the Dami research station with personnel from the PNG Oil Palm Research Association (OPRA). The times selected for interviews and food garden visits were those most convenient for those who chose to participate. Culturally appropriate scheduling yielded a more representative sample of those actively

engaged in food gardening and oil palm cultivation (e.g. women had domestic responsibilities at certain times of the day which were best respected).

3.4.2 Participant selection

Participant selection commenced from a number of different avenues prior to field work. The village council was contacted on my behalf by staff from the PNG Oil Palm Research Association, who had established cultural and work relationships with Kae community leaders. OPRA staff arranged with the village council for my research to take place in Kae; a host family for me to stay with during field work; and access to oil palm growers who wished to participate in the research project. Utilising the cultural agency of OPRA staff was a time-effective and cost-effective means of requesting the involvement of Kae food gardeners and oil palm growers in the research.

Further, OPRA staff assisted in bringing together people from the village at the central betel nut market. The purpose of this casual village meeting was to introduce myself and the purpose of my research to the people prior to field work commencing. An information sheet about the research and the request for participants was provided to attendees in both English and Tok Pisin (see Appendix 3 and 4). I asked for people who wished to participate to speak to me after the meeting. This strategy produced a large number of willing participants, and over the course of field work more people notified me they wished to participate in the study. In summary, participants were selected by means of the recommendations of the village council, OPRA and OPIC; the village meeting process; and most consistently by my presence in the village and word of mouth.

3.4.3 Participant observation and interviews

A range of practices were utilised to create a space for an exchange between researcher and participants. I arranged to accompany women to their food gardens and to work with them for the day if they would like the help. The willingness to participate in daily activities created the context where one could ask to be taught the techniques for planting taro, and other crops, and ask about livelihoods, and share stories.

Participant observation included all aspects of time spent in Kae village. In agreement with Robin Kearns: watching and participating in village life was the only way to gather contextual information which 'complements the aggregated data gathered by more formal means', and assists in interpreting the knowledge embedded in a place (Kearns, 2008, in Hay ed., 2008, p. 194).

Unstructured interviews occurred mainly with male oil palm block owners. As a young female there was more agency for me to interact with my own gender in the space of the food garden, in which I could take on the role of 'student'. On the other hand, access to information about oil palm

cultivation practices was through the owner of the block, who was generally male. As a westerner, I was clearly outside the cultural constructions of gender in the village. Nonetheless instincts and previous experience in PNG implied a more formal approach should be taken when interacting with men. Information on managing an oil palm block was gained through sitting in the communal household space (generally the haus kuk) and conversing with the block owner. The family of the block owner was always present. Conversations were not structured, but did have similarities in progression and in the establishment of 'truths'. For example conversations generally began with a sharing of personal information: why I am here?; am I married?; do I have children?; How many?; Do I have siblings?; What age? What does my husband do? This would be followed by information which established what the participant thought he *should* say to me, such as questions about who I work for, and who else have I spoke too.

The local soil typology was primarily established from the first practical session with each food gardener. The local typology evolved gradually as more soils were identified and described. Participants gradually pre-empted the knowledge which I was interested in and volunteered to show me the different soil types in situ. This allowed for further assessment of what was being described and observations of what the soil was being used for. This approach to creating a preliminary local soil classification is similar to Birmingham's work with four villages in West Africa (Birmingham, 1998) and Sandor and Furbees anthropological approach in Colca Valley, Peru (Furbee and Sandor, 1996). However, both those research projects also undertook scientific soil surveys during field work for comparison with local knowledge.

All interviews were recorded on a dictaphone, whether conducted in the food garden, the village proper, or oil palm blocks. Recorded material was reviewed daily, sometimes with the assistance of the translators, and additional notes were taken on the content.

Note taking during unstructured interviews also established meaning, as this technique implies a level of formality in a culture where written information is generally undertaken by someone in an 'official' capacity like a teacher or magistrate.

3.4.4 Field Notes

Field notes are a basic skill of research and the basis for reviewing and deconstructing information captured in-situ. Field notes were taken continuously during field work, and across contexts, such as interviews of oil palm block owners to information on soil practices in the food garden. Taking notes during a conversation also allowed quantitative information to be recorded, such as how many people were working on the block, how often fertiliser was applied to soil, and how many crops types were planted in the food garden. Such 'counted' information was useful for establishing

trends, which could be coded, but was ultimately too reductionist to develop any comprehensive understanding of place and is not presented in this thesis.

3.4.5 Recording unwritten Nakanai terms in the Vere dialect.

A central part of field notes was the recording of Vere terms for different soils, plants and environmental features of relevance. In order to report on findings there was a need for the spoken language to be recorded in written form. Establishing written norms for an 'unwritten' language is called Orthography, and this requires in depth knowledge of more than words. It must cover the relative placement of letters, word spacing, punctuation, diacritics, capitalisation, hyphenation and other aspects which may be relevant in a written standard. Orthographies must also be '(a) linguistically sound, (b) acceptable to all stakeholders, (c) teachable, and (d) easy to reproduce' (Cahill and Karan, 2008, p.3). The research objectives were not to develop an acceptable orthography for the Vere dialect of Kae. Though the words used by participants to describe soils were a considerable component of research.

The symbols for phonemes and graphemes for the Vere dialect were based on symbols already recorded for the Nakanai language by Johnson (1978 and, Johnson in Franklin (Eds.), 1981). If a repeated sound was not represented in the documented language, then the existing phonetic system was used along with established linguistic conventions of Tok Pisin, a language that Vere speakers already have knowledge of. It is also relevant to note Cahill and Karan's (2008) findings on *doing* an orthography that sounds also differ when spoken individually and apart from naturally flowing language (e.g. a participant repeating or sounding out a soil term for the benefit of the researcher).

3.4.6 Coding and Mapping

The technique of replicating a food garden in the form of a 'birds-eye-view' map was employed during field work for its practicality in recording important physical spaces and their characteristics, such as local soil classifications and crops. As part of field notes, maps were coded to represent information which was consistently being reproduced, such as where different soil types and crops were in the garden. Coding and mapping simplify a complex landscape, only including information of value to the author's perspective. In simplifying an agricultural system to maps and symbols there is an obvious loss of content. However, coding was used here for its practicality, as information had to be mapped quickly and accurately in the field.

3.4.7 Photography

Photography was used to capture images of information which the author identified as important. It also captured 'inconsistencies' in the discourse, such as when aging or slope gardening changed the

common gardening practices. The role of photography in field work was evidentiary, visually chronicling the data collected.

Photographs form part of the discourse, and can also identify the subject position of the author and the intended audience. For example photographs in this regard, are used to show a 'truth' of an experience to an audience who has little knowledge of that encounter. Photography can also be used to construct authenticity as the medium itself, in the context of qualitative research, signifies a faithful visual reproduction of a time and place.

Photography also formed part of an unintentional process of reaffirming results from previous field work in Kae. During initial field work I took photographs of soil samples which were identified and given certain characteristics by local food gardeners as part of the field notes process. In subsequent field trips people asked to see my photos from last trip and as we went through the garden and soil photos on the camera, individuals (of various ages and genders) would name the soil type from the photograph. Birmingham (1998) also used similar exploratory techniques with his participant group by creating deliberate 'exercises' where individuals looked at soil samples months after the initial collection. The participants were asked to identify unlabelled soil samples, and also give their reasons for identifying it as a particular soil type.

3.4.8 Soil science techniques

Soil samples were taken from the top layer (0 horizon and A horizon) of the soil profile, from each identified soil type in the food garden only when it was possible to do so. The top layer of the profile comprises the 'soil' described by the participants. Soil texture and soil colour were determined. Both aspects of soil are recordable in the field. Soil texture was measured using techniques from the Australian Soil and Land Survey Field Handbook. A small handful of soil was moistened and kneaded into a ball (called a *bolus*) and then pressed between the thumb and forefinger to produce a 'ribbon'. The behaviour of the soil during the formation of the bolus and in the production of the ribbon is indicative of its texture. The Australian Soil and Land Survey Field Handbook commonly recognises 19 grades of texture which indicate the approximate percentage of clay, silt and sand in the soil profile. For example a Silty clay (SiC) bolus will feel plastic and be smooth and silky to manipulate, it will commonly form a ribbon of 5cm to 7.5cm, indicating a clay content of 35 to 40 per cent (see Australian Soil and Land Survey Field Handbook, 3rd ed). Colour was described by scoring hue, value and chroma (Munsell Soil Colour Book, 2009). Observations on visible organic matter were also possible with the different soil types of Kae.

Chapter 4: Common soil practices in Kae Village

This chapter presents a translation of the soil classifications of Kae within their context. The chapter is organised as follows: the first part presents and explains soil descriptions; which is followed by two case studies of soil knowledge connected to major soil types and their relevance for crop production. The chapter concludes with a brief discussion on the lack of soil knowledge connected to oil palm cultivation.

The results presented in this chapter are a collaborative translation of the soil classifications in the Vere dialect of the Central Nakanai language (see section 4.2.3 for language and translation methods). The language used for describing soil reflected extensive knowledge about soil characteristics, the surrounding environment (including biota), and the length of time it had been cultivated for. Sillitoe's 1995 article on the Wola people of Nipa District in the Southern Highlands of PNG establishes that local language terms are important to a discussion on soil knowledge. In the context of Kae, particular terms used to describe particular soil -- such as 'Parra-kurru magassa' -- initially appeared to have a simple literal English language translation such as 'black soil'. However, the local language meaning was actually embedded with complex significance if understood in the context of the village. These four syllables, 'Parra-kurru magassa', provide information on an ecosystem which if spoken in English, take multiple sentences to articulate. Parra-kurru magassa is the major soil type belonging to Kae and in this respect it literally tells a Central Nakanai speaker where they are in the world. It tells you what you could plant there and for how long. This soil is historically and currently used for taro the major staple crop of Kae. It tells you that this soil, before the area was cleared for gardening, was a forest environment with mature trees and dense decaying organic matter on the ground. This is the type of landscape Kae villagers seek out to clear for cultivating the fertile soil underneath. It is also the state they wish to restore a food garden to during fallow.

4.1 Central Nakanai – Vere dialect: soil descriptions.

The soil descriptions presented in Table 4.1 are derived from conversations which took place during garden work. The knowledge surrounding each soil type was assessed to form a classification system based on the reoccurring soil characteristics which people articulated. Figure 4 builds on the classifications in Table 4.1 and demonstrates how this soil knowledge is embedded in broader understandings about the local landscape. Both Table 4.1 and Figure 4 are interpretations of knowledge which is indigenous to a people, but not necessarily considered as traditional knowledge

by its custodians. Table 4.1 and Figure 4 presents practical, everyday knowledge that people did not consider 'traditional' in that soil terms were not ancestral cultural information.

Table 4.1: Local soil classifications

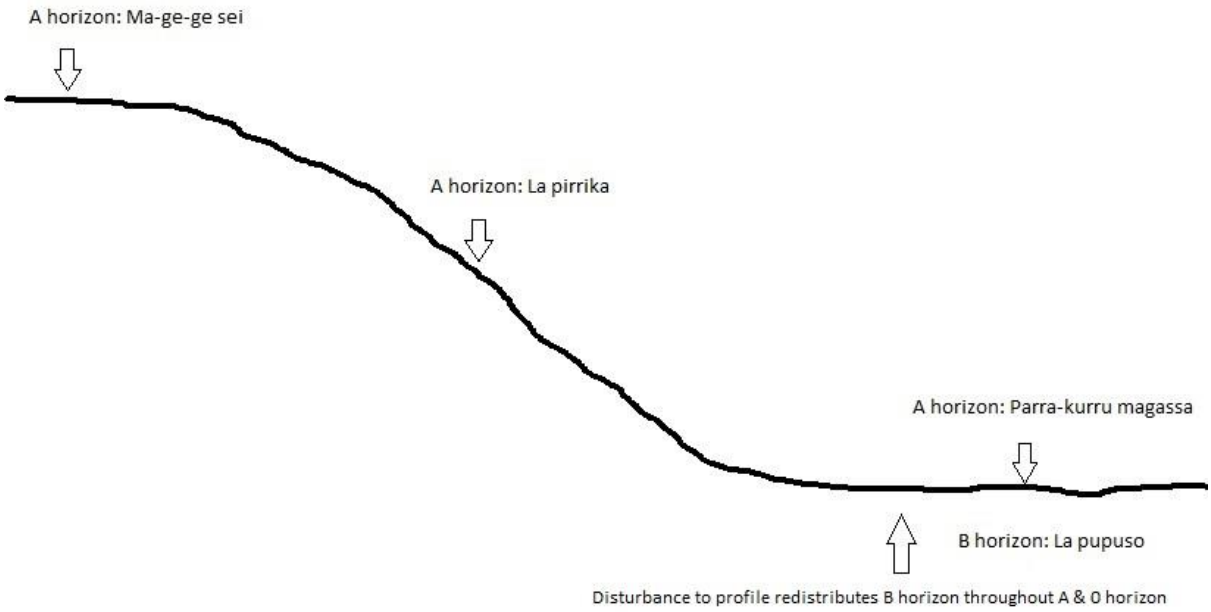
Vere dialect, Central Nakanai language soil types	Description	Associated crops	Vere dialect, Central Nakanai language crop type
Parra-kurru magassa	Predominant soil type of Kae. Literally meaning black (parra) roots kurru) soil (magassa). It is a dark soil with high levels of organic matter. It has good drainage and is difficult to form a firm bolus when squeezed in the hand (it is not strongly coherent).	Taro Betel Nut	La mavo La so so
La pupuso (also called pumice soil by local people)	A mix of a clayey B horizon and underlying pumice layer (see photo 2) brought to the surface by disturbance. It is yellowish brown in colour, with a high clay content and poor drainage compared with Parra-kurru magassa. Small to medium stones are common throughout the profile.	Sweet potato (Kau kau) Yam Aibeka	La kuroo vei La hu-vei and La se-se
La pirrika	Soil found in middle of slopes outside of Kae. Considered a mountain (Goi goi vei) soil. Considered to be a reddish colour by the people of Kae, but similar in colour, composition and characteristics to La pupuso. This soil is considered unsuitable for growing taro by Kae people. However if your garden is on a slope you plant all crops in this soil.	Taro - various varieties Sweet potato Yam – various varieties Aibeka Tapioca Beans Spring onion Banana (out of necessity and lack of access to Parra-kurru magassa)	
Ma-ge-ge sei	This soil is not found in Kae. I am told it is found at the top of the mountain and is red in colour with little to no organic material and low clay content.	Tapioca	La bow

