Livelihood and land-use choices of Papua New Guinean Landowners, and implications for decisions relevant to commercial tree growing

by

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Doctor of Philosophy
of the Australian National University
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Candidate's Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of the author's knowledge, it contains no material previously published or written by another person, except where due reference is made in the text.

Kulala Mulung  
Date: 30 July 2012
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Abstract

This study explores the basis on which Papua New Guinean landowners make land- and resource-use choices, and considers the implications of these for the adoption of commercial tree growing. Theoretical insights from the Hierarchical Needs Theory, Sustainable Livelihoods Framework, and Farmer Adoption-Decision Framework enabled development of a conceptual model, the ‘PNG Landowner Decision Environment’. This model was used to assess landowners’ attitudes and behaviour relevant to the use of household assets, engagement in subsistence and cash-income generating activities, patterns of exchanges and consumption, and allocation of labour, land and financial resources, to understand their choices in land- and resource-use decisions. The primary research question was:

On what basis do Papua New Guinea landowners make land-and-resource-use choices?

This was investigated through two subsidiary questions:

What are landowner households’ livelihood strategies?

How do these strategies influence landowner households’ land- and resource-use choices?

Field research was carried out over an 18-month period from late 2007 to early 2009, at four case study sites; in the Upper Ramu region of Madang Province; in the Upper Markham Valley region of Morobe Province; in the Middle Fly region of Western Province; and in the Gogol, Naru and North Coast region of Madang Province. Participant observation and individual and group interviews were the main research methods employed. In total, 268 participants, comprising 175 men and 93 women, representing 175 households were interviewed.

A strong interrelationship was evident between the motivational factors of landowners and their land- and resources-use choices. Key factors were their needs and aspirations, the livelihood strategies and outcomes, their knowledge and skill base, the institutional systems and processes within which the landowners operated, and their capital assets. PNG landowners’ attitudes and behaviour in relation to adoption choices are largely consistent with those of smallholder farmers elsewhere, with the level of participation and involvement in particular activities influenced by personal preferences and values, and by the imperative of satisfying their basic needs. Landowners’ decisions focused on three time horizons: the immediate future, principally in terms of food production; annual or similar cycles, principally in relation to recurring cash requirements; and the much longer-term, which was associated with intermittent cash requirements and had significant legacy dimensions. Decisions about commercial tree growing options need to be linked to these considerations, and to the different planning horizons that PNG landowners pursue for various livelihood outcomes.
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Acronyms and definitions

ACIAR
Australian Centre for International Agriculture Research

Agroforestry
The term agroforestry is used in the broad sense to mean tree growing integrated with other cropping (cash crop or subsistence) system in farm activities. Thus, agroforestry includes shelter plantings, widely-spaced with other crops beneath, woodlots, amenity planting, natural forest conservation, all within the boundary of a farm land.

Commercial tree growing
Refers to range of activities associated with establishment, growing and management of choice-trees species for the purpose of producing wood for variety of commercial and industrial end uses. The uses may include; fuel wood, fibre, resin, round poles and range of processed wood products.

Farmer/ Landowners
Refers to smallholder farmer in PNG who own and manage farmland with mixed crop regimes of crops as a source of cash income or for subsistence needs.

JANT
Japan and New Guinea Timbers

Kina
Local currency used as legal tender in PNG

OTDF
Ok Tedi Development Foundation

PNG
Papua New Guinea

PNGFA
Papua New Guinea Forest Authority

RAIL
Ramu Agri-Industries Limited

SLF
Sustainable Livelihood Framework
Chapter 1: Introduction

1.1 Introduction

Papua New Guinea (PNG) is globally distinctive in many respects. It has very high levels of biological and cultural diversity, reflecting in part its geography and topography. It is one of the cradles of agriculture globally (Groube 1989) and its landscapes are cultivated to varying degrees (Kennedy and Clarke 2004). Its customary land tenure systems are enshrined in the 1975 National Constitution, providing customary landowners with full rights to the land and resources traditionally held by their land groups, such as clans. However, despite the richness of its natural resources, including forests and minerals, PNG remains amongst the lowest-ranked countries globally in terms of human development indicators – for example, the UN’s Human Development Index score for PNG for 2011 is 0.431, ranking the country at 157 of 187, and in the low category of this index (UNDP 2011).

More than 85% of Papua New Guineans live in rural areas and depend on agriculture of various forms for both subsistence and income generation (Allen and Bourke 2009). This thesis investigates the livelihood strategies and associated land-use choices of these rural people. It also considers the potential implications of these strategies and choices for decisions that rural Papua New Guineans might make about the incorporation of commercial tree growing into their land use systems, as a means of enhancing their livelihoods.

1.2 Contexts for the study

There are a number of contexts for this study. The first is the role of crops and trees in the livelihoods of rural Papua New Guineans; the second is the role and future prospects of forestry in contributing to economic development and rural livelihoods in PNG; and the third is the immediate research context of this PhD study. Each of these is discussed below. In this section, as throughout the thesis, rural Papua New Guineans who farm on a small, family scale and access land through traditional land allocation systems are referred to as ‘landowners’; this is the terminology commonly used in PNG to recognize members of a land-holding group, such as a clan, who exercise resource and use rights over land that is recognized, both customarily and formally, as theirs (see, e.g., Filer and Sekhran 1998). In the context of other countries, PNG landowners would often be described as ‘smallholders’ or the equivalent.

Papua New Guinea has a dual economy, comprising both formal and informal elements. The formal economy is dominated by large-scale resource projects, particularly in mining, petroleum and logging, and these provide a large proportion of government revenue. The informal economy supports 85% of the people through semi-subsistence agriculture. Most people live and work in the subsistence sector, producing food for consumption, raising animals and building their own housing, as well as producing agricultural commodities for sale in domestic and international markets (McGregor and Bourke 2009). The proportion of people
working in the formal sector is small, and they are concentrated in the urban areas and mining towns. Most rural Papua New Guinean receive limited income from agriculture and associated activities such as selling firewood, fish or animals. The estimated cash income to rural households from the sale of agricultural produce for the period 1990 -1995 was about K200 million per year (McGregor and Bourke 2009). A third of this was from the production of Arabica coffee; income from the sale of fresh food accounted for 22 percent, cocoa 11 percent, betel nut and betel pepper 10 percent, copra 8 percent, oil palm 3 percent, firewood 3 percent and fresh fish and shells 2 percent (McGregor and Bourke 2009). Sales of fresh food provided cash income to more households than any other activity. Income sources for rural households from non-agricultural sources included those from small retail business, particularly retail stores; transport business; the sale of manufactured goods; trading as middle man; paid labour for other villagers, or for businesses such as logging or plantation companies; remittance of money from relatives; royalties from mining and logging activities; and compensation from mining operations (McGregor and Bourke 2009).

1.2.1 The role of forest resources in rural livelihood systems in PNG

PNG has a history of agriculture of about 10,000 years (Bourke 2009). Trees grown or managed for particular purposes are an integral part of PNG farming and land use systems, and the diversity and dynamism of these systems reflect PNG’s high level of innovation and adaptation in agriculture (Kanowski et al. 2008).

Throughout PNG, plant resources are fundamental for people’s livelihoods. Plants provide people with – for example - energy, fibres, food, medicines, poisons, raw material for building shelters and boats, tools and weapons; Powell (1976) recorded 1035 plant species, representing 470 genera of 146 families, with specific uses in PNG. Traditionally, a significant proportion of the total food output in subsistence production systems originated from tree crops (Barrau 1955; Powell 1976). For example, Hanson et al. (2001) estimate that some 10 percent of the population of PNG is dependent on sago as the dominant staple. Food from trees originates from wild, semi-domesticated and domesticated sources, some of which are cultivated in gardens and some of which are collected from forested landscapes (Kennedy and Clarke 2004). Powell (1976) listed 251 plant species as source of food; 63 percent of these were gathered from forests, savannahs and grasslands; 20 percent were both cultivated and harvested as wild resources, and 17 percent were cultivated. As well as their use as food and raw materials, some PNG tree species have been adapted and used extensively as part of the fallow cropping to manage soil productivity; a notable example is *Casuarina oligodon* in the highlands fringes of Papua New Guinea (Bourke 1997; Clarke 1993).
1.2.2 The role of forestry in PNG’s development

Some 71 percent (33 million ha) of PNG’s total land area of 46 million ha is still forested (Shearman et al. 2008). There is an active debate about the extent, rate and causes of deforestation and forest degradation in PNG (e.g., Filer et al. 2008; Shearman et al. 2008). Filer and Sekhran (1998) reported that some 4 million ha of PNG’s forests had been intensively harvested for log exports, with perhaps 0.5 million ha of these subsequently converted to agriculture, around 1 million ha regenerating to forest, and around 1.5 million remaining as degraded secondary forest. Shearman et al. (2008) suggest that rates of deforestation and degradation have been higher. However, it is widely agreed that unsustainable forest harvesting levels and practices over more than 30 years, extensively documented elsewhere (e.g., Filer and Sekhran 1998; Hunt 2002; ODI 2006), mean that commercially-accessible natural forest will largely be depleted over the next decade or so. More recently, the use of Special Agricultural and Business Leases and associated Forest Clearing Authorities appears to have offered developers a means to convert large areas of forest to agriculture without the usual constraints applying to forest-based development, and may accelerate the deforestation rate greatly (Ase et al. 2011).

A further constraint to future forest-based development is that the history of unsustainable forest harvesting practices means that secondary forests resulting from harvesting since the 1970s are unable to support the levels of yield envisaged in forest management planning (Bird et al. 2007). The potential income stream from forest harvesting to both landowners and the national government will diminish substantially as a consequence.

Small-scale ‘eco-forestry’ projects, based principally around the use of portable sawmills, were initiated largely by non-government organizations in the 1980’s as an alternative to the large industrial exploitation model of native forest. However, as Hunt (2000) discusses, eco-forestry enterprises have seldom have proved success without external subsidy. The main constraints here are transport infrastructure and market access (Holzknecht et al. 2011).

There has been limited plantation forestry development in most parts of PNG, notably 6,500 ha of Araucaria plantations near Bulolo; 27,800 ha of Eucalyptus in Madang, East and West New Britain and Western Highland Provinces; some 12,000 ha of Acacia grown for wood pulp near Madang, 4,200 ha of Tectona grandis at different locations around the country; and 5,000 ha of balsa plantation in East New Britain Province (Midgley et al. 2010). Nucleus estate agriculture with other tree crops, initially with coffee in the Highland and more recently with oil palm in East and West New Britain and Oro provinces, has been particularly successful; the earlier central role of plantation estates in coffee production has now significantly diminished, and smallholder coffee production on customary-owned land now provides up to 80 percent of PNG’s coffee exports (ADB 2007).
The reasons for PNG's poor status in rankings such as the Human Development Index have been extensively discussed elsewhere (e.g., AusAID 2006; Filer and Sekhran 1998). Although analyses and proposed policy responses vary, there is broad agreement on the need for PNG landowners to generate income from land uses that are more sustainable and enduring than industrial-scale logging has proven to be in the PNG context (e.g., AusAID 2006).