Photo 1: Example of Parra-kurru magassa from Ruby's garden

Photo 2: Example of La pupuso from Ruby's garden

Photo 3: La Pirrika sample from mid slope in Paula's garden

Figure 4: General distribution of local soil classifications in the landscape

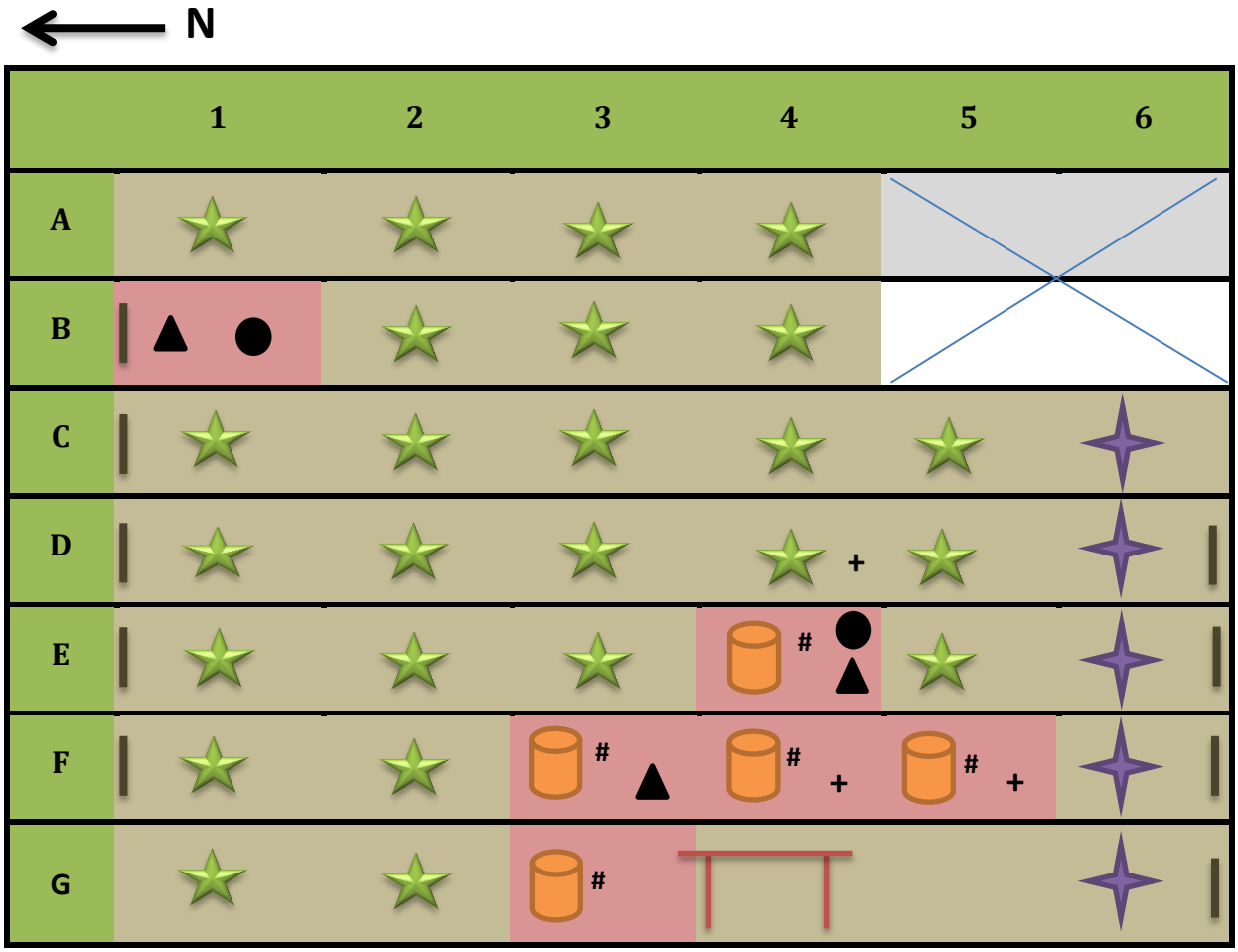


4.2 Ruby's garden

Ruby's garden was typical of the gardens I visited in Kae. It represents the clustering of certain knowledge pertaining to women, gardening and soil. Ruby's garden was approximately 40metres wide by 85metres long. Aspects of the environment which Ruby spoke about as important to her garden regime were the presence of black nutrient rich soils, the surrounding vegetation which was mainly mature trees, the weather which Ruby remarked was changing to 'longer bigger rains', and the slight slope of the block as it affected drainage. I asked Ruby to show me the soils on her block. Ruby showed me two different soil types as we weeded and scared off birds: Parra-kurru magasa and La pupuso. In explaining why the soils were different, apart from their appearance (colour and texture), her choice of language illustrated it was about the *type* of crop which could grow in the soil, and the crop's significance for household food. These two soils were used for different crops and Ruby had used different cultivation techniques to manage the crop/soil relationship.

The following information comes from discussions with Ruby about her food garden, and from observations along with practical experience. Ruby's garden is just one example of the soil knowledge/practice in Kae which was repeated during participatory interviews in the food gardens. While represented in one place (Ruby's garden) the collection of this local soil knowledge evolved gradually on the basis of fragmentary information and the way in which the local soils were described.

Figure 5: Ruby's garden



Key

- Planted with taro
- Garden shelter
- Popondetta taro
- La pupuso
- Parra-kurru magassa
- Soil with no name/ water pooling
- Tree stump
- # Aibeka planted against tree stump
- Yam
- + Non-staple crops (cucumber, shallots, chillies)
- Sweet potato (kau kau)
- Border logs

4.2.1 Choosing a garden site

Ruby chose her garden site based on her knowledge and shared knowledge in the community, of time since last cultivation, along with observations of the vegetation. The area Ruby chose to clear and cultivate is pronounced in the Vere dialect as, 'Lay-la-lee la ma-hu-ma', which literally means a food garden for taro. This term is applied to sites with certain pre-cultivation characteristics which are apparent to the people of Kae. These characteristics may include, but are not limited to, a position far enough away from oil palm blocks and being close to a river, but not at the river level or below it. It also means if the site was previously cultivated, it has reached a regrowth stage where the area is considered 'virgin' or 'new' (there was a difference in translation). Observations based on a number of abandoned garden beds in various stages of regrowth, indicate that the final stage of regrowth includes mature trees dominating the area and dense leaf litter covering the ground underneath. According to the gardeners of Kae, this process takes around seven to ten years (See photo 5). Unlike the Wola (Sillitoe, 1995), the people of Kae do not wait for all people to have known the garden to have died. Ruby's daughter Layla told me her son, who was now in his sixth year, was born around the time they abandoned one of the garden sites (see photo 5 for bush regrowth). The state of regrowth of the bush was then used to estimate the average age of the abandoned gardens as being either less or more than six years of regrowth.

I waited until Ruby brought up the food gardens proximity to an oil palm block before asking any questions on the subject. I did not want to introduce the idea that oil palm may be detrimental to soil health. Ruby told me about her belief that a food garden should be far away from an oil palm block as possible, considering land availability. Photo 3 shows the walk to Ruby's food garden, with the estimated distance from the central village to the garden being approximately two kilometres. Along the path we passed abandoned gardens, houses, and forest segments. Ruby explained that taro came up smaller and takes longer to grow, when planted close to oil palm blocks. The reason she gave was that the palms 'suck up all the water in the ground', leaving little for the taro to grow. Ruby's wariness of planting near oil palm was framed by her understanding of an expected decline in taro growth. Ruby's understanding of the oil palm's sucking up ground water may be feasible according to a previous study by Zaharah et al., (1989) on Malaysian oil palm blocks, which found that oil palm roots can be active up to 36metres from the stem.

Photo 4: Ruby, her sister and a number of children from the village walking the distance to Ruby's garden

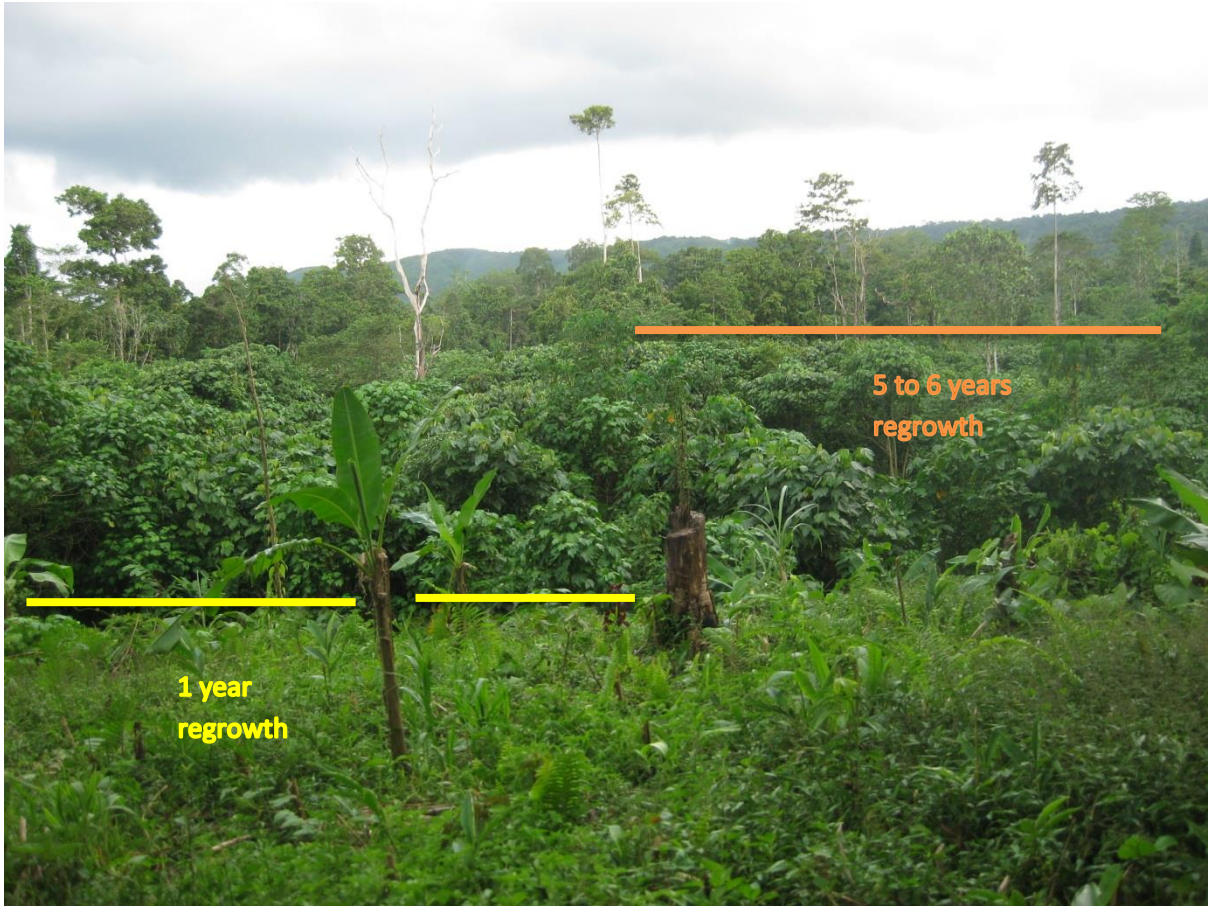


Photo 5: Example of two different stages of bush regrowth. The foreground of the photograph shows a garden which was abandoned one year ago. The saplings in the background are regrowth from five to six years ago.

4.2.2 Parra-kurru magassa – good soil for taro

Ruby also planted a taro test crop, which is a common pre-clearing practice in Kae village. By doing this Ruby confirmed her assumptions that her choice of location had the highly valued Parra-kurru magassa - black soil, and its soil fertility or 'gris bilong graun' (in Tok Pisin) was good. If the taro came out an appropriate size (see photo 14), then Ruby's husband and family would help her clear the block ready for cultivation. If the test taro was too small, Ruby would look for another garden location, and leave the current area to rest for more time. Ruby's gardening regime was highly interconnected with the overall ecology. If one aspect did not provide the right feedback into the system, such as a small taro test crop, Ruby would adapt and change her cultivation choices. Ruby's skill in reading the soil's capabilities based on one or two vital signs was a combination of knowledge passed on by her mother, with further refinement by Ruby over her life-time through trial and error in the garden. Ruby's acquisition of soil knowledge is as Sillitoe describes, '…the heritage of practical everyday life, with its functional demands, and is fluid and constantly changing, being subject to ongoing negotiation between people and their environments' (Sillitoe, 1998, p.189).

In contrast to the principal Parra-kurru magassa/taro relationship found in the soil knowledge of Kae, Sandor and Furbee reported on a broad 'secondary' local soil classification category as 'soils considered suitable for agriculture', from the indigenous soil knowledge of the Colca Valley, Peru (Sandor and Furbee, 1996, p.1507). Instead of an overt soil/crop regime being present in the local discourse on agriculture, Sandor and Furbee found that 'a number of soil physical and chemical properties and landscape features are seen to be incorporated into the indigenous knowledge framework' (Sandor and Furbee, 1996, p. 1507). The soil and central crop association depicted in Ruby's garden knowledge/practice better reflects Sillitoes' findings on the Wola (in PNG) people's garden regime around a central crop's (sweet potato) soil requirements (Sillitoe, 1995). However, as Figure 4 shows, local soil classifications in Kae are also indicative of where a particular soil type is present in the landscape, for example Parra-kurru magassa is found on flat ground at the bottom of slopes.