1.2.3 Implications for tree growing

The preceding discussion has outlined both the importance of forests to rural Papua New Guineans and the imperative for income generation to enhance their livelihoods. Generally, the income generation options for PNG landowners are very constrained. The area that can be developed as intensive agriculture is limited by inherent environmental constraints, particularly soil (Blaikie and Brookfield 1987) and by lack of infrastructure. Consequently, incorporation of other valuable crops, such as trees, into land use systems is likely to be a good option for landowners in many parts of PNG (e.g., AusAID 2006). Growing commercial timber trees can build on PNG landowners' traditions of innovation in farming systems and capitalize on the improving terms of trade for high-value tropical timber (Kanowski et al. 2008). Partly in recognition of these factors, the PNG Forest Authority has developed draft national eco-forestry and reforestation policies; these are indicative of the emerging focus on forms of forestry activity other than industrial-scale logging. However, these policies have yet to be adopted formally and, as many analysts have noted (e.g., Bond 2006; Hunt 2000), policy implementation is severely constrained by capacity and financial limitations, and so little of the good policy intent is able to be realized by government agencies. For these reasons, as Filer and Sekhran (1998) have noted, community-based and non-government organization have played, and continue to play, fundamentally important roles in policy implementation.

It was in recognition of these contexts that the Australian Council for International Agricultural Research (ACIAR) commissioned a project, summarized by Kanowski et al. (2008), with the primary objective of conducting research to provide information that would foster the adoption of commercial tree growing by rural Papua New Guineans as a means of enhancing their livelihoods. The ACIAR project was developed from a scoping study that concluded:

The depletion of Papua New Guinea's natural forests, the skills and innovativeness of many PNG landowners in adaptive farming systems, and the good market prospects for tree species that can be grown in PNG, create new opportunities for PNG customary landowners to benefit from deliberately planting and managing commercially valuable trees.

Research and experience in PNG farming systems and forestry suggest that there are both land use systems and regions in which various forms of high-value tree growing could be developed on a commercial scale. There is already good knowledge of PNG land use systems, candidate species, and institutional and structural
This PhD study was situated within that ACIAR project in order to address the limited knowledge of PNG landowner decision-making processes relevant to tree growing for income generation at the household level.

1.3 Research approach, objectives and theoretical frameworks

The research approach and objectives for this study were developed in the context of three theoretical frameworks. Each of these, and the rationale for drawing from each of them, is discussed in Chapter 2. The first of the theoretical frameworks draws largely from human psychology, particularly that developed by Maslow (1954) as the Hierarchical Needs Theory; this is used to explore the different kinds of motivation influencing individuals’ land-use decisions. It informs the understanding of the motives, aspirations and needs of landowners and points of articulation between the household and market economies. The second theoretical framework is the Sustainable Livelihood Framework (Chambers and Conway 1992); this is used to explore the relationship between people and their livelihood assets, and examines how these assets are deployed to enhance their livelihoods. It informs the understanding of the interactions between two forms of economy in which PNG landowners operate, and how these influence landowners’ decisions and land-use behavior. The third theoretical framework is the Farmer’s Land-Use Decision Framework (Pannell et al. 2006; Rogers 1995); this is used to examine landowner’s land-use decision processes. It informs the understanding of how the interaction of these processes affects decisions about the opportunities for commercial tree growing as a livelihood option for PNG landowners.

Thus, this research takes the household as the unit of analysis and seeks to understand land-use decisions and practices in the context of a household’s aspirations, motives and behavior. It therefore necessarily addresses the interface between subsistence food production and cash economy and seeks to elucidate the process by which these two economies, as well as the biophysical and social environments, interact and influence the land-use choices of PNG rural households.

In this context, the specific research objective for this study was to understand how PNG landowners, operating at the interface of the subsistence and cash economies and in particular biophysical and social environments, make land-use choices in the context of their livelihood strategies. A subsidiary objective was to consider how these choices might impact on the opportunities for landowners’ adoption of commercial tree growing.

The research was conducted on a case study basis in four regions of PNG. The case study locations and reasons for their choice are discussed further in Chapter 4.
1.4 Research questions

The primary research question on which the study focused was:

*On what basis do Papua New Guinea landowners make land-and-resource-use choices?*

This primary question was investigated through two subsidiary questions:

1) *What are landowner households' livelihood strategies?*

   This requires assessment of relevant components of households' livelihood assets, household engagement in subsistence and cash income-generating activities, household patterns of consumption and expenditure, and household allocation of labour.

2) *How do these strategies influence landowner households' land- and resource-use choices?*

   This requires assessment of households' decision processes about use of their land and other resources.

The thesis also considers the implications of the answers to these questions for decisions landowners might make about the adoption of commercial tree growing. This requires situating landowners' tree-growing decisions in the context of those about land- and resource-use.

1.5 Outline of thesis

The thesis is organized and presented in four parts:

Part 1 comprises introductory, background and contextual chapters. In Chapter 1, I introduce the research topic with brief descriptions of forests in the context of the livelihood system of the rural people in PNG and as a resource for the country's economic development. From this background, I then develop the research questions guiding this study. Chapter 2 provides a background literature review, the first part of which takes a synoptic overview of theoretical constructs used in these analyses. In the second part, I bring these into the context of PNG landowners and review the household economy (production, consumption, exchange behaviour, labour organization) of rural communities in PNG and assess their land-use choice decisions.

Part 2 covers Research Methodology and comprises Chapters 3 and 4. Chapter 3 presents detailed accounts of research design, ethical considerations and methodological procedures involved in both the work of field data collection and the data analyses processes. Chapter 4 presents study sites and their general characteristics; these are the Upper Ramu Valley, the Upper Markham Valley, Western Province and the Lower Madang region. This chapter is concerned with providing the general socio-economic and environmental context against which landowners' land-use decisions are assessed.
Part 3 of the thesis presents the case study results in each of Chapters 5, 6, 7 and 8. These chapters provide a detailed synthesis of land-use behavior analyses for each of the study sites investigated, and explore the overarching drivers in the land-use choices of PNG landowners.

Part 4 comprises Chapters 9 and 10. In Chapter 9, I consolidate the study findings from the earlier chapters and their relationship to the research questions. In Chapter 10, I explore the implications of the research results for possible strategies for commercial tree growing as a contribution to the livelihoods of the rural people of PNG.
Chapter 2: Literature Review

2.1 Introduction

In this chapter, I first provide a review of theoretical perspectives and frameworks most relevant to understanding Papua New Guinea landowners’ decision-processes about their livelihoods options. I then use these as a basis to examine the behavioural patterns of adoption, production, consumption and exchange activities in relation to their land-and-resources use choices. Lastly, I provide a brief overview of small-scale tree growing in general, and explore how an understanding of landowners’ land-use decision processes in general might inform decision-making relevant to commercial tree growing options. This chapter is organised and presented in the same order.

2.1.1 Perspectives on human behaviour

The relationship between human motives, decisions and behaviours is well documented in the literature from a number of different disciplines, including economics, sociology and socio-psychology. Examples include the theory of planned behaviour (Ajzen 1991); motivational needs theory (Maslow 1954; Latham and Pinder 2005; Macfadyen 1986); and various economic perspectives describing ‘decisions’ under conditions of uncertainty, including rational choice, utility, expectant and normative theories (Simon 1959; Tversky 1975). Studies from each of these perspectives show that human beings have reasons to behave in the ways they do. The reasons embody intention and needs; they express emotions and actions, and often are influenced by current ideas about values (Hollis 1994).

In the forestry context, Allen et al. (2009) observed people’s values, expectation and beliefs to have significant influence on their attitudes toward forest and land resource management decisions. Community-wide support from society can be engendered if these perceptions and values are recognised and catered for in forest management and development strategies (Allen et al. 2009). In addition, investigations in a variety of agricultural and forestry contexts (for example; Pannell et al. 2006; Ridley 2004; Mercer 2004; Byron 2001) show that farmers’ ‘behavioural actions’ in adoption and production decisions are purposive and goal-directed. In general terms, these goals represent the expression of economic, social and environmental values (Pannell et al. 2006); individually, the goals in land use decisions vary widely among farmers, reflecting personal circumstances and preferences. Recognising these values, both at the individual farmer level and across the populations of farmers, assists understanding of farmers’ preferences and choices in adoption and production decision. This is the first step in any behavioural or development interventions.

The variety and means of setting goals amongst individual farmers, and their land- and resource-use decisions that follow, are the primary concern of and focus for this study. This study explores how PNG smallholder farmers (in the PNG context, ‘landowners’) assign
meaning and value to various activities, and how this determines their land use decisions. The overall goal of the study is to develop a greater understanding about the relationship between smallholder motives, perceptions, and behaviour in terms of land- and resource-use decisions. Since smallholder motives, behaviour and land- and resource-use decisions are driven in large part by the livelihood needs of landowners, the study explores rural livelihood strategies in the four case study regions.

The research involves inferential analysis (interpretation) of land use behaviour based on field observation, of script analysis (from the literature), and of experiences generated from the ‘story telling’ of the smallholder (in response to researcher-led semi-structured interviews and discussions). It also involves understanding landowners’ needs and aspirations, and their attitudes and perceptions formed as a result of social, cultural, economic, environmental norms and beliefs—all of which are embedded in the contemporary context. These factors vary widely between individuals and are very complex. Hence, causal relationships between motives, perceptions and behaviour are not easily discernable from a single theoretical construct. This study is based on the premise that understanding relationships between PNG landowner intention and behaviour are the basis for understanding their land-and resource-use choice, and for informing interventions directed at promoting the adoption of commercial tree growing by PNG land owners.

As noted in Chapter 1, the primary research question on which the study focused is:

*On what basis do Papua New Guinea landowners make land-and-resource-use choices?*

This primary question is investigated through two subsidiary questions:

1) *What are landowner households’ livelihood strategies?*

2) *How do these strategies influence landowner households’ land-and resource-use choices?*

These questions raise a number of other underlying questions that embody needs and aspirations, and are highly subjective in nature; hence, it becomes increasingly complex to understand the driving entities for land use choices from within a single analytical framework. The challenge, then, was to develop a framework that was coherent and rigorous, and that was adequate in scope, to provide an objective means for the analyses of smallholder land-and associated resource-use decision processes. On the basis of these considerations, three themes emerged as those of focus for the analysis. The first set of factors characterised the needs and aspirations of individual farmer households. The second set of factors characterised various relationships between an individual farmer household, the society of which they are part, and their resource usage. The third set of factors characterised attitudes and perceptions linking the contemporary social, cultural, economic and environmental norms of the people. Given these considerations, I decided to draw from three theoretical models, each of which were relevant to explaining the processes and mechanisms by which land-use decisions were made by
smallholders in PNG. The theoretical models selected and applied in PNG smallholder land use decisions are considered in the next section.

2.2 Theoretical concepts

This review describes the three theoretical frameworks adopted and applied in the analysis of processes and factors influencing Papua New Guinean landowners’ land-use decisions and farming behaviour. They comprise Maslow’s hierarchical needs theory (Maslow 1970), the sustainable livelihood framework (SLF) (Conway 1992), and the farmer adoption-decision framework (Pannell et al. 2006).

Each of the models has a separate and distinct role in the analysis of landowner land-use decision-making processes: farmer motivation factors were analysed using Maslow’s hierarchical needs theory framework; farmers’ relationships with the environment and their societies were assessed with the SLF; and the issue of heterogeneous behaviour and attitudes between farmers was analysed with a farmer-decision framework. Each of these theoretical frameworks has their own inherent strengths and limitations; together, they are largely complementary, and their use enabled a rigorous and detailed analysis of PNG farmer land-use decision-making processes. For example, Maslow’s hierarchical needs theory over-emphasises the individualistic nature of needs-satisfaction and understates the importance of society, culture, and the natural environment (Jackson 2004). Furthermore, the needs-based theory explains why a person must act; it does not explain why specific actions are chosen in specific situations to obtain specific outcomes. In addition, it does not easily account for individual differences. The use of the SLF model (Conway 1992) lends itself to assessing the types of assets available to the farmer, and the lateral relationships between an individual and the society and between an individual and the environment. However, SLF does not provide explicit explanations of the hierarchical motivational aspirations of individual farmers. The farmer adoption decision framework - the origin of which is traced to a family of theories including rational choice, goal-oriented or expectant theory, optimal theory and normative theory - is dependent on the nature and subsequent expected outcomes of the decision (Pannell et al. 2006). It serves as a good analytical tool to explain individual differences between the farmers in land-use choices and decision-making processes, a feature not so easily accessible from Maslow’s hierarchical need theory nor from the SLF. I review each of the frameworks in turn below.

2.2.1 Maslow’s Hierarchical Needs Theory

Under this theory (see Figure 2.1), needs are presumed to derive from deficits. Such deficiencies mean that there are discrepancies between the actual state of a person and some fixed optimal equilibrium state, characterised by physiological variables such as the levels of sugar, water, oxygen and temperature in the blood, and psychological ones such as feeling,
empathy, belongingness and self-esteem. Abraham Maslow (1954) attempted to synthesize a large body of research related to human motivation. According to Maslow, human behaviour is motivated by sets of needs. Maslow (1954) devised a hierarchical ordering of needs based on two groupings: deficiency needs and growth needs. Here he argued that needs low in the hierarchy must be at least partially satisfied before the needs higher in the hierarchy may become a factor for motivation (Steers et al. 2004). Which needs are most active in driving behaviour depends on two principles (Steers et al. 2004):

1) a need which is satisfied is no longer active; the higher the satisfaction, the less the activity (with the probable exception to this rule being the need for self-actualisation);
2) needs can be ordered in a hierarchy, so that non-satisfied lower order needs, or physiological needs, are more urgent in the sense that they must be satisfied before a higher need can take over the control.

Maslow (1954) classified human needs into seven categories. These include physiological needs (e.g., food, shelter, water, health, minimising effort); safety needs (e.g., security, stability, freedom from fear, chaos, need for order, protection); belongingness and love needs (e.g., feelings of giving and receiving love, need for friendship and belongingness); esteem needs (e.g., feeling of confidence, achievement, prestige, self-esteem and esteem of others); self-actualisation needs (e.g., self-fulfilment, self-realisation, growth, maturity). Maslow (1954) termed lower-order needs as ‘material needs’, the middle-order needs were ‘social needs’, and the higher-order needs were called ‘growth’ or ‘self-actualisation needs’ in which one becomes wiser (developing wisdom and automatically knowing what to do in a wide variety of situations). Maslow believed that these types of human needs could motivate human behaviour.

Maslow's hierarchy needs theory has been widely cited in the literature (Steers et al. 2004) as a model in the processes and mechanisms for evaluating consumer behaviour in a range of disciplines from psychology and marketing to organisational and personal management and policy analysis. It has been used, for example, in consumer needs and behaviour (Jackson et al. 2004), national development policy analysis (Hargerty 1998); personnel management and work motivation (Latham 2005); and in household financial needs analysis. In a study on development policy analysis, Hargety (1998) demonstrated that Maslow's hierarchical needs theory could be applied to analysing a 35-year data set of economic variables, family life, esteem, and self-actualisation. The results confirmed some parts of Maslow's theory, particularly the time trajectories showing significant increases over the period, but not reaching the expected sigmoid curve as predicted by the theory. The study also showed that the sequence of actual need fulfilment significantly correlated with Maslow's hierarchical predictions (Hargety 1998). Latham and Pinder (2005) observed that needs-based theory explains why a person must act; they do not explain why specific actions are chosen in specific situations to obtain specific outcomes. Moreover, they do not easily account for individual differences.
Criticisms of the theory include a lack of empirical evidence, lack of conceptual and empirical clarity in the definition of self-actualisation – the highest order need in the hierarchy (Heylighen 1991). They showed that between-goal correlations across four samples of college students supported Maslow’s theory when intentions to act were rated rather than the measures of importance. Furthermore, the hierarchical needs theory over-emphasises the individualistic nature of needs-satisfaction and underestimates the importance of society, culture, and the natural environment, by treating this as secondary in importance to individual motivation (Jackson 2004). Heyligen (1991) proposed that the inclusion of temporal and cognitive factors would help to provide human motivation in response to risk and shock events.

While accepting its limitation, this study situates PNG smallholders’ land-use decision-making process within the context of Maslow’s hierarchical needs theory, and

- analyses and identifies motivational needs, psychological need for food, the need for water, the need for security, and needs for love and affection that influence land-use decisions;
- explains the relationship between farmer-behavioural intent and the action (behaviour) of the farmer in the land-use choice decisions;
- analyses higher social relations between a farmer and members of the group within the context of existing social and cultural norms in which a farmer operates.

On the basis of individual farmer analysis, aggregated behavioural patterns for groups can be drawn and applied as group behaviour based on data saturation principles.
2.2.2 Sustainable Livelihood Framework (SLF)

The Sustainable Livelihood Framework (SLF) is a conceptual construct through which objectives, scope, and priorities for development interventions are viewed and analysed by improving performance in poverty reduction. Drawing from Chambers and Conway (1991: 6), a livelihood is defined as

'comprising the capabilities, assets (including both material and social resources) and activities required for a means of living. Livelihood is sustainable when it can cope with and recover from shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base'.

The SLF is diagrammatically represented in Figure 2.2. The framework outlines the factors in sustainable livelihood systems and shows the relationship between each of the factors. Hence the main features are livelihood assets, including five categories of capital - human, finance, natural, social and physical. The relationships between each of the factors defining various system and processes (including policies, legislation, institutions, culture, and power relations) all interact and influence these factors (DFID 1999). These strategies are pursued to enhance livelihoods. The underpinning rationale of the framework is that people pursue their preferred livelihood outcomes by drawing on a range of capital assets to pursue a variety of livelihood strategies. The choice of livelihood strategies is driven in part by preferences and priorities. However, it is also influenced by policies (and their implementation) and by various institutions and processes. The central theme in the livelihoods approach is poverty eradication through participatory processes between the people for whom the projects and programs are designed and the agents facilitating the process (Chambers and Conway 1992; Asley and Carney 1999; DFID 1999; Baumann and Sinha 2001). The SLF approach had been used widely to design, manage and evaluate projects and programmes; for examples, see Asley and Carney (1999), Bebbington (1999), Bauman and Sinha (2001), Rakodi (2002), and Arce (2003), among others.

As a conceptual framework, SLF's positive attributes include a holistic and realistic representation of livelihoods systems and reflect poverty in the broad sense. As an analytical tool it lends practitioners and theorists a lens to view and understand the reality of the poor and the complexities of rural life (Scoones 1998; DFID 1999; Asley and Carney 1999). As a tool, the SLF framework helps to explain why and in what ways people are poor (DFID 1999; Asley and Carney 1999). Criticisms of this framework include over-simplification in the ways in which it portrays the complex relationships between the factors (Bauman and Sinha 2001); that it is too complex and ambitious, and of limited guidance on the way forward (Carney 1999); in terms of operations, the SL approach is designed to work across sectors. However, in reality most government institutions and organisations operate and are funded on a sector basis observe that the issue of accessibility and the relationship between access and decision-making involving strategic and unintentional behaviour and structural factor are real challenges with the SLF approach. They observe that accessibility to livelihood opportunities is governed by social
relationships, institutions and organisations, and include power as an important explanatory variable. Baumann and Sinha (2001) in their analysis of power relationships influencing accessibility to assets and entitlements by the poor, observed that this kind of accessibility is often governed by power relations which have political implications. The SL framework in its present form, however, cannot facilitate detailed or rigorous analysis. On the basis of their observations, political capital was suggested as an additional factor that should also be included in the asset category. Similarly, Arce (2003) argues that both community development and sustainable livelihood approaches ignore the complex social property of value-contestation in development policies; this, in turn, gives rise to sociological concerns over whether or not the orientation of development has the potential to positively change peoples' reality.

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**Figure 2.2 Sustainable Livelihoods Framework**

*Source: Department for International Development DFID (1999: 1.1)*

Despite the associated complexities in the definitions and the intended cross-sector applications, there are certain components of the framework are useful to this study. The relevant components of the framework can be located and applied in the analysis of Papua New Guinea farmers' land-use decision-making processes. Of particular significance are capital assets, livelihood strategies and risk-coping strategies.

This study situates PNG farmers' land-use decision-making processes in the SL framework, and uses it to:

- analyse the types of livelihood strategies farmers pursue;
- assess the type of livelihood assets available to and accessed by PNG landowners, analyse measures that farmers adopt in preparation for vulnerability conditions, and evaluate how existing institutional systems and processes influence farmer land-use choices.
2.2.3 Farmer adoption-decision framework

In the context of agricultural and forestry practices, a decision for a particular adoption of production practice or a new innovation is based on subjective perceptions or expectations (Ridley 2004; Mercer 2004; Pannell et al. 2006). Rogers (1995) describes adoption/diffusion as having five characteristic aspects in the sequence of an adoption process. They include relative advantage, compatibility, complexity, trialability and observability (Rogers 1995). The specific details of these theoretical constructs are discussed further in Section 2.6 below. The main principles are summarised here. ‘Relative advantage’ refers to the degree to which an innovation is perceived as better than the idea that it supersedes. ‘Compatibility’ refers to the degree to which innovation is perceived as being consistent with values and norms of a social system. ‘Complexity’ this refers to the degree to which an innovation is perceived as difficult to understand and use. ‘Trialability’ refers to the degree to which an innovation may be experimented with on a limited basis. ‘Observability’ is the degree to which the result of innovation is visible to others.