4.2.3 Clearing the soil

Once the taro test crop is finalised, Ruby prepared her garden according to her soil classification on the block. As the majority of the new garden was Parra-kurru magassa, the block was first cleared (see photo 6). Hard timber was taken for building or used as border logs for the perimeter of the garden (see photo 7 and Figure 5). A number of tree stumps were left to fulfil cultivation requirements for certain crops. All the remaining cuttings from clearing the block were then left in the garden to dry. After approximately two weeks of sunny weather the block was ready to be burnt. The final stage of clearing was burning the dry matter, and leaving the ash on top of the soil ready for planting.

Photo 6: Cleared garden site drying out in preparation to be burnt.

Photo 7: Large tree cleared from garden site and used to mark the border of the garden

4.2.4 Burning and the soil

Ruby spoke about fire doing two things for her garden's soil: 1) it 'sanitised' the soil, killing diseases and parasites which may affect her crops; and 2) it made the taro 'come up good'. Ruby knew that taro came up faster and healthier when planted into the ash which formed the 0 horizon, or top soil (see photo 8). Discussing the use of fire in the garden with Ruby also established that there was a relationship between the use of fire for clearing and soil preparation and the weather. The clearing and drying stage of garden preparation, Ruby noted, had to occur in the dry season in order for cuttings to dry sufficiently enough to be burnt on the garden block. Ruby had also previously commented that the weather was changing and the rain season was lengthening and intensifying. A change in the rain season would be expected to pre-empt a change in the timing of the agricultural sequence in Kae. When asked directly if the weather changes Ruby had previously mentioned had affected her garden preparation or her use of fire, Ruby replied they had not. Pausing a while, Ruby then qualified her first response by suggesting 'maybe it will soon'. I asked Ruby why she thought change may happen 'soon', and she did not know. The translators then indicated to me that Ruby thought I needed an answer. As Ruby offered no more information on this topic voluntarily and my

line of questioning seemed to be overtly manipulating her response, I did not pursue it further. From this interaction it was apparent that Ruby was aware of seasonal change occurring but had not definitively attached it to a cause.

Photo 8: Recently burnt garden in Kae. Logs selected for construction are piled in the background, while the topsoil in the foreground is covered with ash and ready to plant.

4.2.5 Planting of the soil

After burning the block, the Parra-kurru magasa soil is ready for planting. All available black soil is used for taro, which is planted by hand directly into the ash-covered topsoil (see photos 9, 10, 11, and 13). Ruby told me that she prefers to plant on the very hot days, 'when the air does not move and the birds fly low', as this usually means rain would come later in the day to water her newly planted taro crop. Ruby was also given some Popondetta taro 'suckers' as a gift from her relative (see photo 9). The soil preparation for this taro differed from the local taro. Popondetta taro was planted close to the boarder of the garden for ease in locating it (see Figure 5, quadrants 6C to G). The planting area also received a second burn, of a small localised fire, about 60centre-metres wide. The ash from this secondary fire was piled up in a small mound and the Popondetta taro was planted

directly into the ash mound. While the soil was treated differently for the Popondetta taro, the two-burn practice had similarities to the other garden practices, in that all actions were multipurpose. The most regularly articulated reason was for the second burn was that it increased the fertility of the soil, and therefore increased the likelihood of success of a rare and valuable taro. With two burns, Ruby speculated, it is less likely any bug, such as the taro weevil, would affect the taro, and twice as likely that the taro would have plenty of 'plant food' (from the ash) to grow.

While considering which parts of field work data to utilise for constructing a narrative, it came to my attention that in the example of the Popondetta taro and Ruby's soil practices, I may have recorded Ruby adapting her soil knowledge for an unknown element (introduced taro). Unfortunately this moment of realisation did not happen during the time with Ruby, and I am therefore only able to briefly comment on what was observed.

Photo 9: Popondetta taro planted in secondary ash mound near boundary log

Photo 10: Ruby's sister demonstrating how to plant taro into the burnt topsoil

Photo 11: Ruby's sister finishing planting the taro sucker. A freshly burnt patch of soil is visible behind her, it will be planted with taro soon.

Photo 12: New taro 'suckers' which Ruby and I planted into Parra-kurru magassa:

Photo 13: A newly planted taro garden (approximately 2 months old). The burnt topsoil is still evident.

Photo 14: Example of a 'good' sized taro harvested from Kae. This indicates the Parra-kurru magassa is still fertile

4.2.6 Maintenance of Parra-kurru magassa

Figure 5 shows the majority of the garden is Parra-kurru magassa, with high fertility, for growing taro. Ruby's garden was on its fourth consecutive taro planting and according to Ruby the soil was still producing large healthy taro. No fertiliser or outside inputs (such as compost or green waste) had been added to the garden. Ruby weeded the garden almost daily. However it became apparent that this was more for something to do than because she was concerned with the level of vegetation encroachment or the effect on her crops (as found by Sillitoe, 1995). If the vegetation encroachment had reached a level which required too much effort on Ruby's behalf, she would have already abandoned the garden.

The main garden pest which the gardeners of Kae spoke of was the 'parrot'. Parrots, or some type of bird, were renowned for devastating taro crops during the morning hours (see photo of scarecrow). The damage is often severe enough to affect the livelihood of the garden owner or force them to abandon the garden and start again (see photo 15). Due to this threat Ruby would walk to her garden just after dawn, sit under the shelter (see Figure 5) she had built to protect her from the sun,

and wait to scare away the birds. While Ruby waited she would weed periodically when it suited her, to pass the time.

Photo 15: Makeshift scarecrow placed in mature taro crop to ward off parrots.

4.2.7 La pupuso – good for crops other than taro

There were sections of the garden which Ruby classified as La pupuso (see Figure 5 quadrants B1, E4, F3-5, and G3). Ruby described this as a "mixed" soil. I was unsure of what Ruby thought made up the soil 'mix', and asked her to show me. Ruby dug into the La pupuso mound (see photo 17) and pointed to the elements which made up the 'mix'. "Parra-kurru magassa" she pointed to the black soil; "pumice" for the clay clump with stones in it, and "roots" pointing to the visible plant roots throughout the soil. Ruby told me she expected to find stones throughout La pupuso. Ruby and other gardeners would also interchangeably use the English term 'pumice' to describe this local soil type. I attempted to find out when or how this term became part of the local lexicon around soil, but this line of enquiry did not produce any certainty. It is possible to draw some conclusions based on awareness of the origin of the term 'pumice' and the observations of its use in conversations in the local language. 'Pumice' most likely came from the influence of a western scientific context at some point in the past decades, possibly from the extensive soil surveying work undertaken in WNB in

1968 (see Zijsvelt and Torlach, 1975). In technocratic geology, 'pumice' is defined as highly vesicular rough textured, extrusive igneous rock, composed of volcanic glass, with 'bubble' walls. It is commonly, but not exclusively, of silicic or felsic composition (McPhie, Doyle, and Allen, 1993, p.198). The word is not a recent addition to the Vere dialect as its meaning had been adapted to suit the local context (Ruby remembers always using it for La pupuso and her teachers using the word in school). 'Pumice' as a signifier, was used interchangeably with 'La pupuso' during conversations with people about this soil.

For the people of Kae 'pumice' described a soil type which was good for growing sweet potato and yam, if you built a soil mound. It was stony and yellow in colour, with some handfuls having a high clay content, and others crumbling easily when crushed in your hand. Ruby also told me the "water gets stuck [in the soil]" and making a mound helps the water to "leave" the soil and "feed" the plants. This language indicated to me that La pupuso had poor drainage qualities, and that the local practice of mounding reflected this knowledge. Another aspect which I observed as associated with this soil was that it occurred around uprooted trees, or where older tree stumps had been left to decay in the block (see photo 16). It was observed that this soil type was indeed a mix of soil materials. The tree roots brought up a mix of clay and pumice from the under lying soil horizons and this mixed with the black soil at the top of the profile. The black soil is part of a tephra layer which possibly originated from the Witori complex described by Machida et al., (1996). Photo 18 is an example of the undisturbed soil horizons which may contribute to La pupuso.

Photo 16: Example of soil horizon disturbance. La pupuso is brought to the surface from the roots of an upturned tree.

Photo 17: Side profile of 'mound' of La pupuso, showing a 'mix' of black soil, large aggregates, stones and visible organic matter.

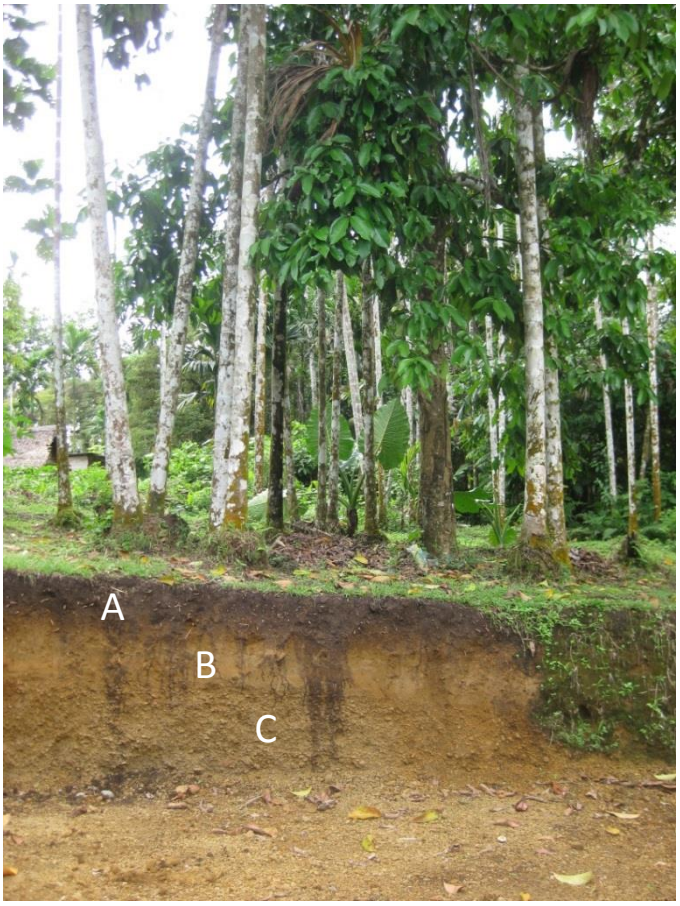


Photo 18: Cutting around house clearing in Kae showing the A horizon of black 'Parra-kurru magassa' soil, a B horizon of a yellowish clay, and a C horizon of pumice. Elements of all three horizons found in 'La pupuso'.

La pupuso was locally considered 'no good' for planting taro according to all the gardeners spoken to during field work. It was common to hear the sentence, 'Dispela graun, i no gat gris bilong em' when working with La pupuso. Translated this means the soil is without nutrients, or the soil's fertility is low. The soil was not literally without nutrients, but it was without the required properties to grow taro. The soil knowledge here showed strong links with the cultivation of taro, this again demonstrated that soil fertility appeared to be gauged on the soil's ability to produce sizeable taro.

Throughout the gardens visited the most common crop planted in La pupuso was sweet potato (Kau kau) and yam. Two staple food crops, but not as culturally significant as taro for daily nutrition in Kae, where at least two meals daily would contain taro. Sweet potato was a component of one meal approximately every two days. Ruby prepared the ground for planting (after the burning stage) in a different way to the black soil. Ruby also believed her preparation of the La pupuso addressed the growing needs of sweet potato, and maximised the soil's resources for the crop to grow.

4.2.8 Mounding of soil

Ruby dug up the La pupuso, upturning the soil profile, and creating a mound (see photo 17). The sweet potato and yam were then planted deep into the mound. Ruby told me on more than one occasion that she had learnt this practice and others, from her late mother. I felt that Ruby wanted me to know, and was proud, that much of her garden knowledge came from her mother and that it was successful. The mounding and digging of the La pupuso was a contrast to the minimal digging approach when planting taro in the same garden. Ruby said the mounding practice helped the water stay in the soil longer and get to the plant roots. Ruby also indicated that these crops were shallow root crops, by saying that "the roots don't go down far, but it (the plant) likes to grow wide". Other soil knowledge I recorded while working with La pupuso in Ruby's garden included the relationship between the topsoil and vegetation. Ruby told me that if the sweet potato does not grow fast enough across the mounded soil, it will start to erode. Ruby also managed the weak structural stability of this soil by not weeding the mound while waiting for the sweet potato to grow, allowing encroaching vegetation to provide an intermediary ground cover and stabilise the soil.

Photo 19: An example of mounded La pupuso in Ruby's garden, with sweet potato (Kau kau) growing.

Photo 20: The same soil mound, showing the 'stoney' aggregates the local people described

4.2.9 Soil with no name – unsuitable for crops

The other major distinction Ruby made in her food garden was soil which would not be cultivated due to the fact water pooled on the surface for 'too long' after rain (clarified by Ruby as 'maybe two days'). In Figure 5, the section of Ruby's garden which suffered from water pooling is located in quadrants 5AB and 6AB. Ruby noticed the lack of drainage in this area after she had originally cleared the block four or so years ago, and before she had planted it. This area of the garden had never been cultivated and does not have a soil name associated with it as it is not arable (see photo 21).

Photo 21: View from the garden shelter of the section of Ruby's garden where water pooled. It is possible to see from this photograph that there is a slight depression in the ground here.

4.3 Paula's garden

Paula was the older sister of my host father Andrew, and thought her age was 47. Andrew's family came from the next village along the road called Salelubu, no more than six kilometres away from Kae. Arable land shortages due to population increase in Salelubu had occurred while Andrew and his sisters were growing up there. Food gardening had moved to the hill slopes behind the village and a different skill set for soil management had developed for these conditions. Paula's garden was a slope garden next to the road and was easy to access for research purposes. This slope garden was technically not on Kae land, though geographically it was in the same area. I was taken to see this garden by Andrew as this formed part of the story he wanted to tell me about his soil knowledge. He wanted to show me a soil type which was not found in Kae as they have no slope gardens. The word for the soil exists in their language, and forms part of the discourse around soil and crops. I have included this experience as it added to my placement of soil knowledge in Kae. Andrew showed me the boundary for Kae's soils, and how knowledge sharing between villages and inter-generationally will change these boundaries.