This study draws on the principles of adoption/diffusion processes as described by Rogers (1995) and Pannell et al. (2006) in an agricultural and forestry context to describe PNG farmers’ land- and associated resource-use decision-making processes. Drawing from these principles, the study identifies from within the farming system the characteristics that influenced farmer decisions for adoption and production practices. The study assessed crop characteristics, adoption and diffusion mechanisms, management and marketing characteristics, farmer characteristics, infrastructure systems and the underlying social, cultural and economic systems interacting with farmers’ own decision-environment. A diffusion mechanism describes the process in which a new idea, practice or object was first heard about, a decision made about its application, and then its use applied within a particular context (Pannell et al. 2006). Understanding the bases for farmer choices in decision processes has important implications for informing decisions about options for commercial tree growing opportunities.

How these theoretical constructs are applied in analysing PNG smallholder land use decision processes will be described in detail in Chapter 3. In the next sub-section, I explore various concepts used throughout this study.

2.3 Motive, behaviour and land use decisions

In this section, I examine theoretical constructs in the concepts of motive and behaviour, and discuss how they inform understanding of landowner behaviour in context of livelihood strategies, and how it aligns landowners’ land use decisions with their needs and household goals.
2.3.1 The concept of motive

Most contemporary theories of motivation assume that people initiate and persist at behaviours to the extent they believe the behaviour will lead to desired outcome (Maslow 1957; Simon 1959; Mitchell 1982; Ajzen 1991; Deci and Ryan 2000). The theoretical basis of the relationship between human motivation and behaviour was presented in this section. In this section, I focus attention on the concept of ‘motive’ in respect to smallholder land use behaviour.

Everyday usage of the word ‘motive’ ascribes a situation where an individual wants and tries hard to do well at a particular task or job. The Oxford Advanced English Dictionary defines ‘motive’ as ‘reason for doing something’. In more technical usage, the word motive describes psychological processes that cause the arousal, direction and persistence of voluntary actions that are goal directed (Mitchell 1982). Mitchell (1982) explains that the question of arousal in a motive focuses on ‘what is it’ that gets people activated. What circumstances arouse people so they want to do well? The question of ‘direction’ refers to the preference in the choice that leads individual to willingly engage and maintain behaviours that subsequently achieves the desired intention. The assumption about arousal is found in the theories of need. This theory’s emphasis is on individual needs and postulates that the arousal process is due to need deficiencies (Maslow 1954; Mitchell 1982). That is, people want certain things in their lives and they work to fulfil those needs. The concept of needs was discussed and presented at some length in Part 1 of this Chapter. In contrast to need a deficiency driven motive, another theoretical construct also found in the concept of motive is ‘reinforcement’ where behaviour is assumed to be reinforced if it consistently reoccurs due to the presence of a positive reinforcer. Macfadyen (1986) notes that reinforcement theory is similar to preference theory in economics, where economic choice behaviour is presumed to be motivated by an individual’s preference. Macfadyen (1986) notes that the difficulty with the concept of motivation is that it cannot be directly observed, but must be inferred from what an individual does or says. However, it is possible that a person may not tell an observer the reason for a particular behaviour (perhaps behaviour is habitual or unconscious) or that that verbal response may bear little or no relation to that person’s future behaviour (Macfadyen 1986). In some cases the inference may be strongly supported with evidence, whereas in other cases it is not. For this reason, Macfadyen (1986) suggests that since motives do not function independently of either the environment or the innate capacities of the individual, it may be necessary to include several motivational constructs within a single prediction model if maximum variance in behaviour is to be accounted for. Macfadyen (1986: 67-102) describes five major motivational constructs in predicting human behaviour:

1) There is a ‘push’ construct of motivation such as instinct or drive. The knowledge of different levels of physiological deprivation or ‘need’ is predictive of both
direction and in many cases the goal of behaviour. However, this construct currently lacks empirical evidence;

2) Reinforcement comprises a distinct motivational construct that is assumed to ‘pull’ behaviour. In this sense reinforcement can be considered as a construct that is to some extent independent of a physiological ‘push’ construct, in that if an incentive is strong enough, it will motivate an organism in the predicted direction even if there is little or no physiological need. The ‘pull behaviour’ is influenced by environmental factors;

3) Activation or arousal level is another motivational construct which needs to be seriously considered when explaining and predicting behaviour since it is assumed that each individual as a unique arousal. This motivational construct could be considered in terms of motivational ‘filter’ through which physiological needs and environmental stimuli are screened;

4) Cognitive motivational constructs have come to fill an important role in explaining and predicting human behaviour. There is sufficient evidence that even when a strong physiological state is present, a reinforcement for satisfying the physiological need is available; and the question is in a high state of arousal, cognitive motives (e.g., conscious values of right and wrong) can be the deciding factor in determining subsequent behaviour; and

5) The source of ‘individual’ motivation may need to be considered separately from ‘push’ motives, ‘pull’ motives, levels of activation and cognitive sources of motivation. Each individual has a unique potential for self-actualisation, and that motive can energise and direct subsequent behaviour.

2.3.2 The concept of behaviour

The word ‘behaviour’ in this context refers to what PNG landowners say and do (including performance, actions, deeds, manners and conduct) and express implicitly or explicitly in their efforts towards livelihood strategies. Alfred Marshall (1890: 1) said

‘For man's character has been moulded by his every-day work and the material resources which he thereby procures’.

This quote sets the stage for the following discussion. A person is defined by the character and character is observable in that person’s behaviour. However, explaining human behaviour is a difficult task due to the subjective and cognitive complexity that is involved in the interpretations. At one extreme it concerns physiological processes, while at the other extreme it deals with social, economic and political institutions. Various theoretical constructs have been postulated in attempt to describe human behaviour. For the purpose of this study, a narrow focus is taken by applying a theory of planned behaviour (Ajzen 2005; 1991) as the lens to gain insight and understanding of PNG smallholder behaviour in land use decisions.
Planned behaviour or reasoned action is based on the assumption that human beings usually behave in a sensible manner; that they take account of available information and implicitly or explicitly consider the implications of their actions (Ajzen 2005; 1991). The theory further assumes that a person's intention to perform (or not perform) a particular behaviour is the most important determinant of the action. According to Ajzen (2005), intention and behaviour are functions of three basic determinants. The first is that behaviour and intentions are personal in nature; the second is that behaviour and intentions reflect social influence; and the third aspect deals with issues of control. The personal factor is the individual's attitude towards the behaviour; that is the individual positive or negative evaluation of performing particular behaviour of interest. The second determinant of intention is that person's perception of social pressure to perform (or not) the behaviour under consideration. Since it deals with perceived normative presumption, that factor is termed 'subjective norm'. Finally, the third determinant of intention is the sense of self-efficacy or ability to perform particular activity of interest, termed perceived behaviour control. The theoretical construct is represented schematically in Figure 2.3 (Ajzen, 2005; 1991). It also points out that there are two important features about theoretical concepts - first is that the theory assumes that perceived behaviour control has motivational implication for intentions, and, second, is the possibility of a link between perceived behavioural control and behaviour. In the first one, people who believe that they have neither resources nor opportunities to perform certain behaviour are unlikely to form strong behaviour intention to engage in that behaviour. The second aspect takes the view that performance of behaviour depends not only on the motivation, but also on adequate control over the behaviour in question. It follows that perceived behaviour control can help predict goal attainment independent of behaviour intention.

Figure 2.3 Theory of Planned behaviour
Source: Ajzen (1991: 182)
2.3.3 Link between motives, needs, behaviour and land-use decisions

Theoretical constructs examined in the preceding section provide insights to the relationships between motives, expectations, behaviour and land-use decision. I now turn my focus on the livelihood strategies of the landowners and, using the theoretical insights explored earlier, attempt to illuminate understanding of the linkages between motives, values, expectations and the land- and related resource-use choice in question.

To understand the motives, expectation and needs of landowners, one has to turn to economic and social activities that take place at the household unit. According to the theory of Sustainable Livelihood Framework (Chamber and Conway 1992; DFID 1991), a household unit is 'the basic residential unit in which economic production, consumption, inheritance, child rearing, and shelter are organized and carried out. In the rural PNG context, this includes both immediate and extended family members living and contributing to economic and social activities of the residential unit. Household behaviour should reveal the objectives and functioning of the economic system at the household level.

The following themes emerge strongly from the literature focused on household behaviour in PNG. There is no homogeneity among smallholder behaviour; each activity is pursued with different levels of rigour and preferences (Epstein 1962; Finney 1973; Moulik 1973; Shand and Straatmans 1974; Boyd 1975; Morauta 1983; Thomson 1986; Kozcberski and Curry 2009). This suggests that smallholder goals and pursuits are multi-dimensional and include social, economic and environmental factors. Furthermore, production patterns across different regions or even within the same social grouping differ greatly. However, certain thematic patterns emerged strongly in the production, consumption and exchange activities. These included subsistence production, cash cropping activities, risk aversion strategies, raising capital for business ventures, customary economics and social networks. These themes represent the range of needs that smallholders pursue; hence these are also the household goals.

In the next series of sub-section, I review the livelihood systems (production, consumption and exchanges activities) of the rural people in PNG, in order to elicit relationships between motive, behaviour and choices in land-use decisions.

2.4 Village agricultural production systems

PNG landowners' land-use decisions are characterised by production which is primarily intended to feed and clothe members of the household, meet the costs of educational and health services, and to enable other household needs and social obligations to be met, as well as also providing food for animals and other intermediate inputs (Thompson 1986). Individuals within the household unit provide labour for these activities. Unlike commercial agriculture, where the drive is to create surplus and profit, the primary objective with smallholders is survival, self-sufficiency, minimising risk and maximisation of household income to meet basic needs. In
In addition, social values including identity, ownership, and maintaining important social relationships are important factors in the process of land-use decisions. The household economy in the rural PNG setting is predominantly based on two economic systems, namely subsistence food production and cash income generation activities. Household production, consumption, exchange and risk aversion strategies of PNG smallholders are built and sustained around these activities. Some description of these production systems is necessary at this stage, to bring out particular characteristic features and underlying factors that dictate farmer choices and preferences in their land-use decisions.