During research in Kae village, access to arable land was often spoken about with language indicating an overabundance of land. Further, the fallow practices of Kae gardeners demonstrated they had enough access to fertile land that they could abandon a garden to regrow for as long as ten years or more. When Andrew took me to his sister's slope garden he spoke about his fears for Kae, by showing me what 'had happened' to his old village. Andrew was the only person to speak to me about the possibility of an increasing population in Kae, and the need for his children and his grandchildren to have access to land to build a house. He believed that in his life time there would not be enough flat land in Kae to accommodate all the necessary food gardens. There would come a time when his children or maybe grandchildren would need to look for arable land further and further away from the central village, and start to cultivate on the slopes nearby.

Photo 22: Paula's slope garden with log 'barriers' down the slope to stop erosion

Photo 23: Established taro growing in Paula's slope garden. An erosion barrier log is visible at Andrew's feet.

4.3.1 La Pirrika – soil of the slopes

Paula's garden was visited briefly on one occasion only. Paula showed and explained her main soil type for food growing, which was La pirrika (see photo 24). This soil was 'only found on the mountain slopes'. La pirrika was described as having a weak structure and being highly susceptible to erosion. Management of these characteristics were evident in Paula's garden practices. The garden was still cleared, but not burnt, leaving some vegetation holding the topsoil together and retaining soil moisture. The larger logs and organic matter cleared from the block were lined up at intervals down the slope to stop erosion (see photo 22). Taro suckers were planted directly into the La pirrika soil. Observations of other differences in gardening practices which were relevant to soil management, and/or indicated soil knowledge, included the allocation of crops and trees. In Ruby's garden trees like banana and tapioca are not cultivated as they grow well in surrounding vegetation and require no cultivation. In Paula's slope garden the best and deepest soil was at the bottom of the slope. Paula chose to grow banana trees here as part of her garden crop as there was no surrounding vegetation which allowed for the emergence of non-cultivated banana trees. The slopes were covered in a patch-work of food gardens, and the lower gradients of the slope were intensely planted with oil palm blocks. Due to land restrictions Paula had to make choices with her small section of deeper La pirikka soil. Taro would still grow on the shallow soil of the slope, but the trees would not, Paula said. Therefore bananas were chosen to grow in the deeper soil at the bottom of the slope (see photo 25).

Photo 24: La pirrika sample from mid slope.

Photo 25: Bottom of Paula's slope garden showing the established Banana trees. Photo also shows the road cutting, the dotted line indicates a change in the soil horizons.

4.3.2 Burning soil only for 'Blue' taro.

After Paula and Andrew had stated they did not use burning to clear the slope, a few small burnt patches were noticed, approximately fifty centimetres in diameter, around the base of taro with light purple/brown stems (see photo 27). The darker stem taro differed from the commonly cultivated variety of Kae, as they have green stems and leaves. I enquired as to why this patch of ground was burnt, and Andrew explained that this was a special 'outside' taro, it came from somewhere else in PNG and the soil had to be treated using fire to 'clean' it. This was a similar explanation to Ruby's Popondetta taro, regarding soil preparation for a taro from outside the area.

Photo 26: Andrew pointing out a small burnt patch in his sister's garden, prepared for the special 'blue' taro

Photo 27: Example of 'blue' taro in Paula's garden, planted into small ash pile

4.4 Oil palm cultivation

After organising interviews and speaking with fifteen block owners and their families, similar stories and discourse on soils were expressed repeatedly. A saturation point for soil knowledge/practice on oil palm blocks in Kae had been reached. With more time and the opportunity to work with people when they are planting or tending to young palms, I believe there would be embedded knowledge in the practices associated with oil palm cultivation, just as was found by working in the food gardens.

From interviewing and visiting oil palm blocks the impression was given that it was not as pivotal to the growth of oil palm to classify soils, as it was in the food garden. There was no soil/crop relationship made evident by the actions of block owners or their discussions with me. The driving factors behind the choice of a location for an oil palm block were economic and access based. The blocks needed to be as close to a road as possible, preferably with at least one side of the block edging the road. This was for ease of access for oil palm fruit bunch collection by the milling company trucks. The second aspect for oil palm growth which was important, and which was mentioned repeatedly during interviews, was that the ground needed to be flat as the palms dislike growing on a slope. Also some block owners close to rivers spoke about not planting in an area which was prone to flooding.

4.4.1 Soil knowledge and practices in oil palm blocks

Information on soil management emerged from discussions on how to cultivate a 'successful' oil palm block. Male block owners spoke about practices which indicated a consideration for soil nutrients in the early years of the oil palm crop, such as clearing the block regularly and cutting back old fronds and pilling the debris in alternate rows with the oil palms (see photo 28). It was explained that this practice is what the Oil Palm Industry Corporation (OPIC) has trained local block owners to do, and they understood it recycles nutrients back into the soil which could be accessed by the young palms.

Photo 28: Andrew standing in a relative's oil palm block in Kae, with composting frond row to his left. You can see from the knee high vegetation regrowth that this block was cleared about a month ago.

Nonetheless, field observations in combination with some relaxed conversations in the haus win (an open structure built for communal gatherings and socialising) with the people of the village of an evening, confirmed that once the oil palm crop is established the practice of clearing only occurs as a consequence of another requirement, such as when the block is too overgrown to harvest easily (see photo 29), or at least once a year when the OPIC block inspection occurs. The OPIC block inspection checks to see the local block owner is managing their block in accordance with OPIC and the PNG Oil Palm Research Association (OPRA) best practice. If all is in order, an allocation of fertiliser is awarded to the block and payment for the fertiliser is deducted from several future payments for fruit.

Field work interviews with block owners were pre- arranged so that people could be located at a certain time and there was as little interference with their working day as possible. However the method for interviewing was not structured and conversation took time to evolve into soil-related topics. Within this naturally occurring conversation space it was found that the relation between fertiliser application and soil health was a point of difference between the perspectives of younger men (between 19 and 30 years of age) and more mature male block owners (ranging in age from late 30's to over 70 years of age). The latter believed the application of both fertiliser and pesticide was not necessary and that over time it 'did not work' and 'made the soil tired and useless'. Notably, the older generation was not attending to work on the block as regularly as their younger family members.

Photo 29: Example of an oil palm block which has not been cleared for a number of months. In between the rows of palms, ferns are covering the previous cuttings from the last block clearing.

In summary, this chapter has established *where* and *how* soil knowledge and practices are present in Kae, and a pattern of what may be considered common agricultural practices. The soil categories and agricultural practices presented here arose from information collected from participants rather than being imposed from other sources (see methodology ch.4.1). The following chapter discusses cases studies in which variations from this common soil knowledge were observed in Kae and the possible reasons behind the changes in knowledge/practice.

Chapter 5: Variations in common soil practices: age, aging and gender

This chapter discusses the influence of age, aging, and gender roles on soil knowledge/practices. The elders of the village, both male and female, provided the strongest examples of how change can diversify soil knowledge and cultivation practices. Changes in soil knowledge, and in particular perceptions on soil fertility, were recorded across different age brackets. Change was evident in daily actions and in how the elder people of the village spoke about soil related matters such as food gardening and fertilising oil palm blocks. This chapter uses two examples from field work to highlight age and aging as an important driver of change in soil knowledge/practices. The first is 'Molly', aged 78, a widower of some years who provides child care for her grandchildren so that her two daughters in the village can undertake more work in their food gardens. The second example is 'George', a 67 year old grandfather of eight who was an ex-General in the PNG national army and returned to the village 20 years ago to grow oil palm on his family's customary land.

Gender roles were also significant for understanding the distribution of soil knowledge in Kae. A number of case studies are used here to discuss the variations in soil related practices which were observed when men were not present during field work in the food gardens.

5.1 Aging: Molly's garden

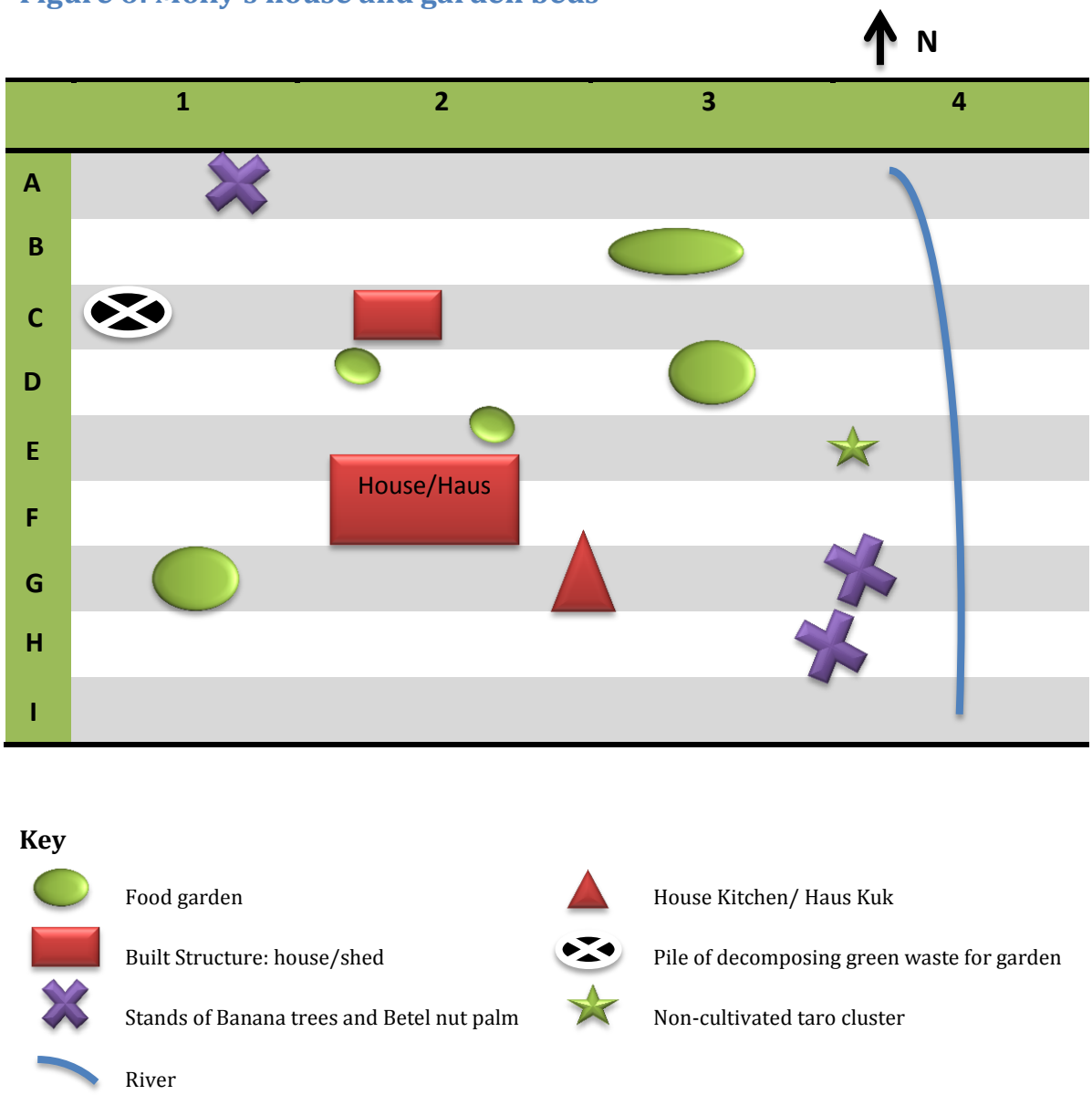
Molly had a small but diverse garden compared to other food gardens in the village. Her garden was sectioned into garden beds, rather than encompassing a large singular block. Moreover, Molly's garden beds were in the immediate vicinity of her house (see Figure 6). This was in contrast to most food gardens in Kae which are on customary land some distance (up to several kilometres) from

central houses in the village. Molly explained her motivations behind the configuration of her food garden:

> "I can't walk long distances to garden now, and I can't look after a big garden. I just have what I need here" (referring to multiple small garden beds surrounding her house, as two small children in her care wandered in-between us) (Pers-comm with 'Molly', during field interview conducted 16 May 2013).

Photo 30: Molly standing in her taro garden where she has let banana and tapioca grow 'wild' amongst the crop.

Figure 6: Molly's house and garden beds



5.1.1 A move away from fallow and burning

Molly had adapted her gardening practices to suit her changing situation with age and to be a child care provider for her kin. Molly tailored her gardening knowledge to best suit her mobility and situation, by establishing a series of smaller garden beds around her house area, which she rotated crops through (see Figure 6). Molly had also purposefully incorporated regular nutrient recycling into her cultivation sequence in the form of green household waste. Compost was added to individual garden beds after a crop cycle had finished by digging it in to the topsoil with a large stick. If it was during the dry season, Molly would wait for vegetation to cover the bed, sometimes as short as three weeks (see photo 31). Following this brief regrowth period Molly would weed and set aside the material from the bed to dry. Molly would then plant her crop and place the drying weeded

vegetation on top of the block to cover the soil while the seedlings emerged. Routine composting was utilised rather than labour-intensive practices of fallowing and burning to maintain soil fertility. Molly clearly understood that there was a need to maintain fertility in the soil which was continuously cultivated by providing a nutrient-rich input. And Molly used an input which she had access to and could create herself by the simple 'compost heap' she showed me at the back of her house (see Figure 6, quadrant 1C). Molly's knowledge that the input of organic matter to her garden beds maintained soil fertility is reinforced by Nelson et al., (2010) who found that the addition of organic matter to soils in the tropics improves water infiltration, carbon and nutrients, and soil biological activity. Especially important, for soils in high-rainfall areas like WNB, is the slow release of accessible nitrogen in the top layer of soil (0 to 10cm) provided by the decomposition of organic matter (Nelson et al., 2010, p.45).

Photo 31: Small garden bed resting in the rotation sequence with vegetation being allowed to cover the bed

5.1.2 Cultivation of exotic crops

Molly's age and declining need for large quantities of staple food (no dependants) influenced her to reduce the size of her garden and thus the amount of time spent working in it. Nonetheless, Molly also exhibited a freedom to expand, and even experiment with, her soil knowledge/practices and crop choices.

Photo 32: A South-East Asian chilli which emerged from scraps behind Molly's house

Molly had to re-use the same garden beds continuously, and had expanded her crops to include seasonal and exotic foods (i.e. tomatoes, South-East Asian chilli varieties, cucumbers, mint, and pumpkins), as well as staples. Exotic crops such as tomato are not as utilitarian as taro or sweet potato, and local people do not usually commit garden space and time to their cultivation. While Molly varied from the common soil practices established in Chapter 4, the discourse undergirding her soil knowledge was the same as the other food gardeners in the village. Molly used the same language to describe and classify her soils as the other research participants (such as Paula and Ruby), and used this to inform her choice of crop. For example taro was still planted in a garden bed she had made on Parra-kurru magassa, and sweet potato (kau kau) was planted in a mounded garden bed of La pupuso. Banana trees, tapioca and pawpaw were all allowed to grow if they sprung up around the house in a position which was convenient to Molly, such as boundary areas and towards the back of the house clearing (see Figure 6, quadrant 1A). If seeds from surrounding vegetation emerged in an inconvenient place Molly would either choose to replant them somewhere to her liking, or if she did not have the energy or alternative motivation, she would simply 'raus' (*to remove* in Tok Pisin) the seedling to the compost heap or to the paia blong kuk (*fire for cooking* in Tok Pisin).

5.1.3 Seasonality, mobility and soil practices

This section addresses the wet season and what this meant for Molly's garden. Molly still gardened in the wet season. However she described high crop losses due to lack of surrounding forest shelter in the clearing made for her house, depending on the strength and length of time it rained. Molly also knew from decades of gardening that the best time to plant seedlings was as the wet season declined, when the soil was moist, and the sun was bringing up new growth in the forest segments surrounding her house area. Molly also spoke of the fear of 'pundaun' (*falling down* in Tok Pisin*)'* in the wet weather, and would not risk her mobility to garden if the rain had left the house clearing slippery and water logged.

5.2 An elder: George's view on oil palm and fertiliser

George was the head of a family of fifteen: his wife Nancy (see photo 33), their three adult children and their partners, and eight grandchildren. He had grown up in Kae working on his family's land and left for military service around 1963. George openly discussed his lack of formal 'schooling' using his seemingly natural grasp of the English language. He had learnt to speak English with some level of formality during his military career, assisted by two separate one-year exchanges to Australia with the Australian Defence Force. As is the customary practice for the people of Kae, George returned home to his family's land following the death of his father about twenty years ago. George explained that there are many traditional and practical undertakings which must be attended to following the death of the head of the household, such as dismantling the house his late father had lived in.

Photo 33: George and his wife Nancy posing for a photo in their food garden

George was introduced to me by the local translators and guides, Silas and Anton (see photo 34), as a village elder in Kae. George's status as 'elder', combined with the lack of confusion in our communication with each other, created a different interview dynamic. George was the first oil palm block owner with whom I did not have to rely heavily on the translators and myself to negotiate communicating between a triplicate (Vere, Tok Pisin and English) of languages.

Photo 34: My local translators, Anton (left) and Silas (right), standing in a young taro crop

During the days preceding my encounter with George I had walked from oil palm block to oil palm block chatting with my two companions about their own perspectives on what I was researching. A common topic connected with oil palm was fertiliser. Both young men seemed to consider fertiliser to be a necessary but costly input to their oil palm blocks. Between evening conversation with Anton, Silas and a group of their peers, and numerous interviews with oil palm block owners I felt able to confirm a shared understanding of, and discourse on, fertiliser. Many of the men thought

that fertiliser was vital for their block to become economically productive. The young men spoke of wanting larger, heavier fruit bunches from their oil palm and the only way to do this was to apply fertiliser. Through the eyes and apparently ears of my translators there seemed to be a consensus that: a) fertiliser was necessary for economic productivity, b) that it caused no detrimental changes to the soil and c) that OPIC were unfair in making the purchase of fertiliser from them compulsory and charging the block owner too much for its procurement.

George and I had a good rapport and I did not feel that asking him direct questions about fertiliser would be 'leading' him to say something he might otherwise have not. When I asked him directly about whether he used fertiliser on his block the exchange between us changed. The pace of his spoken English rapidly increased and his tone heightened. We both understood that the deliberate speed at which George was speaking meant those around us could not understand our conversation.

George said he refused to use fertiliser even though OPIC extension officers insisted that he must purchase it and apply it to his block. He disclosed that he would give up, or sometimes sell, his quantity of mandatory fertiliser to other block owners in the village or his extended family. George insisted that the nitrogen fertiliser that OPIC provided ruined the ability of the soil to grow other crops, and diminished the soils ability to replenish itself during a fallow period. George was adamant that the benefits of fertiliser worked "only for the short-term", with disastrous ecological consequences in the long term.

> "Here [in Kae] (pointing straight down to the ground), we have good soil, rich soil. There is no need for fertiliser." (pers-comm with 'George', during field interview conducted 17 May 2013).

George also made a link to taro in his belief structure surrounding fertiliser. He believed that prior to the expansion of "plantation" oil palm and the input of "chemical fertilisers" that there had been over twenty species of taro in the area. He strongly believed that the introduction of "agricultural science" (e.g. fertilisers and pesticides) connected to the plantations, was responsible for the "loss" of local taro species.

George re-iterated some of what he had said about the negative long term effects of fertiliser in Tok Pisin for the benefit of his family and Anton and Silas. It was surprising to observe Anton and Silas nodding their heads slowly and seriously, verbally agreeing with George's opinion. If I had not previously observed and listened to how adamant an advocate for fertiliser both men were, I would have believed their concurrence with George to be their honest and enduring opinion. The dynamics of this moment were complex, to say the least. What was observed was that being an 'elder', in the

context in which we were communicating, was a powerful symbol, which was respected by the younger men of Kae.

George's and Molly's examples are indicative of the inconsistencies in knowledge this research sought to investigate as part of the objectives. Molly's account tells of how aging engenders change to the established common agricultural practices in Kae. For Molly, aging altered and built upon her soil knowledge/practices developed over a life time (See Rubenstein and Parmlee, 1992 for discussion on the place specific knowledge of older people). George's example demonstrates how people of different ages frame certain soil fertility issues in the context of oil palm cultivation. George's perception of fertiliser as 'unnecessary' and damaging to soil fertility speaks to his knowledge development over time. His reasons are based on his own discernment of how things 'were', and provide a point of difference between current best-practice 'scientific' knowledge delivered by OPIC and village oil palm growers who have access to knowledge of pre-plantation soils. Some research indicates that recommended fertiliser rates are not necessarily economic for oil palm smallholders in WNB, especially at the uniform region-wide rates currently recommended (Webb et al. 2011), thus giving credence to George's view. In summary, both George's and Molly's stories illustrate that local soil knowledge/practice are constantly open to 'ongoing negotiation' (Sillitoe, 1998, p.189), throughout the course of a person's life.

5.3 Women's choices in the food garden

Photo 35: Me carrying yams and taro with Ruby and Dorothy

Throughout the course of the research it became apparent that gender was another variable affecting how people engaged with the dominant soil knowledge/practises of Kae (see Chapter 4). During the first two field trips, for example, the information collection was characterised by the presence of two young male translators. The local translators accompanied me into the food gardens where women were working. During conversations with women in their gardens, regardless of whether I requested help or not, the translators would tell me what the women were doing and *why*. During the third field trip, the novelty of my presence had faded somewhat, and being in the village as a guest was more socially comfortable. For this reason, and possibly others unknown to me, the young men did not continue to accompany me during the four days of the third and final field trip.

The lack of male accompaniment in food gardens during the final field trip changed the context in which communicating with women took place. Interactions became less agenda-driven and more familiar/social. The women of Kae and myself were able to reciprocate each other's communication in a manner which felt more relaxed. In this regard, another layer of 'authenticity' was established

around soil knowledge (Jones and Yarrow, 2013). The female gender dynamics were also evidently useful in establishing rapport and thus assisted in collecting information (see Chapter 3.3).

The first example of how the absence of men changed the dynamics of knowledge exchange was the broader use of language by women to discuss their food gardens. Previously, when the same group of women were asked about what they planted on a particular soil type, the male translators regularly spoke on behalf of the gardener. In this way, discourses of soil knowledge/practice and crop type were always articulated as a male perspective *on* a female practice. Phrases such as "women only plant taro in this (pointing to black soil) soil", were quite common. When alone with the same group of women in their individual food gardens, a more complex decision making system around crops emerged. Communication in these circumstances was not based primarily on language but on both parties being willing to reciprocate. Actions were helpful in creating an understanding, such as my eagerness to be shown how to dig holes to plant taro. From my perspective, both I and the other women were more comfortable with teaching me gardening practices when the men were not present and watching. We were able to enjoy the complexities of trying to communicate using Tok Pisin with some English words, rather than being self-conscious about our attempts. The ladies were also noticeably amused by my practicing of Tok Ples words. It was evident that when this group of women were given the chance to describe their choice of what to plant in their gardens, their discourse became more complex, and encompassed broader motivations and individual experiences.

5.3.1 Ruby's garden

An example of women's choices can be seen when Ruby spoke about how she liked to plant aibeka directly adjacent to a tree stump in her block (see photo 36). There were two reasons behind this practice. The first was that Ruby believed the aibeka fed off the decaying tree roots and grew better this way. The second was that the tree stump protected the aibeka during high winds (for position of aibeka in Ruby's garden see Figure 4, quadrants E4, F3:5 and G3). Ruby's family liked eating aibeka, so Ruby left more tree stumps in her garden compared to other gardens close by and planted aibeka against the stumps scattered amongst the taro on the Parra-kurru magassa soil. Ruby's discourse around taro did not vary in this example: it simply made the crop system more complex than what the male translators had explained previously. Further, Ruby pointed out that "mi maski long kamap tapioca, banana na paw paw insait garden bilong mi" - she didn't bother to grow tapioca, paw paw or banana in her garden, as all three grew "well enough" and "close enough" in the "wild forest" adjacent to her garden (Pers-comm with Ruby, 23 July 2013).

Photo 36: Aibeka planted with tree stump in Ruby's garden.

Photo 37: Mary (centre) growing beans on her black soil in between taro

5.3.2 Mary's garden

Mary's garden also confirmed the common practices of land clearing, burning, and planting taro in the black soil and sweet potato in the yellow pumice soil (see Chapter 4). Mary said she had "good luck" growing beans: she proudly described herself as the "bean meri" of the village. In between rows of taro, growing horizontally, Mary utilised the vertical space by growing beans up slim tree branches stuck in the ground for support. Mary's bean success can be seen in photo 37. Mary also grew aibeka, but did not employ the same tree-stump growing method as Ruby. Mary's practices around aibeka were less deliberate and coordinated. Mary planted cucumber, spring onions, and aibeka together amongst the young taro crop in only one location in her garden (see photo 38). When asked about her planting method Mary stated "I just threw some seeds over there". For Mary, aibeka and cucumber were incidental crops and she had faith in the fertility of her Parra-kurru Magassa as long as the taro still "kamap bikpela" (*grew big* in Tok Pisin). Mary planned to harvest the aibeka and cucumber before they encroached on the taro.

Photo 38: A cucumber vine and aibeka growing amongst younger taro in Mary's garden

Photo 39: Mary (left) and MoiKae (Right) resting in the shade for a betel nut break.

Photo 40: Gloria walking to her food garden with me in tow.

5.3.3 Gloria's garden

While we rested after a mornings work, another lady carrying a large bush knife appeared from a bush path behind us. This was Gloria. Gloria was slightly older than the other women teaching me their gardening practices. Even though Gloria was on her way to have a break when we met, she was kind enough to take me to her food garden before she rested.

Gloria had divided her large food garden into segments using the felled timber from clearing her garden block (see photo 41). As in the previous example of Mary and Ruby's garden, Gloria had undertaken garden preparation practices common to Kae and then added her personal touches. The segmented garden arrangement provided new information on garden practices. The majority of gardens (apart from the sloped gardens) observed were large open plots with barriers only employed to demarcate the periphery. Further, most taro crops were planted simultaneously in the garden, as once grown to an 'edible' size, taro can be left in the ground until needed. Gloria, however, had divided her Parra-kurru magassa soil for growing taro into four plots and was planting her taro at one-to-two-month intervals between the plots (see photo 41).

Photo 41: Gloria used the felled timber from her garden to separate her garden into sections. Taro is planted in intervals.

Gloria also incorporated a second or third crop into her soil/crop classification in the garden. Aibeka, in this instance, was grown in the mounded La pupuso along with yams and sweet potato. Unlike Ruby, Gloria had decided to deliberately cultivate banana trees as part of her food garden, incorporating them as a border crop (see photo 42).

Photo 42: La pupuso mound planed with sweet potato and aibeka in Gloria's garden

All three examples demonstrate that women share common gardening knowledge/practices around a 'central crop' and local soil classifications (Sillitoe, 1995, p.97). However, women also have considerable authority over the composition of their individual food gardens, which is evident by their different choices of what to add to the regular cultivation regime and where to plant it (Francis, 1998, p. 88). Decisions were sometimes complex and considered, and at other times appear to be casual exploitation of soil resources to chance spontaneous crop growth (Sillitoe, 1995, p. 83).