2.4.1 Subsistence production PNG context

Up until about the 1880s – when the European colonial era formally began - Papua New Guinean people were predominantly subsistence producers (Bourke and Harwood 2009; Denoon 1981; Lacey 1981). Subsistence food production strategies included cultivation of staple crops, horticulture, tree husbandry, animal husbandry, hunting, fishing and gathering (Yen 1984). The main staple foods produced and consumed were starchy staples such as sweet potato, yam, taro, sago and banana, and traditional greens, fruits and nuts. In many areas of PNG, subsistence food gardens were cultivated intensively for up to three years with considerable labour input for clearing and preparing the site, the planting of food crops, weeding and harvesting, after which the garden enters a low input phase until its abandonment to the fallow (Kesavan 1983; Allen et al. 2001). Foraging systems were and continue to be practiced, with people drawing many of their needs directly from nature for resources such as water, firewood, fish, hunted animal and vegetable (Barrau 1955; Powell 1976). A significant proportion of food gathered from foraging activities originates from tree crops. For example, Hanson et al. (2001) estimated some 10 percent of the population of PNG depended on sago as the dominant staple. Powell (1976) listed 251 plant species as source of food, of which 17 percent were cultivated. A further 20 percent are both cultivated and harvested as wild resources and 63 percent are gathered from forest, savannahs and grasslands.

The concept of subsistence

Todaro (1995: 235) defines the concept of subsistence production as a farming system in which crop and livestock production, and other activities are conducted mainly for personal consumption and characterised by low productivity, risk and uncertainty. The labour requirement for subsistence production is essentially provided by family labour or those individuals within the household unit. Producers seek survival rather than surplus and profit. Contemporary agricultural practices in PNG, however, cannot be described simply as subsistence in the strict sense of the definition. There is a considerable degree of overlap and interchange in terms of production objectives, as well as behavioural attitude toward subsistence food production strategies and cash income opportunities.
Thompson (1986) and others describe this form of economic activity as Simple Commodity Production (SCP); here there are varying degrees of exchange also taking place. Thompson (1986) observes that in SCP decision-making within a household is aimed at minimising risk in both production and use and for exchange, but the level of material welfare is also dependent on the historical settings of the social formations. Thomson (1986) notes that because of the widely held view that capitalist mode of production globally is more dominant, the SCP in PNG is viewed as subordinate form of production and is in constant flux between disintegration and recreation. While subsistence production is aimed at producers' immediate consumption needs, the exchanges that do take place enable producers between different groups to obtain goods that couldn't be produced locally, due to unfavourable environmental conditions or natural calamities such as flood, drought or frost (Allen et al. 1995). Lacy (1983) and Morauta (1973), among others, observed that people living in different ecological zones balanced out their needs by building networks of trade and exchange.

**The role of subsistence in PNG**

The synthesis based on an economic perspective, however, provides only a narrow focus on subsistence production, thus limiting its scope to simply an activity that is aimed at only meeting household consumption needs. It blurs the line in the heterogeneous nature of the processes involved in decision-making and the relationships between the decision-outcomes and intentions of the decision-maker. For example, other conceptualisations such as a Sustainable Livelihood Approach do recognise the heterogeneity within rural communities, the diversity of economic and agricultural strategies, risk minimisation and accessibility to resources and assets in creating and sustaining livelihood (see Bebbington 1990; Conway and Chalmers 1992; Scoones 1998).

In the rural Papua New Guinea context, subsistence strategies are more than just mundane production and consumption activities at a household level. The dynamic and functional system of the village sector economy revolves around food production to meet household requirements as well as the surplus being sold, exchanged or fed to animals (Kesavan 1983; Morauta 1983). The subsistence system also has other inherent options that allow household production/consumption and exchange with considerable flexibility in terms of access, utility, security and management of important resources. In addition, it has important provisions for social networking, relationships and exchanging of goods and services (these also include labour and expertise). For example, Boyd (1975) in the case of Ilakian subsistence agriculture in Eastern Highlands Province of PNG, described how the Ilakian people strategized their annual subsistence cycles, access to garden land, division of labour in subsistence task, and auxiliary subsistence labour. Finney (1973) notes subsistence activities were also involved in ceremonial exchanges of valuables. Pigs, various seashells, ornamental stones axes, necklaces of dog teeth, bird of paradise plumes, headdresses of cassowary feathers and bundles of salt were regarded
traditionally as valuable by Goroka people and were used in ceremonial exchanges (Finney 1973). Lacey (1983) also observes that pre-colonial economies in PNG revolved around four main activities: cultivation, feasting, warfare and trade.

Subsistence production strategies play a critical role in sustaining people and their harmonious relationships with each other and their environment. In these strategies, the act of making choices between different options in land-use decisions is an important one, centre-stage at every step of operational aspects of household activities. The SLF concept enables a systematic approach to the unpacking and understanding of factors influencing farmers’land-use decisions at each step in the decision-processes. The conceptual framework assists in visualising social and economic relationships, and also explains how people relate to the opportunities provided by the natural resources within their setting. The conceptual framework also describes how the institutional processes (social, cultural, political systems) influence behaviour and attitudes of the people in the way they perceive opportunities and make their decisions. I shall explore aspects of how the social, cultural and political norms influence behavioural attitude in Chapter 3.3. The conceptual framework in Chapter 3.3 also assists in explaining people’s behaviour and attitude in response to natural calamities such as drought, frost, landslides, volcanic eruptions, and floods, or in preparedness to possible risks that might affect them. These factors have an important bearing on the ways in which people perceive land-use opportunities and hence are influenced by them when making land use decisions. The role of subsistence agriculture in PNG is an important one in terms of its contribution to the rural sector village economy and the development of the country. About 80 percent of total food consumed in the country is produced by the sector (Hanson et al. 2001; Bourke 2002). It is also dynamic in terms of responding to institutional policy changes. Bourke (2002; 2009) observed that policy decisions, for example in the devaluation of currency in 1994 and again in 1997, resulted in three fold increases in prices of imported food and the sector responded by producing more food for sale in local markets.

2.4.2 Cash cropping agriculture and cash income strategies

The other important economic activity in the household economy of rural people in Papua New Guinea is cash cropping. Cash cropping agriculture in PNG began with Western colonisation (McKillop and Firth 1981). The introduction, establishment and development of commercial agriculture in PNG took two major forms. The first is based on estate farming and involved planning of its output in the light of market conditions, labour mobility and organisation, transportation and the raising of capital. These activities were owned and managed by expatriates on alienated land. Labour was organised within local sources or from other regions within the country (McKillop and Firth 1981). The second type of cash crop agriculture model, which is much more widespread than the former, was the sporadic proliferation of many blocks of smallholdings planted on customary land and owned by indigenous people. Here, the
smallholder farmers added a few hectares of cash crops to their subsistence crops, marketing the outputs in order to pay tax and purchase a few consumer goods, while continuing to produce all household food as well. This farming system required little or no capital in its establishment (McKillop 1981). Smallholder farmers are characterised as smallholdings of land planted with cash crops, either integrated with other food crops or in pure stands on customary land. It is characterised by relatively low productivity and low risk, and is often not linked to the prevailing market conditions. Labour needs in cash crop production are provided by family labour at household, community or tribal level. The main feature of smallholder agriculture production is that it is loose and does not have close links with the market. In many cases, the primary aims of smallholder production are self-sufficiency while income maximisation and farm efficiency are not of primary significance to the producer.

Having discussed the production landscapes in which decisions and behaviour occur, I shall now focus on the conditions leading to the processes involved in decision making by smallholders. This begins with motivation and attitude of smallholders with reference to the choice of their decision. In earlier sub-sections of Chapter 2, I explored the theoretical relationship between motivation and behaviour. In the next section, I shall use the reasoning from a ‘motivation-behaviour-relationship’ to examine the behavioural attitudes of smallholders in their land-use choices, and will pay particular attention to smallholder behaviour in the adaptation processes of new innovation, crops and new ideas.

### 2.4.3 Landowners, forest and opportunities for cash income

In Sections 1.2.1 and 1.2.2, I briefly discussed the role of forestry in terms of its contribution to rural livelihood systems and the development needs of the country. In this section, I examine commercial forestry options more closely, and provide a general assessment of peoples’ perceptions and attitude to these activities, in order to understand factors motivating and influencing their land-use decisions relevant to commercial tree growing.

As noted earlier and again subsequently in Sections 2.6.1 and 2.6.2, almost all land within Papua New Guinea is held under customary tenure, and forest resources on the land also belong to the community or clan groups who own the land. The right to use, develop, inherit, defend, hand-down or to exclude others is defined by the norms within the customary law (Power 2008; Fingleton 2005; Ward 1981). The main form of commercial forestry in Papua New Guinea has been, and remains, harvesting of natural forests and being exported as logs. Accessibility and use of customary-owned forest resources by the State and a third party commercial developer is achieved in a number of ways. Prior to 1991, this was arranged through a mechanism known as Timber Rights Purchase Agreement (TRP) under the Forestry Act, Chapter No. 216. The agreement allows the state to purchase the right of timber resources on the customary land and from the forest owners and leases this to a third party developer, who then enters the forest to conduct timber development business. The developer pays royalty for the use of forest resources
to the State, who in turn pays this to the forest owners. Land is indirectly involved here, and therefore does not exchange hand in this process. This has been superseded by the current Forestry Act 1991. The Act firstly allows the State to enter into a Forest Management Agreement (FMA) with landowners, to acquire cutting rights to their forests, and secondly issue those rights to forest to a third party development company through a timber permit. To enable this, the landowners form a legal entity known as an Incorporated Land Group (discussed further in Section 2.6.2), through which the royalties generated from logging activities are channelled and distributed to individual members (Power 2008). The third method of accessing customary-owned forest resources is provided by Private Dealing Act, Forestry Act 215, where developer access and signs agreement with forest owner directly. However, in theory this is limited to very small quantities of timber, hypothetically 500 cubic metres per permit. The main features across the different legislation are, that trees on the land are purchased from the owners of the land, the land does not change hands. Because land is directly involved, not having title to land nor legislation to enable second or third party to gain title and therefore is not a problem.

Small-scale logging and wood processing are other commercial forestry activities pursued by some landowners. Mobile sawmills provide an affordable and practical way of utilising timber resources and significant benefits in terms of direct income and employment. They also have a potential advantage in that they cause minimum environmental damage. Hunt (2002) and Holzknecht et al. (2011) have reviewed the use of mobile sawmills in PNG. Operators of portable sawmills can operate within their own community-owned forests without a permit or a forest management plan; there is notionally a cutting limit of no more than 500 cubic metres per mill annually, but this is difficult to enforce. In practice, there are virtually no controls on the use of portable sawmills and no regular required reporting on the volume of timber felled and processed. Most portable sawmills in PNG are used on an intermittent, community-needs basis, rather than for commercial timber production (Holzknecht et al. 2011). Although the PNG Forest Authority has drafted an Eco-Forestry Act, as an enabling framework for the greater use of portable sawmills, the Act has yet to be promulgated (Kanowski et al. 2008; Holzknecht et al. 2011).

In summary, both commercial-and small-scale harvesting of landowners’ natural forest resources provide only intermittent and limited income generation opportunities for landowner households. A form of forestry activity that provides income more directly to landowners, and on a more consistent basis, would clearly be advantageous. The experiences from the smallholder outgrower model with private sector partnership (Bourke and Harwood 2009), lends useful insights necessary for the learning and adoption for commercial tree growing options.
2.5 Attitudes in adoption decisions

In this section, I explore the concept of adoption/diffusion processes and use this as a tool to assess attitudes of Papua New Guineans in land-use adoption decisions and diffusion of innovative ideas and practice. From this analysis, I then identify conditions that influence or constrain adoption decisions.