5.4 Oil palm…. Men's work?

Soil knowledge/practices were less complex in oil palm blocks than food gardens in Kae. This may be for a number of reasons, such as the gendered division of labour and the relatively recent inclusion of oil palm as a cash crop. Gina Koczberski has noted in a similar study in WNB that:

> 'smallholders spend considerably more time in food gardening than they do in oil palm-related work, especially women who allocate almost 2.5 times as much of their labour to food gardening than to oil palm. Men allocate about equal amounts of time to each activity' (Koczberski, 2005, p.329).

The gendered division of labour in Kae appeared to be more extensive than Koczberski's (2005) findings, with women choosing to spend the least amount of time as possible working on oil palm related tasks (Pers-comm with Ruby, Mary, MoiKae and Esther, in Kae village haus kuk, 27 July 2013). Further, men were not observed working in food gardens at any time during field work. However in conversations with women about the role of men in the garden it was apparent that men were expected to do the 'heavy' tasks, such as lifting large logs and building the frame for the garden shelter.

Oil palm, as a recently introduced cash crop, creates little emphasis or space for local observations and practices to be tried and tested on the blocks. Oil palm replaced cocoa as a cash crop in the Kae area (circa 1967) and the 30 year average production period of oil palm means the majority of blocks are still on their first oil palm crop (for oil palm production information see Nelson et al, 2010; and for cash income from oil palm see Bourke & Harwood, 2009, p.331). Compared with the extensive cultural association with taro over many generations, the short association with oil palm may explain the lack of soil knowledge development connected with its cultivation. Further, practices for the cultivation of oil palm are disseminated primarily from corporate entities, with male dominated work cultures, such as New Britain Palm Oil Ltd, and OPIC (see Nelson et al, 2010, for oil palm industry structure). Also for consideration are the different motivations and world views behind knowledge generated by a profit-driven corporation and knowledge generated to sustain livelihoods.

This research found that soil knowledge was clustered in gendered practices associated with labour. Male perspectives dominated the discourse on oil palm, as all oil palm growers involved in the research were male and generally mature in appearance (exact ages were sometimes unknown). Further, women expressed little interest in increasing their involvement in the oil palm blocks. There appeared to be no desire to "add" to their daily tasks of gardening, cooking and other household activities. However, women did say that they preferred their husbands and/or sons to come and assist them in the food gardens if it was not harvest time on the oil palm block. Women were able to

utilise the physical strength of the men for garden tasks such as lifting and moving heavier logs, and constructing garden shelters. Male associated tasks were generally 'one-off' and not part of the daily garden activities which constitute the domain of women's knowledge.

In contrast to this particular division of labour by gender in Kae, Gina Koczberski's 2007 'Loose Fruit Mammas' article suggests a socio-economic imperative for woman to be financially incorporated in oil palm activities. Koczberski encountered women who wanted to spend more time engaged in oil palm activities, such as collecting loose fruit. The women who provided their perspective on the issues in Kae had no such economic motivation to spend more hours working than they needed too, especially when the oil palm work 'belonged to men'. The pressures which Koczberski attributes to the 'Loose fruit mamma' phenomenon -- such as population increase, limited arable land resources, and limited economic activities for women – are currently not present in Kae.

5.5 Betel nut – a local economy cash crop

The success of the local betel nut market is one possible reason why the women in Kae do not feel it necessary to devote more hours to work associated with oil palm. Kae has a steady local betel nut market which is a lucrative economic activity retained by women. Betel nut is sold at a large (compared to the small size of the village) road side market of approximately ten vendors, all of whom are women. Kae betel nut vendors stress that their village is known for producing the best betel nut in WNB as they have the best soils and people will drive a long way to buy large quantities (Pers-comm with various betel nut sellers in Kae, May 2013). There was some evidence of this during field research. It was observed on a number of occasions that visitors to WNB from other PNG provinces drove out of their way to the Kae betel nut market (at least an hour and a half drive from the Hoskins airport) simply for the purpose of buying a large bag of betel nut to take home to their relatives on mainland PNG.

The betel nut palm is mainly planted in clusters along the border of the house and domestic areas in Kae. This is comparable with Koczberski's findings that smallholders had established 'dense stands (of betel nut) around houses' (Koczberski, 2005, p. 333). There were also a small number of juvenile oil palm blocks (less than ten years old) in Kae where banana and betel nut were planted in between one or two rows of oil palm to increase the economic productivity of the block while the young palms reached their fruit bunch production capacity. This example of inter-cropping indicated that neither bananas nor betel nut had specific soil requirements, except for the soil depth also required by the oil palms. One oil palm block owner with this mixed tree system explained that it was 'isi' (*easy* in Tok Pisin) on such a small scale. Once the oil palms grew to a height where they formed a

dense canopy, the banana and betel nut would eventually die off. Growing extra income in the form of betel nut was not labour or time intensive, as Nelson et al. (2010) note about oil palm.

Betel nut is sold in bulk by women at the local market in Kae. Profits are kept by the women and primarily used on one-off or major household expenses such as shoes or books for children to take to school. The economic position of betel nut in Kae corresponded with Koczberski's finding among smallholders in WNB, that betel nut was the '…second or third most important income after oil palm' (Koczberski, 2005, p.333). It can be argued that betel nut is a cash crop for the local economy of Kae, and more so than oil palm, it provides an opportunity for gender roles present in agricultural knowledge/practice to be diversified in ways which are instigated and accepted by the people of Kae: e.g. betel nut grown in small quantities in oil palm blocks, harvested by adolescent household members and sold by women who have the final decision on the revenue

Photo 43: Teenager from Kae harvesting betel nut

Photo 44: Anton showing me his 'man' bilam made in Kae, the betel nut sellers are visible to the left

5.6 Summary of variations in soil knowledge

This chapter has discussed the variations to the common soil practices categorised in Chapter 4, and the influences behind such changes. In interrogating these inconsistencies in agricultural knowledge/practice we are able to observe power dynamics established through gender roles. For example it was observed that the soil knowledge articulated by women in the food garden (in the absence of men) was more complex than when men described what women did in the food garden and why. However both women and men shared the common soil knowledge discussed in Chapter 4, confirming that such knowledge was considered 'common-sense' among the village. Discourse on age and aging also provided points of difference to be interrogated. Molly and George's case studies further supported soil knowledge development through the mechanism of inconsistencies – it was evident that knowledge was in a constant state of collaboration between people and their environment. Molly's account of aging as an influence which changes gardening practices is also an example of the active presence of the invisible. No sources were found that prioritised the characteristics of aging as a valid truth in agricultural knowledge in WNB. The silence, or discursive structure, of aging meant information gathered was not influenced by pre-existing sources and Molly's story can contribute to an understanding of how aging diversifies soil knowledge/practices.

Chapter 6: General discussions and Conclusions

6.1 Soil Knowledge

The soil knowledge of Kae was not a singular entity, nor was it compartmentalised as a clearly defined segment of a larger knowledge system. It was broadly distributed by age and gender, however in some aspects – such as with taro cultivation and food gardening practices - an overarching discourse was present and aided in the dissemination of this knowledge between generations. Soil knowledge was interwoven in the daily practices and skills of the people of Kae, mainly in customs around food cultivation. The research uncovered that the process for passing down agricultural/ecological practices was characterised by oral transmission and a culture of learning through experience and repetition. There was strong evidence, including the local soil classifications, of a dominant discourse on soils and their relationship with particular crops.

The common agricultural practices of preparing, planting and tending to the food garden produced the classification of soils in Kae. In addition to soil properties, other features of soil and landscapes were recognised by Kae gardeners. Evidence concerning knowledge on soil variation with depth, the place of the soil in the landscape (see Figure 4), and changes in soil behaviour under different conditions, were present in the soil terms in the local dialect of Vere. Chapter 4 highlights that local soil classifications reflect a place on the immediate landscape: 'Parra-kuru magassa' is only found on the flat land in and around Kae proper; 'La pirrika' does not exist in Kae as it is a mid-slope soil in the surrounding hills; and 'Ma-ge-ge sei' is only found at the top of a hill (see Figure 4 for soil distribution in landscape). The practice of mounding 'La pupuso' to improve drainage and encourage root growth, along with the local reconciliation with 'pumice' as a description, demonstrate an awareness of soil variation at depth and also how this particular soil responds when under heavy rain conditions. It is clear that the soil classification system in Kae is oriented towards practical use in the food garden.

6.2 Common agricultural practices in Kae

A common regime of agricultural practice was evident in the information gathered from Kae's food gardeners. Knowledge about the agricultural regime was also widely shared within the Kae community across generations and, irrespective of gender, all were at least aware of similar productive gardening practices (described in Chapter 4). This was made particularly evident in the comparison of the common agricultural knowledge recorded with the male translators assisting and also in their absence (discussed in Chapter 5.3). The sequence of practices (Ch.4) and the soil

rationale (Table 4.1) behind them did not alter drastically between men speaking about what women do, and women speaking for themselves about their garden regime. The difference lay in the detail of the alternative crops women chose to plant, as this did not form part of the common agricultural regime focused on taro and Parra-kurru magassa soil. The common agricultural knowledge has been recorded in this thesis using titles/categories for the linear progression of practices: selection, clearing, burning and planting of a garden. In reality this knowledge was not presented in such a routine way, but was embedded in broader customs and behaviour which I believe are intrinsic to its success. However, the categories for the practices did come from information collected locally in Kae and not from super-imposed sources.

The common garden regime is a low-input, semi-subsistence, swidden agriculture system with taro as the central crop. The importance of taro is encapsulated in the local soil classifications used by Kae gardeners, with soil names and meanings reflecting what staple crop the soil can and should be used for, such as Parra-kurru magassa principally (but not exclusively) being used for taro. Soil is also only classified if it serves a purpose in the food garden or cash crop plot. If the soil is of no use for growing any edible vegetation - such as extremely hydrophobic soils, then it does not receive a soil name. This is an example of discursive processes in the local discourse on soil knowledge as the absence of such information effectively 'silences' unproductive soils.

Further there was no evidence of intermediary soil classifications, such as for soil fertility changing with time under cultivation. The classification was dependent on the relationship between the soil environment and the taro crop's ability to continue to yield adequate produce. If the soil ceased to produce adequate taro, then it was not soil, it was *kama ko kora magassa* (in Tok Ples) translated literally as 'no good ground', and it would be fallowed until considered fertile again. The simplicity of this system is also why it is inherently sustainable. Soil either grows taro or it does not. Soil is not depleted of nutrients, and inputs such as chemical fertilisers are not added to extend the production life of the soil. Further, labour is not deviated to improve soil if it is considered tired. In this regard, the biophysical limits of the soil are never depleted to a point of no return making the fallow sequence successful and beneficial for future generations. The people of Kae do not dwell on naming and deliberately manipulating poor quality ground as they have plenty of fertile areas due in part to geomorphological process, such as tephra layers, but also to their diligent management of their soil assets.

This research did not find evidence of population pressure on land use in Kae. However, this does not mean it will not eventuate within the next few decades, given that the current demographic movement in WNB is predicted to continue. With this in mind it is worth considering the implications

for the agricultural system in Kae and the ability of people to abandon their gardens and start again, with little effort, at the first sign of soil fertility depletion. Future population pressure may force gardeners to retain their blocks long after soil fertility has declined and adopt less arable land for gardening such as hill slopes.

6.3 Variations in soil practices

The unavoidable biological changes which occur with aging were shown to influence modifications to the common agricultural regime. These changes also transmitted to soil practices. The main factor influencing change was decreased mobility.

In the context of Kae, decreased mobility with age did not mean the cessation of food gardening, but its retraction to the immediate vicinity of the home. Large gardens which require daily maintenance and long distances walking to access them were no longer viable. Fallow sequences and nutrient requirements of the soil also changed. Gardening altered from a long fallow sequence rejuvenating the soil, to no fallow periods and small garden 'beds' rotated throughout the year. Nutrient inputs to the garden soil also became a deliberate action, rather than the unintentional manipulation which occurs with fallowing. In the example of 'Molly's' garden, green waste and/or compost was collected and added to the garden beds to maintain their ability to grow crops.

The ability of gardens in Kae to adapt their soil practices to change may be exemplified in Molly's case. This research identified that skills and knowledge existed in the aging generation of Kae to adapt gardening to possible future environmental and socio-economic changes such as a decline in arable land and limited access to land per house hold. However, soil knowledge such as Molly's developed in line with the pace of the change, in this case: aging. If change were to occur in Kae beyond a pace and scale which allowed for knowledge development and practice adaptation, then certain ecological and social boundaries may be breached. For example people in Kae are aware of the La pirrika soils on the slopes, and use this term as a classification to distinguish this soil type from other soil types present in Kae. However Kae gardeners lack the day-to-day knowledge of how to work with La pirrika soil and may experience a period of vulnerability in the event they had to learn to adapt their knowledge/practice to this soil type.

Along with the knowledge of the elder generation, another avenue for resilience to possible changes in soil fertility is the existing slope-gardening skills among kin-folk of neighbouring villages. Slope gardens are already sustaining livelihoods with less fertile soil and less access to land on the hill side than in Kae. While this thesis did not discuss the soil knowledge of slope gardeners in detail, it is

worth noting that such knowledge could be pre-emptively shared among communities to build resilience for predicted types of environmental and population change.

Other knowledge of pre-emptive value was the information provided by George on the possible over-use or unnecessary use of fertilisers for small scale oil palm production. It is evident that a standardised approach to fertilising maintained by OPIC, is not always well received by local small-scale oil palm growers for economic and soil fertility reasons.

6.4 Conclusions

In conclusion the soil knowledge of Kae village demonstrates an intrinsic understanding of environmental patterns, local ecology and the requirements of staple crops. Further, the soil knowledge/practices are comprehensively sustainable, providing a surplus of food for the people of Kae, without jeopardising the ability of the soil to rejuvenate for the requirements of future generations. With the growing need of the international market to procure sustainable and ethical palm oil the oil palm industry in WNB is in a good position to continue to benefit from the soil knowledge and intrinsically sustainable practices of local people whose livelihoods are directly supported by the environment in which they live. This research suggests the need for further efforts by the PNG oil palm industry to develop effective ways to engage with local soil knowledge/practices and then incorporate this knowledge into their production model. There would be economic and environmental benefits to both industry and the local community, such as a more flexible and applicable fertiliser inputs to oil palm blocks rather than the unnecessary and costly 'one-size-fits-all' approach. Further avenues in which this research could be applied include oil palm blocks diversifying to assist with food security and additional income generation, such as intercropping oil palm with other short term cash-crops. Regardless of the application, this research advocates that local soil knowledge is credible, valuable and effective, and should be incorporated into the wider discourse in WNB on both agriculture and oil palm cultivation.

Chapter 7: References

1. Australian Soil and Land Survey Field Handbook, 3rd Edition, National Committee on Soil and Terrain, CSIRO Publishing, Canberra.

2. Birmingham, D. M, 1998, 'Learning local knowledge of soils: a focus on methodology', *Indigenous Knowledge and Development Monitor*, 6, no.2, pp. 7-10.

3. Bleeker, P. 1983. Soils of Papua New Guinea. CSIRO and ANU Press, The Australian National University, Canberra.

4. Bourke, R. Michael and Harwood, Tracy, (Eds.) 2009. Food and Agriculture in Papua New Guinea. ANU E Press, The Australian National University, Canberra.

5. Berit Brandth and Marit S. Haugen, 2005, 'Doing rural masculinity: from logging to outfield tourism', *Journal of Gender Studies,* 14, no.1, pp.13-22.

6. Brookfield, Harold and Padoch, Christine, 1994, 'Appreciating agrodiversity: A look at the dynamics of indigenous farming practices', *Environment*, 36, no. 5, pp. 6-45

7. Cahill, M and Karan, E, 2008, 'Factors in designing effective orthographies for unwritten languages', *SIL Electronic Working Papers*, 2008-001, February.

8. Curry, George N. and Koczberski, Gina, 2007. Seeds of discontent: oil palm and the changing production strategies among smallholders in Papua New Guinea, in Connell, J. and Waddell, E. (Eds), *Environment, Development and Change in Rural Asia-Pacific: Between local and the global*, Routledge, London, pp. 108-126.

9. Duncan, J.S. 1987, 'Review of urban imagery: urban semiotics', *Urban Geography*, 8, no.5, pp. 473-83.

10. Edwards, E., 2003, ' Negotiating spaces', in J.M. Schartz and J.R. Ryan (Eds.), *Picturing Place Photography and the Geographical Imagination*, I.B Tauris, London and New York.

11. Francis, E, 1998, 'Gender and rural livelihoods in Kenya', *Journal of Development Studies*, 35, no. 2, pp. 72-95.

12. Gill, R. 1996, 'Discourse analysis: practical implementations', in J.T.E. Richardson (Eds.), *Handbook of Qualitative Methods for Psychology and the Social Sciences*, British Psychological Society, Leicester. pp. 141-56.

13. Golson, J. 1982, 'Kuk and the history of agriculture in the New Guinea highlands', in May, R. J. and Nelson (Eds.), *Melanesia: Beyond Diversity*. The Australian National University, Canberra, pp.297-307

14. Johnson, R. L., (1981), 'Conceptualizing in Nakanai and English: A case study of grammatical categories,' in K. J. Franklin (Eds.), *Syntax and semantics in Papua New Guinea languages*, pp. 212-24.

15. Johnson, R. L., (1978), 'Nakanai Syntax.' Ph.D. Dissertation, The Australian National University, Canberra, Ts. xiv + p.417.

16. Jones, Sian and Yarrow, Thomas, 2013, 'Crafting authenticity: An ethnography of conservative practice', *Journal of Material Culture,* March 2013, 18 no. 13-26.

17. Hanson, L.W., Allen, B.J., Bourke, R.M., and McCarthy, T.J. 2001. Papua New Guinea Rural Development Handbook, The Australian National University, Canberra.

18. Koczberski, Gina; Curry, George; and Bue, Veronice, 2012, 'Oil palm, food security and adaptions among smallholder households in Papua New Guinea', *Asia Pacific Viewpoint,* 53, no. 3, pp. 289-299.

19. Koczberski, Gina, 2007, 'Loose Fruit Mamas: Creating Incentives for Smallholder Women in Oil Palm Production in Papua New Guinea', *World Development*, 35, no.7, pp. 1172-1185.

20. Koczberski, Gina and Curry, George, 2005, 'Making a living: Land pressures and Changing livelihood strategies among oil palm settlers in Papua New Guinea', *Agricultural Systems,* 85, no.3, pp.324 -339.

21. Lamers, J.P.A., and Feil, P.R., 1995, 'Farmers' knowledge and management of spatial soil and crop growth variability in Niger, West Africa', *Netherlands Journal of Agricultural Science,* 43, pp. 375-389.

22. Liepens, R., 2000, 'Making Men: The Construction and Representation of Agriculture-Based Masculinity in Australia and New Zealand', *Rural Sociology,* 65, no.4, pp. 605-620.

23. Machida, H., Blong, R. J., Specht, J., Moriwaki, H., Torrence, R., Hayakawa, Y., Talai, B., Lolok, D., Pain, C. F. (1996): Holocene explosive eruptions of Witori and Dakataua Caldera volcanoes in West New Britain, Papua New Guinea. Quaternary Int. 34–36, 65–78.

24. McPhie, J., M. Doyle, and R. Allen, 1993. Volcanic Textures: A guide to the interpretation of textures in volcanic rocks, Centre for Ore Deposits and Exploration Studies, University of Tasmania, Hobart, Australia. p.198.

25. Munsell Soil Colour Book, 2009, Revised Edition, Munsell X-Rite, Incorporated, Michigan, USA.

26. Nelson, P., Webb, M.J., Orrell, I., Van Rees, H., Banabas, M., Berthelsen, S., Sheaves, M., Bakani, F., Pukam, O., Hoare, O., Griffiths, W., King, G., Carberry, P., Pipai, R., McNeill, A.,

Meekers, P., Lord, S., Butler, J., Pattison, T., Armour, J., and Dewhurst, C., 2010, 'Environmental sustainability of oil palm cultivation, Australian Centre for International Agricultural Research', ACIAR Technical Report no.75, Canberra, Australia.

27. Ostberg, W. and Reij, C. 1998. Culture and local knowledge – their roles in soil and water conservation. In: Blume, H. P., et al (Eds.), Toward Sustainable Land Use: Furthering Cooperation Between People and Institutions, vol. 2. Catena Verlag, Reiskirchen, Germany, pp. 1349-1358

28. Potter, J. 1996, 'Discourse analysis and constructionist approaches: theoretical background', in J.T.E. Richardson (ed.), *Handbook of Qualitative Methods for Psychology and the Social Sciences*, British Psychological Society, Leicester.

29. Rose, G. 2001. *Visual Methodologies. An Introduction to the Interpretation of Visual Materials*, Sage Publications, London

30. Rubinstein, Robert I., and Parmelee, Patricia A., 1992, 'Attachment to Place and the Representation of the Life Course by the elderly', in Place Attachment: *Human Behaviour and Environment*, vol.12, pp.139- 163.

31. Sandor, J.A. and Furbee, L., 1996, 'Indigenous Knowledge and Classification of Soils in the Andes of Southern Peru', *Soil Science Society of America*, 60, pp. 1502-1512.

32. Sayer, Jeffrey; Ghazoul, Jaboury; Nelson, Paul; Boedhihartono Klintuni, Agni, 2012, 'Oil palm expansion transforms tropical landscapes and livelihoods', *Global Food Security,* 1, pp. 114-119.

33. Sillitoe, Paul, 1995, 'Fallow and Fertility Under Subsistence Cultivation in the Papua New Guinea Highlands: I. Fallow Successions', *Singapore Journal of Tropical Geography*, 16, no.1, pp. 82-100.

34. Sillitoe, Paul, 1998, 'Knowing the land: soil and land resource evaluation and indigenous knowledge', *Soil Use and Management*, 14, pp. 188-193.

35. Sillitoe, Paul; Dixon, Peter, and Barr, Julian. 2006. Indigenous Knowledge Inquiries: A Methodologies Manual for Development Programmes and Projects (Indigenous Knowledge and Development Series), Practical Action, Rugby, United Kingdom.

36. Soil Survey Staff 2010. Keys to Soil Taxonomy, 11th ed. USDA-SCS, Washington, D.C.

37. Tabor, J.A., 1992, 'Ethnopedological surveys – soil surveys that incorporate local systems of land classification' *Soil Survey Horizons*, Spring.

38. Toledo, V.M. 2000. Indigenous knowledge on soils: an ethnoecological conceptualization. In. Barrera-Bassols, N., Zinck, J.A. (Eds), Ethnopedology in a Worldwide Perspective. An annotated Bibliography. ITC Publication, vol. 77. ITC, Enschede, The Netherlands, pp. 1-9.

39. Warren, D.M., Slikkerveer, L.J., and Brokensha, D.l., (Eds.). 1995. The cultural dimension of development: Indigenous knowledge systems. Intermediate Tech Publ., London.

40. Webb MJ, Nelson PN, Rogers LG, Curry GN. 2011. Site-specific fertilizer recommendations for oil palm smallholders using information from large plantations. Journal of Plant Nutrition and Soil Science 174, pp. 311-320.

41. Williams, B. J., and Ortiz-Solorio, C.A., 1981, 'Middle American folk soil taxonomy', *Annals of the Association of American Geographers,* 71, pp. 335-358.

42. Winchester, H.P.M., 1996, 'Interviews and questionnaires as mixed methods in population geography: The case of lone fathers in Newcastle, Australia', *Professional Geographer*, 51, no.1, pp. 60-67.

43. WinklerPrins, A.M.G.A., 1999, 'Local soil knowledge: a tool for sustainable land management', *Society and Natural Resources,* 12, no. 2, pp. 151-161.

44. Zaharah AR, Sharifuddin HAH, Ahmad Sahali M, Mohd Hussein MS, 1989, 'Fertilizer placement studies in mature oil palm using isotope technique', *Planter Kuala Lumpur* 65, pp. 384–388

45. Zijsvelt, M. F. W., Torlach, D. A. (1975): Soil survey and land use potential of the Ala-Kapiura area, West New Britain, Papua New Guinea. Research Bulletin No. 17. Department of Agriculture, Stock and Fisheries, Port Moresby, 1 map (#440), 1 report.

Appendix 1: Ethics Approval

JAMES COOK UNIVERSITY AUSTRALIA

James Cook University
Townsville Qld. 4811 Australia
Tina Langford, Manager, Research Ethics & Grants
Research Services Ph: 47815011; Fax: 47815521
email: ethics@jcu.edu.au

Human Research Ethics Committee *APPROVAL FOR RESEARCH OR TEACHING INVOLVING HUMAN SUBJECTS*			Application ID H5110
PRINCIPAL INVESTIGATOR	Claire Docherty		Student
SCHOOL	Environmental Sciences & Geography		
CO-INVESTIGATOR(S)			
SUPERVISOR(S)	Paul Nelson and Lisa Law		
PROJECT TITLE	Mekim graun kamap gut: an investigation of local knowledge and practices surrounding soil fertility for food crops and oil palm in Kae Village, West New Britain, Papua New Guinea		
APPROVAL DATE: 17/06/2013	**EXPIRY DATE:** 31/05/2014	**CATEGORY:** 1	

This project has been allocated Ethics Approval Number H5110, with the following conditions:

1. All subsequent records and correspondence relating to this project must refer to this number.

2. That there is NO departure from the approved protocols unless prior approval has been sought from the Human Research Ethics Committee.

3. The Principal Investigator must advise the responsible Human Ethics Advisor:
   - periodically of the progress of the project,
   - when the project is completed, suspended or prematurely terminated for any reason,
   - within 48 hours of any adverse effects on participants,
   - of any unforeseen events that might affect continued ethical acceptability of the project.

4. In compliance with the National Health and Medical Research Council (NHMRC) "National Statement on Ethical Conduct in Human Research" (2007), it is MANDATORY that you provide an annual report on the progress and conduct of your project. This report must detail compliance with approvals granted and any unexpected events or serious adverse effects that may have occurred during the study.

Human Ethics Advisor :	Cottrell, Alison
Email :	Alison.Cottrell@jcu.edu.au

This project was Approved by Executive on 17 Jun 2013

Dr Anne Swinbourne
Chair, Human Research Ethics Committee

Approval_Form_H

Printed on 17 Jun 2013

Appendix 2: PNG Oil Palm Research Association Letter of Support

Dami Research Station - P.O. Box 97, Kimbe, West New Britain Province 621, Papua New Guinea
Telephone: (675) 985 4009 / 985 4015 — Facsimile: (675) 985 4040

To Whom it May Concern

6 February 2012

Dear Sirs,

Project entitled Mekim giraun kamap gut: an investigation of local knowledge and practices surrounding soil fertility for food crops and oil palm in Rapuri Village, West New Britain Province, Papua New Guinea
by Claire Docherty

PNG Oil Palm Research Association (PNGOPRA) is based in West New Britain specifically to undertake applied research and provide technical advice to growers and affiliated milling companies in Papua New Guinea.
We have, as a part of our support structure, very active and knowledgeable Agronomy and Socio-economics Sections.

I can confirm our support to Ms Claire Docherty for her honours degree research visit to West New Britain. I also confirm that the Agronomy and Socio-economics team in Dami will assist her by coordinating and providing logistics for her collaborative research under the umbrella and prescribed mandate of an approved Association and on-going ACIAR Project entitled: *Sustainable management of soil and water resources for oil palm production systems in PNG (ACIAR Project #: SMCN/2009/013).*

Ms Docherty will be conducting her research with the local people on their understanding of soil fertility, and most importantly how they can maintain soil fertility in their food gardens and oil palm blocks.