2.5.1 Concept and definition

Rogers (1995) describes diffusion as a process by which an innovation (idea, practice or object) is communicated through certain channels over time among the members of a social system. It is a special kind of communication that the message is concerned with new ideas. He notes that objective newness or discovery, as measured by time lapse since it was first used or discovered, is irrelevant. The ‘newness’ refers to a situation where someone who may have known about an innovation but not yet developed a favourable or unfavourable attitude towards it nor have adopted or rejected it. The concept of diffusion refers to the spread of ideas, innovation, new technology and acceptance of products to another culture, society or interest group; ‘adoption’ is the rate of uptake of this ideas, innovation and technology. Pannell et al. (2006) defined adoption as a learning process and adoption decisions as dependant on a range of personal, social, cultural and economic factors, as well as on the characteristics of the innovation itself. As a learning process, it has two distinct aspects (Pannell et al. 2006). The first aspect involves collection, integration and evaluation of new information to allow better decisions about innovation. Pannell et al. (2006) observe that early in the adoption/diffusion process, landholders’ uncertainty is high hence quality of decision is low. As the process continues, uncertainty decreases with more experience and judgement on the innovation so the quality of decision increases. The second aspect of learning in the adoption/diffusion process is in the improvement in applying the innovation to a particular situation. Furthermore, as a process, the rate of adoption is progressive in nature and may commence from the point in time when the idea is first introduced or heard to a stage where adoption can be distinguished (Feder and Umali 1993; Guerin and Guerin 1994; Pannell et al. 2006). Pannell et al. (2006) observe that most farming innovations require a certain level of knowledge and skill for them to be applied in practice, and there can be a wide range of choices in the methods of implementation. Through learning by doing, as well as by reading, listening and watching, the necessary adoption can be established and enhanced. This dynamic process has been broken down into phases. One typical description of the sequence is awareness, interest, evaluation, trial and adoption as necessary steps before innovation could be adopted as a practice; Guerin and Guerin 1994; Rogers 1995; Pannell et al. 2006). In the next section, I examine Rogers’ (1995) model to explore landowners’ attitude to acceptance and spread of cash cropping agriculture in PNG.
2.5.2 Adoption/diffusion processes

Rogers' (1995) model of the adoption/diffusion concept has five characteristic aspects in the sequence of adoption process. These are relative advantage, compatibility, complexity, trialability and observability. As noted in section 2.6, relative advantage refers to the degree to which an innovation is perceived as a better than the idea that it supersedes. The degree of relative advantage may be measured in economic terms (Feder and Umali 1993; Guerin and Guerin 1994; Pannell et al. 2006), and as contingent with rational choice or expectancy theory notions (Simon 1959. Rogers (1995) points out that innovation must be perceived as advantageous to the user rather than the objective advantage of the innovation. In an agroforestry context (Mercer 2004), concludes that adoption follows the predictions of economic theory. Mercer (2004) further notes that farmers will invest in agroforestry or farm forestry when the expected return from new enterprise exceeds those from current and other alternatives use of land, labour and capital resources. Mercer (2004) characterises early adopters are those with high risk capital in the form of higher income or larger gift of key resources of land, labour, capital, experience and education which allows them to explore new innovations or ideas. The second aspect of the model is 'compatibility', which refers to the degree to which innovation is perceived as being consistent with the existing values, past experiences and the needs of potential adopters. Rogers notes that, for an innovation to be adopted, it must be compatible with the values and norms of a social system. Rogers assumes that incompatible innovation or idea will not be adopted as rapidly as an innovation that is compatible. The next aspect of adoption/diffusion in Rogers' model is complexity, which refers to the degree to which an innovation is perceived as difficult to understand and use. Rogers (1995) notes that some innovations are readily understood by most members of a social system; others are more complex and will be adopted more slowly. The next aspect of adoption is trialability, which refers to the degree to which an innovation may be experimented with on a limited basis. New ideas that can be tried in instalments will generally be adopted more quickly than innovations that are not divisible. Observability is the degree to which the results of an innovation are visible to others. The easier it is for individuals to see the results of an innovation, the more likely they are to adopt. Rogers' (1995) model set the dynamic approach to the understand of adoption and diffusion behaviour, however, many empirical studies of farmer adoption of new technology typically focus on the role of farm characteristics, such as farm size, land quality, or farmer education, to explain why at a given point in time, some farms have adopted while others have not (see, e.g., Feder and Umali 1993). Diffusion studies usually lack micro-data on individual firms and instead rely on aggregate data to explain difference in the rate of diffusion of different types of technologies or the same technology in different geographic regions.
2.5.3 Attitude, perceptions and choices in crop adoption

'Attitude' in this context refers holistically to the approaches, stances, beliefs, feelings, thoughts, and mindsets of the landowners about new crops, new production techniques, new values of labour, food and other social and economic opportunities in the PNG rural village context. 'Perception' refers to how landowners view and assess opportunities in the land use choices that are available to them. In this section I examine attitudes and perceptions of landowners in the way they perceive subsistence and cash cropping activities.

As far as attitudes are concerned, generally there is continuity as well as change, and these are closely linked with social and economic changes. For example, in many parts of the country, traditional values are still strong among older people, while educated younger generations of the community tend to be less tolerant of these. Modern forms of economic activity frequently supplement rather than replace traditional ones in the minds of the people (Moulik 1973; Finney 1973; Morauta 1983). As observed in the literature as well as in my own experience, many people in rural communities seek a mixture of traditional and modern satisfactions, in which they continue to place positive values on gardening, sago-making, fishing and hunting, while increasingly seeing the benefits of other activities (e.g., cash cropping). Attitudes of smallholders to adoption decision are explored from this backdrop.

PNG is believed to be one of the cradles of agriculture globally, with a history of agriculture of some 10,000 years (Bourke 2009). Trees grown or managed for particular purposes are integral parts of traditional PNG farming and land use systems, and the diversity and dynamism of this system reflect PNG's high levels of innovation and adaptation in agriculture (Kanowski et al. 2008). Through a process of continuous trialling, people had developed and adopted a wide range of food productions strategies that are finely tuned to match the diverse agro-ecological zones and cultural traditions over generations (Barrau 1955; Brookfield and Hart 1971; Vasey 1981). Modern transportation systems, the movement of people between different places, as well as the traditional culture of people in being willing to try out new crops, have greatly increased the introduction of new crops and food varieties into farming systems. Brookfield and Hart (1971) observe that Papua New Guineans have a keen interest in introducing crop species and crop varieties and are readily willing to test or try out new innovations and crops. It was this willing attitude about 'trying out' new crops, ideas and values that enabled the adoption of cash cropping activities in certain parts of the country relatively easily. But, as Epstein (1962) notes, the innovation must fit within existing systems and strategies. He observed this in the attitude of Tolai people with introduction of coconut and cocoa: innovation was adopted as long as the cash producing activities required little labour and other factors of production required were in ample supply to help perpetuate traditional systems. PNG landowners' attitude and behaviour to adoption decision do not necessarily conform to Rogers' (1995) model, but people often adopt new innovations without knowing very much about them. This pattern of behaviour was observed in Moulik (1973) work on 'money
motivation and cash cropping', where the adoption curve is very steep in when an innovation is first introduced, but it is often followed by a failure to continue with the innovation. This suggests that landowners adopt innovation as a community or group and they do most of the learning after the adoption. This behaviour further suggests that decisions about adoption and production are strongly influenced by return to scarce labour. People only discover how much labour is involved after they have adopted the innovation. If returns to labour are acceptable relative other options, and if labour required does not constraint subsistence production, then the innovation is likely to be sustained; otherwise, it will be discontinued.

**Diffusion of new crops into village agriculture production**

For the purposes of this study, I shall confine my focus on attitudes to adoption in the contemporary agricultural practices (as described in Sections 3.2.1 and 3.2.2) following colonial contact in the 1880s. Allen et al. (1994) observed that a number of crop species, and high yielding varieties of existing crops, which were introduced in the late 1880s and early 1900s, diffused rapidly and were widely adopted. They included Chinese taro (*Xanthosoma*), corn, pumpkin, choko, potato, peanut, cassava, triploid bananas and high yielding varieties of sweet potato. They have specific advantages - some provided additional food for additional labour, others yielded better than existing crops on poor soil, and potatoes were less susceptible to frost than sweet potatoes. The authors noted that very little formal extension was involved in their spread or integration into existing agricultural system. Sweet potato continued to spread, replacing taro in many parts of the New Guinea Islands region, and was adopted throughout the lowlands, where it has become a staple. Allen et al. (1994, citing Salisbury 1962) note that the introduction of steel tools (axes, bush knives, shovels and spades) increased labour efficiency by approximately 1.5 to 3 times.

There are also other factors influencing adoption decisions, particularly the relationship between an individual’s social status and their food production and consumption. Traditional village status systems elevated hardworking, skilled and successful food producers (Morauta 1983); they also regarded what a person ate as a measure of that individual’s worth and standard of living. The variety available to an individual is determined by food that they produce themselves, or receive as gifts or presentations. Morauta (1983) observes further that most societies regarded some food as inferior, one that people would eat when they had to, but not desirable as a substitute. Meat of fish, and of wild and domesticated animals (pigs, chicken and birds), was considered as superior goods and prized in transfers. In some traditional societies, the production of food in typically large quantities was leverage for acquiring political influence in that community. Food also played an important role in the proper conduct of personal relationship in many areas. The threat of withdrawing food support or fear of shame from defaulting in food exchanges helped to maintain orderly relations. Morauta (1983) also notes that this was particularly so in societies where the political systems were dependent on
achievement rather than attribution. Consequently, these norms can both encourage innovation that is perceived to be likely to enhance status, but also discourage adoption that is judged to be too risky in these terms.

Finney (1973) observed that a high rate of adoption in coffee and business enterprises among the Gorokan "big men" was motivated by a number of factors. The most obvious of these factors on the surface was profit, but the underlying drivers in the motivation were service, status, security and prestige. The term "big men" refers to local Goroka business leaders (Finney 1973: 84), whose attitudes to adoption decision and behaviour were conducive to establishing a range of business activities (coffee, trade stores, transport, fast food shops) between the 1960's and 1970's. Finney (1973) argues that traditional values and institutions have been useful vehicles for attaining modern goals.

Smallholder attitudes in adoption decision to cash cropping

A wide range of literature (including Epstein 1962; Finney 1973; Moulik 1973; Shand and Strannan 1971; McSwain 1977) shows that attitudes to and the uptake rate of cash cropping in PNG differed greatly from case to case. However, the theme that emerged strongly across each of the studies was how readily Papua New Guineans accepted agricultural or economic innovations. The main reason influencing the adoption decision was the degree of flexibility associated with the attention required in managing and maintaining their productivity required relatively little extra input of time and labour by smallholder farmers after the initial planting and establishment. These characteristics made it attractive for smallholder farmers to engage in cash cropping while still maintaining their subsistence food production (including fishing and hunting).