Yours faithfully,

Charles F Dewhurst
Head of Entomology and Acting Director of Research

Appendix 3: Information sheet – English

JAMES COOK UNIVERSITY
AUSTRALIA

INFORMATION SHEET

Makim graun kamap gut: What does soil fertility mean to the people of Kae?

You are invited to take part in a research project that is examining what soil fertility means to the people of Kae Village, West New Britain, and how you manage soil fertility for growing a) food crops and, b) oil palm.
The study is being conducted by Claire Docherty and will contribute to her Honours project at James Cook University.

If you agree to be involved in the study, you will be invited to be interviewed and to demonstrate to the student how you ascertain soil fertility to grow your crops. The questions the student will focus on will be about how you identify different soil quality, and what you grow with it, and also how your soil may have changed over time and what this means for your choice of crops.

Taking part in this study is completely voluntary and you can stop taking part in the study at any time without explanation or prejudice. You may also withdraw any unprocessed data from the study.

If you know of others that might be interested in this study, can you please pass on this information sheet to them so they may contact me to volunteer for the study?

Your responses and contact details will be strictly confidential. The data from the study will be used in research publications. You will not be identified in any way in these publications.

If you have any questions about the study, please contact **Miss Claire Docherty or Mr Steve Nake.**

Principal Investigator: Claire Docherty
School of Earth and Environmental Sciences
James Cook University
Cairns, Australia
Phone: 70506916
Email: claire.docherty@my.jcu.edu.au

PNG Supervisor: Mr Steven Nake
Head of Agronomy
PNG Oil Palm Research Association
Kimbe, West New Britain, PNG
Phone: 71556148
Email: steven.nake@pngopra.org.pg

If you have any concerns regarding the ethical conduct of the study, please contact:
Helen Griffiths ,Human Ethics and Grants Administrator, Research Office,
James Cook University,
Townsville, Qld, 4811. Phone: 4781 6575, Helen.Griffiths@jcu.edu.au

Appendix 4: Information sheet - Tok Pisin

JAMES COOK UNIVERSITY AUSTRALIA

INFORMATION SHEET

Mekim graun kamap gut na fres: What does soil fertility mean to the people of Kae?

Mi laik invitim yupela lo wok wantaim mi lo projek mi wok lo mekim. Projek bilong mi i lukluk lo giraun. Taim mi tok giraun, mi minim giraun yupela I usim lo planim gaden kaikai na oil palm. Projek bilong mi I lukluk lo hau yupela i save mekim giraun I kamap gut lo halivim ol gaden kaikai na oil palm lo kamap gut.
Nem blo mi Claire Docherty na mi mekim dispela studi lo halivim mi lo pinisim skul projek blo mi lo James Cook University.

Sapos yupela I wanbel lo studi bilong mi, bai mi invitim yupela lo givim sampela toktok lo showim dispela sumatin lo hau yupela I save mekim giraun I kamap gut lo growim garden kaikai bilong yupela. Sapos em orait wantaim yupela, bai mi askim yupela sampela questen wei bai takim sampela taim lo yupela givim ansa. Bai mi mekim disla insite lo peles blo yupela. Ol qesten bilong mi I lukluk lo hau yupela I save mekim giraun in kamap gut na fres, wanem samting yupela I save usim lo mekim giraun I kamap gut na fres na wanem kain kaikai yupela I save planim, na hau giraun I save senis taim yupela I usim pinis na wanem kain kaikai yupela I save planim taim giraun I senis olsem.

Em laik blong yuplela sapos yupela laik stap wantaim mi na halivim mi wantaim dispela studi. Sapos u no laik halivim mi lo dispela studi, em laik bilong yu tu. Na tu, yu nap kisim bek ol samting yu bin givim pastaim lo mi lo taim blong studi.

Sapos yu save lo ol narapela lain husat I laik halivim mi lo studi blo mi, plis passim dispela pepa or toksave igo lo ol na ol ken contactim mi na halivim lo studi blong mi.

Ol toktok yupela givim lo studi blo mi, nem na namba blo yupela, em bai mi tasol bai save lo em. Mi no inap lo showim ol narapela manmeri. Bai mi kipim secret stret. Ol wok painim blo mi em mipela bai I putim lo pepa na putim aut skul blo mi so ol narapela man meri lo wol I ken redim na save lo hau yupela I usim mama giraun blo yupela lo planim kaikai na tu lo mekim em kamap gut na fres lo planim kaikai.

Sapos yupela igat sampela questen lo dispela studi, plis contactim **Miss Claire Docherty or Mr Steve Nake.**

Principal Investigator: Claire Docherty
School of Earth and Environmental Sciences
James Cook University
Cairns, Australia
Phone: 70506916
Email: claire.docherty@my.jcu.edu.au

PNG Supervisor: Mr Steven Nake
Head of Agronomy
PNG Oil Palm Research Association
Kimbe, West New Britain, PNG
Phone: 71556148
Email: steven.nake@pngopra.org.pg

If you have any concerns regarding the ethical conduct of the study, please contact:
Helen Griffiths ,Human Ethics and Grants Administrator, Research Office,
James Cook University,
Townsville, Qld, 4811. Phone: 4781 6575, Helen.Griffiths@jcu.edu.au

Cairns - Townsville - Brisbane – Singapore
CRICOS Provider Code 00117J

Appendix 5: Nakanai Language Tool

Organised Phonology Data

Nakanai [Bileki dialect] (Lakalai, Bileki) Language [NAK]
Cape Hoskins – West New Britain Province

Oceanic; *Meso-Melanesian Network*; Willaumez Chain

Population census: 10.500 (1980)

Major villages: Waisissi, Kassia, Porapora, Gavaiva, Valoka, Gavuvu, Gule, Rikau, Kavutu, Karapi, Rapuri, Gusi, Tarobi, Pasusu, Kaiamo, Umu, Movai, Bubuu, Apapulu, Ewasse, Baikahea

Linguistic work done by: Early Catholic priests, SIL, A. Chowing, W. Goodenough

Data checked by: R. Johnston (September 1992)

Phonemic and Orthographic Inventory

ɑ	b	d	ɛ	g	h	i	k	l	m	o	p	r	s	t	u	β
a	b	d	e	g	h	i	k	l	m	o	p	r	s	t	u	v
A	B	D	E	G	H	I	K	L	M	O	P	R	S	T	U	V

Consonants

	Bilab	LabDen	Dental	Alveo	Postalv	Retro	Palatal	Velar	Uvular	Pharyn	Glottal
Plosive	p b		t d					k g			
Nasal	m										
Trill			r								
Tap/Flap											
Fricative	β			s							h
Lateral Fricative											
Approx											
Lateral Approx			l								
Ejective Stop											
Implos											

p	la paga	'thing'	t	tou	'dislike'
	sipa	'cut hair'		kiiti	'adhered'
b	la baga	'large crushing stone'	d	e doudou	'termites'
	la liba	'cemetery / grave'		poukidi	'sit properly'
m	la maga	'light'	s	sou	'dam water'
	la lima	'hand'		kisi	'tie'
β	la vaga	'pig food'	r	rou	'compensate / redeem'
	la iva	'brother-in-;aw'		giri	'tickle'

Appendix 6: Oil Palm Industry Stakeholders in West New Britain

Round Table on Sustainable Palm Oil (RSPO)

The Roundtable on Sustainable Palm Oil (RSPO) was formally established on 8 April 2004 to ensure fair representation of all stakeholders throughout the entire oil palm supply chain. The RSPO includes in the term 'supply chain': ecosystems, communities, growers, traders, processors, consumer goods manufacturers, retailers, financial institutions and civil society. The RSPO provides a globally recognised sustainability certification for oil palm growers, producers and manufacturers. Smallholders have separate sustainability criteria compared to companies under the RSPO guidelines.

In PNG the milling companies, such as New Britain Palm Oil Limited (NBPOL), work with the RSPO and the local smallholders to produce RSPO certified 'sustainable' palm oil.

Smallholder Oil Palm Sector

The smallholder sector of the PNG oil palm industry is described by the RSPO as being 'Associated Smallholders'. Smallholders in PNG vary in situation, though compared to the smallholder industries in Indonesia or Malaysia (RSPO http://www.rspo.org/en/definition), there is a greater percentage of customary ownership and discretionary power in terms of land use and management. However the sector in PNG remains linked with milling companies for logistical, research, certification, and extension purposes. The term 'Associated Smallholders' is specifically developed for PNG Smallholders and used by the RSPO to describe an intermediary category between its two primary definitions of Smallholders; 'Scheme' and 'Independent':

> ***Scheme Smallholders*** are bound by some form of contractual agreement to a particular milling company. They are generally supervised in their planting and crop management techniques, '…and are often organized, supervised or directly managed by the managers of the mill, estate or scheme to which they are structurally linked' (Accessed RSPO website http://www.rspo.org/en/definition on 7 August 2013); and
>
> ***Independent Smallholders*** are defined by the RSPO by their 'freedom to choose how to use their lands, which crops to plant and how to manage them; being self-organized, self-managed and self-financed; and by not being contractually bound to any particular mill or any particular association' (Accessed RSPO website http://www.rspo.org/en/definition on 7 August 2013) They may also receive extension services from government agencies.

In West New Britain Province there are two processing mill companies who are aligned with smallholders; these are New Britain Palm Oil Limited (NBPOL) and Hargy Oil Palms Limited (HOPL). Combined, they have approximately 77,139ha under oil palm cultivation in WNB (Nelson et al., 2010, p.12).

Other key stakeholders in the Smallholder oil palm industry:

- The **Oil Palm Industry Corporation (OPIC)** – the main function of OPIC is to provide agricultural extension services to PNG oil palm smallholders. These services have a practical focus and are intended to raise the grower's productivity level. OPIC also works with smallholders at a local level to develop smallholder grower's collectives to represent the interests of the growers at the provincial and national level (ACIAR, IAS 80, 2012, p. 15). Smallholder groups also provide OPIC with the opportunity to have greater involvement and alignment with local level needs, and to collect information about the industry to provide to the smallholder sector. As a PNG Commodity Board, OPIC liaises with the Government of PNG on oil palm industry matters (ACIAR, IAS 80. 2012, p.15 and OPIC website at <http:www.opicpng.org/opic/about-opic>, accessed 3 August 2013).

- The **Papua New Guinea Oil Palm Research Association (OPRA)** is the research arm of the oil palm industry in PNG. It is an alliance of NBPOL, HOPL and smallholders on approximately 18,000 oil palm blocks. OPRA's focus is to identify and address the research needs and solve the technical problems of its members (ACIAR, IAS 80, 2012,p.16)

Appendix 7: Description of soil map units in which study sites were located (taken from Zijsvelt and Torlach's (1975) soil map (1:50,000) and report).

Ruby, Paula and Gloria's gardens

Unit Description:	This unit comprises an area of flat topography located north of Kai village and supporting a low primary rainforest with patches of secondary growth. The soils are generally well drained soils with wet season water tables expected in the northern and eastern parts of the unit. The soils belong all to the Gavuvu series-Norma Profile and are shallow, friable medium textured overlying several coarse textured layers of which a deep pumice gravel horizon starts between twenty and thirty inches. The unit is suitable for all coastal tree crops and arable crops. Shallowness of the soils and the somewhat suspected drainage in parts of the unit are minor limitations.
Suitability	Land suitable for horticulture but with minor limitations requiring special management
Landuse limitation	Soil hazards of increasing importance; texture of subsoil, depth of soil, presence of rooting inhibiting layers
Landuse limitation2	Drainage limitation
Slope1	0-2 degrees
Drainage1	Moderately well drained soil
Drainage2	Well drained soil
Soil1 1	The soils of Gavuvu series are those volcanic soils that are developed in in-situ parent material and in which the lower boundary of layer IV is always below a depth of fifty inches, while layer I; II AND III can be present. The series consist of a Normal Profile and eight variants. The Normal Profile and the variants can be subdivided into phases, based on drainage characteristics and the presence of cemented layers.

Molly and Mary's gardens

Unit Description:	This unit is located between Sisimi village and Lasibu, just west of the Gau creek. The unit is probably a small volcanic cone and has gentle slopes. The vegetation is a light primary rainforest. The soils are well drained and are expected to be of series 1 and 3. The unit is suitable for arable crops and all coastal tree crops. The infertile coarse textured sub-soil at a shallow depth and an erosion hazard form limitations.
Suitability	Land suitable for horticulture but with minor limitations requiring special management
Landuse limitation	Erosion hazard, not as great a limiting factor to tree crops as it is to arable crops.
Landuse limitation2	Soil hazards of increasing importance; texture of subsoil, depth of soil, presence of rooting inhibiting layers
Slope1	2-5 degrees

Slope2	5-15 degrees
Drainage1	Well drained soil
Soil1 1	The soils of Gavuvu series are those volcanic soils that are developed in in-situ parent material and in which the lower boundary of layer IV is always below a depth of fifty inches, while layer I; II AND III can be present. The series consist of a Normal Profile and eight variants. The Normal Profile and the variants can be subdivided into phases, based on drainage characteristics and the presence of cemented layers.
Soil2 3	The soils of Tarobi series are very closely related to the soils of the Gavuvu series. They differ from the latter series in that there is a characteristic layer V, consisting of a plastic and sticky clay or clay loam, within fifty inches of the surface. The series consists of a Normal profile and seven variants. The Normal Profile and the Variants can have several phases, based on drainage characteristics and the presence of a cemented layer.

Description of the layers referred to the in the tables.

Layer	Description
I	Consisting of yellowish-brown, fine pumice gravel and dark grey to black lapilli sand; overlying,
II	Consisting of a complex of friable, yellowish brown sandy loam, fine sandy loam or silt loam and firm to cemented greyish loamy sand or loamy fine sand layers; overlying,
III	Consisting of a thin loose layer of coarse pumice sand to fine pumice gravel; overlying,
IV	Consisting of a deep layer of coarse angular pumice gravel and pumice pieces; overlying,
V	Consisting of a reddish brown, plastic and sticky clay loam to clay which often contains colourless glasslike minerals.