In addition to this flexibility, especially with tree crop cash cropping agriculture and subsistence food production, the other factors that influenced landowner attitude were the links in terms of infrastructure and technical information and market services that were package with cash cropping activities. The third factor that influenced adoption decisions was financial incentives that encouraged people to engage in cash cropping activities while still maintaining their subsistence food production systems. The flexibility associated with the crop characteristics in PNG cash cropping agriculture are cocoa, coffee, coconut oil palm and rubber. These are all tree crops, and the attention required in managing and maintaining their productivity required relatively little extra input of time and labour by smallholder farmers after the initial planting and establishment. These characteristics made it attractive for smallholder farmers to engage in cash cropping while still maintaining their subsistence food production (including fishing and hunting).

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above, he also notes that while the main motivation for Goroka ‘big men’ in business investment (coffee growing) appeared to be profit, careful observation of their behaviour also revealed that prestige, community service, status and security were equally important drivers in their adoption decisions. In terms of service, Finney (1973) observed so called ‘big men’ who ventured into trade store and trucking businesses had a perception that investment to trade stores and transport was a means to assist communities with trade store goods in the villages and also to provision for transport access to essential services in Goroka, the nearest centre in Eastern Highlands Province. In this context, investment decisions were based primarily on providing service rather than the normal economic principles or a rational choice or expectant theory in starting up a business. In terms of prestige, status and security in the context of traditional society, a leadership position is acquired or leveraged through such influence as producing large quantities of food (Morauta 1983) or through gifts and exchanges (reciprocating) of food, cash or traditional valuables (Finney 1973). Finney (1973: 93) quotes a comment from one of the so-called ‘bigmen’ whose behaviour was being studied, describing how prestige is earned in a traditional context:

When these people are in need, I give them some money because they helped me with coffee. All right, now I help them well by buying some food when they are short, by buying meat, buying rice, and giving pigs at a feast.

Another characteristic feature noted about attitudes towards the adoption of cash cropping was how ‘compatible’ these activities were in relation to household labour demand and their daily rhythms or patterns of activity. In East New Britain Province, Epstein (1962) observed that the transition to agricultural investment was marked by rapid expansion of cash crops. Epstein (1962) attributes the success rate of diffusion in cocoa and coconut smallholder planting by local people was largely due to the fact that the tree crops fitted naturally into the traditional methods of shifting cultivation, both food crops and trees being planted on newly cleared land. In this example, Epstein (1962) observed that the main consideration in adoption was that, as long as the cash producing activities required little labour and other factors of production required were in ample supply, the traditional system could be perpetuated.

The pattern of behavioural attitudes in cash crop introduction and spread (diffusion) usually followed a sigmoidal pattern. Moulik (1973) noted that smallholder participation in coffee, coconut and cocoa planting exhibited a slow start, then a fast rate of increase over a short period, followed by a declining rate of increase. This pattern reflected the increase of grower numbers who were establishing their first cash crop gardens. In contrast to Rogers’ (1995) adoption model, the sigmoidal pattern in the adoption behaviour suggests that landowners adopted cash cropping activities (innovation) initially, but as they realised it was taking away scarce household labour from subsistence activities and then abandon the innovation. For example, as Shand and Straatmans (1974) observed that the first group of adopters were the innovators or leaders in the community who provided the example for
followers or imitators, most of whom decided to participate within a short period. With the new crops, enthusiasm and interest was high amongst the adopters but this gradually faded when they could not cope with the demand for labour exerted by crop maintenance, harvesting while at the same time maintaining their other subsistence and social-cultural activities (Shand and Straatmans 1974). As observed in many studies (e.g., Epstein 1962; Shand and Straatmans 1974; Curry and Kozcberski 2009), scarcity of household labour is a major constraint to adoption and production decisions. Farmer education and other ‘internal’ factors also have a strong influence on the types or choice of production and adoption decisions. This issue is discussed further throughout this section, based on the work conducted by Pannell et al. (2006), among others.

Shand and Straatmans (1974) attributed behaviour in the diffusion of cash cropping to changing circumstances with growth of transport, market facilities and services. In contrast, Shand and Straatmans (1974) also observed that the patterns of adoption of tree cash crops were not so apparent as that of the adoption of peanut or rice cultivation. The reason for this was inconclusive, although they suggested a number of possibilities, including lower cash returns and slower internalisation processes. Other factors also influencing initial adoption decisions were the availability of seeds or seedlings and access to information. Shand and Straatmans (1974) noted high levels of government policy interventions and extension services influenced villagers’ participation and development of cash cropping activities in Boana, Maprik, Chimbu and Karkar Island.

The preceding paragraphs examined PNG smallholder attitudes to adoption decisions and diffusion processes. In the next section, I examine factors motivating smallholders’ decisions, and for this I shall draw on various theoretical perspectives as presented in Chapter 2 to analyse behavioural aspects of the smallholders.

### 2.6 Land assets and its influence on the production

The discussion of the ‘concept of motivation’ in Section 3.2 provided insights into the relationship between landowner household needs and their behaviour in the economic production activities. In this Section, I explore two principle inputs in the landowner household production and how they influence landowners’ choices in the livelihood strategies. These are land and labour and their relationship to various livelihood pursuits of the landowners, and how they affect decisions about different options.

#### 2.6.1 Land

Smallholders’ attitudes to production are influenced by land factors in two ways. The first is that traditional land use and tenure systems are operating and regulating land resources; the second factor is the biophysical condition of the land in which production activities occur. How each of this factors influence land-use decision is discussed below.
Traditional land tenure system and crop production by smallholders

Land use and land tenure systems in PNG provides essential context to understand landowner attitudes and behaviour (Kanowski et al. 2008). In the Pacific region, including Papua New Guinea there are basically three systems of land tenure; customary, public and freehold (AusAID 2008). The various aspects of the customary tenure, including inheritance, allocation of user rights, dispute settlement and record keeping are managed by customary groups according to their own unique processes, often linked to underlying social and spiritual beliefs (AusAID 2008: 4). Although these systems are localised and variable, they share some important common features. Tenure is based on privatised ownership, and use systems of resources are based on established local societal principles (AusAID 2008; Kanowski et al. 2008; Fingleton et al. 2005; Ward 1981). Within these systems, there is a wide range of rights (inheritance, use, access, control) vested in customary groups and individuals within them. These groups are based on kinship relationships; while decisions regarding land and other natural resources can be made at different levels of the group, most often these are made at the level of the clan. Membership of such customary groups is inherited at birth and confirmed by self and mutual recognition. Permanent rights-holders can invite temporary users in to land under their control, but this does not confer permanent rights to these temporary users. Different rights may apply to different natural resources on the same parcel of land. Thus ‘economic trees’ such as coconuts, fruit and nut trees, coffee, or cocoa are planted on clan land, but are individually owned (Kanowski et al. 2008; Fingleton et al. 2005). Resources on clan land are not open access, and individuals may transfer rights to such trees to any other member of the same group. These tenure systems are dynamic; they have generally been resilient, and have coped with significant pressures and changes (e.g., high rates of population increase and incorporation of perennial tree crops, such as coconuts, coffee and cocoa) (Fingleton et al. 2005; Kanowski et al. 2008).

In recent times in some areas of PNG, these systems have undergone changes which means that they are not the same as the system of land tenure was at the time of contact (Quin 1981; Ward 1981). There have been various influences on these changes. Morauta (1983) observes that the cessation of warfare under colonial pacification meant that one of the main sources of territorial adjustment and realignment was lost. Government-sponsored legal recognition of settlement and landownership also influenced the flexibility of the system (Quin 1981; Ward 1981). Investments in land changed a great deal, with more long-term investments in tree crops for the export market (Ward 1981). In contemporary PNG, people make a distinction between using land to grow food for home consumption and using land for commercial purposes; they are more prepared to give non-owners access to land for food than for cash crops.

Public and freehold land is owned by the state where as freehold land is owned and controlled by individual or corporate bodies. Most of the public and freehold in Papua New
Guinea was alienated from customary authority during the colonial era. Public and freehold land can be sold or transferred to someone else, and is referred to as alienated land.

**Challenges and opportunities with respect to traditional tenure systems**

More than 97 percent of the country’s land resources are maintained under customary tenure systems. There are conflicting views about these systems, especially with regard to the commercial use and development needs of the country. The critics of these systems argue that such land arrangements impedes investment and subsequent increases in productivity, as unregistered customary land are not recognised by financiers as security against loans (Ward 1981; Quin 1981; Gosarevski *et al.* 2004). These people argue that economy will not grow until market in the land is created. They content that this will allow the most innovative and energetic to accumulate land so achieve economies of scale in farming, and enable owners to raise capital by borrowing money against their land as security. Advocates of these systems argue, to the contrary, that economic, social and environmental development could be achieved without any need to remove land from its owners (Fingleton *et al.* 2005; Bond 2006; Kanowski *et al.* 2006). Fingleton *et al.* (2005) demonstrated with empirical evidence that people operating under customary tenure systems have the flexibility to adapt to changing demands on their land under modern circumstances, adapting to increased internal migration and new patterns of land settlement, the growing cash economy, new uses of land, and increasing population.

**Incorporated Lands Group in Papua New Guinea – forestry sector**

In recognising these challenges and opportunities, legislation has been enacted to allow customary land groups to use their land in the formal economy. This is in a form of ‘Incorporation’. As Power (2008) states, Incorporation is a legal term where; when a customary landowning group forms a body that has legal status under the formal legal system. That body or organisation, can sue and be sued, hold asset in its name, hire agents, signs contracts and make rules governing its internal affairs (Power 2008: 4). The Oil palm growers in West New Britain in Papua New Guinea have had great success in using the instrument for their own economic benefit. The legislation allows the state to lease a defined area of land from customary landowners for an agreed period and then leases back to the owners a lease, for more less the same period of time. However, as Power (2008) also notes there have also been problem, particularly when incorporated land groups are used as means for receiving compensation payments from mining and forestry companies.

In the forestry context, the 1991 Forestry Act requires landowning groups to be incorporated under the Land Group incorporated Act in areas where logging companies have gained right to harvest the forest. A Forest Management Agreement gives ownership of trees, but not the land, to National Forest Service, which is responsible for negotiating with the logging companies. The National Forest Service is responsible for paying royalties and
compensation to the incorporated land groups. The land group leaders are then responsible for distributing payments to the group members. Currently, landowners receive only about 12 percent of the income generated from forest harvesting (Hunt 2002). Proponents of the current arrangements argue that logging generates other indirect benefits that contribute to the livelihood of landowners, including opportunities for employment in the rural areas, the provision of infrastructure such as roads and public buildings, and indirectly through purchases of goods and service. Despite the fact that landowners receive only a small proportion of the log value, Hunt (2002) notes that there is the opportunity to subsequently grow crops or other land use once the land is cleared. As illustrated by examples in oil palm projects, the Incorporated Lands Group offers an opportunity in which options for commercial tree growing opportunities can be explored further.

**Biophysical aspects of land and production behaviour**

The agricultural landscape in PNG is characterised by its great diversity, reflecting both the diversity of cultural practices and the wide range of agro-climatic zones and biophysical conditions of the country (Barrau 1955). This diversity is expressed in a number of ways. For example, there is a wide range of cultivated and semi-domesticated species (Powell 1976); there is a wealth of genetic diversity expressed as number of clones or cultivar within each major traditional crops (Kesavan 1983); a range of cultivation techniques apply, from minimal tillage to high intensity agriculture in the highland (Barrau 1958); the frequency of cultivation ranges from long fallow periods of over of over 25 years to almost permanent gardening (McEwan 1978); there is variation in the area and number of gardens per household; and enormous environmental variation expressed in terms of location, altitude, annual rainfall, soil types and topography. Bourke and Harwood, (2009); Allen et al. (1995) described 175 different agricultural systems across PNG, based on biophysical conditions (soil fertility, slope, and rainfall); on staple crops grown; on the relationship between fallow periods, cropping intervals and biomass held in the fallow vegetation; agronomic techniques involved; the amount of labour required to create any capital improvements needed to practice particular techniques; and the amount of labour required to achieve harvest. This classification accounts for alternative, non-agricultural sources of food, such as sago; notes the importance of domesticated animals; recognises the impacts of human population density; and identifies cash earning opportunities, in particular the sale of agricultural products. The diversity in the production systems is synonymous with, and should be understood a specific adaptation to, the particular biophysical and climatic conditions in the different localised regions. These physical environmental conditions influence production behaviour in the ways that agricultural practices are carried out.

**Population pressures on land**

Another land-related factor that influences production behaviour in cultivation practices is pressure exerted on the land as a result of increasing population. Boserup (1965) utilised a
"population based model of intensification" to describe production behaviour in subsistence production systems. According to Boserup (1965), subsistence producers are capable of increasing the productivity of their land by applying appropriate farming methods. But because such methods typically demanded higher labour inputs per unit of production, they tended to be adopted only when population pressure and resulting land scarcity forced farmers to work harder to maintain existing levels of subsistence. Boserup (1965) implies that subsistence farmers are labour efficient and will choose the level of intensity in cultivation that will satisfy their agricultural needs with least amount of work. However, this theory requires further support from empirical data. Some studies have yielded a correlation as suggested by Boserup, based on both increasing and decreasing population densities of collective farmer behaviour (Brookfield and Hart 1971). However, there is limited empirical evidence linking farmer behaviour, motivation and the decision for a particular agricultural activity. For example, it is not clear whether intensification strategies were inspired by population growth, or as a result of a particular set of opportunities that are presented. Heterogeneity in farmer behaviour is probably quite significant. Henley (2005) demonstrated with studies carried out on Sulawesi Island, Indonesia, that in agriculturally higher potential areas (i.e., with favourable biophysical conditions), population was denser, and farming more intensive, in naturally fertile areas. A second consideration is the extent to which a local economy was commercialised rather that subsistence-oriented. Allen et al. (1995) observed that determinants of intensification in PNG are multidimensional, and include social, economic, demographic and environmental factors, acting in concert over time; although the factors are operating separately, they may appear to be singular for a particular place or system. McAlpine et al. (2001) observed that there is strong evidence of increasing intensity of use of land in areas with population concentrations and better access to services. McAlpine et al. (2001) also noted that rural village-based food production in PNG, being reliant mainly on crops with low or negligible storage lives, has to ensure adequate yield on a day-to-day basis with near absolute certainty of output. On this basis, they concluded that production food production behaviour in PNG is based on risk minimisation, rather than yield maximisation. Masahiro et al. (2000) observed that in the Tari Basin area of Southern Highlands Province, the fallow period was shortened as a consequent of population growth, and that subsequently led to a decline in productivity of the newly cultivated gardens. Thus, the decline in garden productivity pressured people to increase the per capita area of garden cultivation to maintain the level of total production (Masahiro et al. 2002).

**Competition for land between subsistence and cash crops**

It has been argued that cash crops compete with subsistence food production, in that the introduction or extension of cash crops thus reduces land available for subsistence production itself (Soweii, 2001). The merit of this argument is debatable in the PNG context. Firstly, cash crops and food crops must be in competition for the same area of land. For example, if the
staple is sago and the cash crop is coconut, these two trees do not grow in the same places and so are not in competition for land. Second, there must be a shortage of land such that use of one purpose restricts use by the other. However, as discussed in Section 2.4, and further below, it is rare in PNG for landowners to adopt cash crops at levels that risk subsistence food production.

2.6.2 Household labour and cash cropping activities

In this context, labour refers to a person’s working status as an indicator of individual and family wellbeing. The PNG National Census (2000) defines all persons of 10 years of age or over as falling into the category of being able to provide labour.

Since European contact around the 1880s, a range of new crops for cash and new farming techniques were introduced, each with varying demands for management and labour requirements in their production. These caused significant changes to the patterns of the local peoples’ way of life. This meant changing the established rhythms of work patterns in gardening, hunting and foraging to include cash cropping activities. Associated with cash cropping activities was the increased use of money in some aspects of local peoples’ livelihood. The usage of money has become an important part in certain aspects of everyday life; it is difficult to appreciate the mental transformation that it brought about. This mental transformation concerns the patterns of work, the manner in which the available labour is mobilised so that monetary needs can be met, and the motivations and incentives for adapting to the demand and discipline of new rhythms of work required in cash crop economies. In this section, I examine some of these aspects of smallholder behaviour in cash cropping activities.

Moulik (1973) explored the question of how far the cash return to labour for production and marketing of cash crops and subsistence produce influences the activity patterns of the villagers. The study focussed on monetary incentives; firstly, on the utility of money as an incentive and, secondly, on the return to labour per unit of labour. Moulik’s work focused on behavioural patterns in three case study regions: Manto village near Goroka in Eastern Highland Province, with coffee as the main cash crop activity; Rempi and Aronis villages along the North Coast Road north of Madang in Madang Province; and Watunou, Bubuleta and Bou villages near Alotau, Milne Bay Province. Copra production was the main cash cropping activity in the Madang and Milne Bay case study regions. Each of these study sites is located near the main provincial centres where the necessary infrastructure and market services were available, and were therefore more or less comparable. Moulik’s study (1973) observed that there was a large pool of surplus labour in the village that could be made available for economic activities at a low opportunity cost. His data shows that adequate provision of existing levels of physiological needs required 18.96 to 25.11 hours per week per adult in terms of production activities. According to Moulik (1973), after taking into consideration all requirements (including social and ceremonial obligations), some 40.10 – 48.17 hours per week were available as potential labour resources without any reduction to the existing levels of production and consumption.
The second pattern that emerged in Moulik's (1973) study was the difference between each of the three regions in the amount of labour for certain activities. Moulik observed Eastern Highlanders devoting higher amounts of labour input into cash cropping and subsistence activities than those in the Madang and Milne Bay case studies. He attributed the observed differences to the differences in linkage factor of communication and market facilities, with Manto villagers being closer to Goroka (the main provincial centre) and so having easier access to market outlets for their garden produce.

The third pattern was the question of utility of money as an incentive, and cash returns per unit of labour. Moulik showed that for both factors, labour input into both cash cropping and subsistence production was higher for the Eastern Highlands Province case study, although differences in labour input for cash cropping with the Madang case study were insignificant. Moulik (1973) concluded that, while the importance of cash return to labour as an incentive for labour inputs into economically productive activities should not be downplayed, activities related to the subsistence sector and non-monetary activities came first for the villagers, irrespective of the regions. He also notes that there was no competition in labour demands between cash-producing activities and subsistence and other social and cultural obligations.

In terms of the labour division in cash cropping, Shand and Straatmans (1974) observed that cash cropping (coffee) growing activities in Boana, Morobe Province and Maprik in Sepik Province involved both sexes. The main division of tasks was made between heavier labouring jobs (e.g., clearing, fencing), which were carried out by men, and the lighter ones, which were generally performed by women. Children joined the household workforce at times, but often they were too young, or at school and only helped on weekends. Shand and Straatmans (1974) also noted that relatives and friends also contributed labour for major tasks such as clearing and fencing. Helpers were given food and reciprocal assistance rather than cash. Household members carry out most tasks from establishment to transportation. In addition to cash cropping work, household labour also produced their own food requirements, and many were involved in other work commitments such as construction or maintenance of roads, airstrips or schools, as part of their community service. Similar work patterns and labour divisions were observed in other related studies (Epstein 1962; McSwain 1977; McKillop 1981). It should be borne in mind that the described behaviour patterns of household labour in relation to cash cropping activities must be understood in the context of the time period when these studies were conducted. It is almost 40 years since the majority of these studies were conducted and, in the intervening period, many changes (social, cultural and economic and environmental) have taken place. These changes included new needs, new values to time and land and, similarly, changed behaviour in production, consumption, and exchange activities of smallholders. Box 2.1 below, adapted from Curry and Koczberski (2009), is a demonstration of household labour with respect to the constraints to cocoa production, and shows a characteristic pattern that would apply to most other cash cropping activities.
The second part of Moulik's question (1973), on cash returns to the unit of labour input, has resurfaced in the light of low productivity of certain commodity crops. In more recent studies, Curry and Koczberski (2001; 2009) also observed that there was a labour shortage in smallholder cocoa and oil palm productivity. Their observations found that non-payment or underpayment of family and hired labour were a key factor limiting the supply of labour. Curry and Koczberski (2009), inspired by the hypothesis that the smallholder cocoa and oil palm sectors in PNG were characterised by low productivity and income well below potential levels, studied smallholder house labour behaviour. I now turn my focus to explore this aspect of labour behaviour.

Box 2.1 Typical characteristics of household labour for cash crop production
Source: Adapted from Curry and Koczberski (2009)

<table>
<thead>
<tr>
<th>Characteristics of households with constraints for cocoa production:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Demographic characteristics (e.g., small family size, young family with dependents, absence of adult family members, elderly house-head without co-resident son, young family with pre-school children)</td>
</tr>
<tr>
<td>• Short or long term health problems of adult family members</td>
</tr>
<tr>
<td>• Competing economic demands on household labour (e.g., formal employment, alternate cash crops).</td>
</tr>
<tr>
<td>• Non-economic activities competing with labour for cocoa production (e.g., customary activities, church activities).</td>
</tr>
<tr>
<td>• Under-utilisation of available family labour (e.g., inadequate remuneration of family members lead them to withdraw their labour from cocoa production)</td>
</tr>
<tr>
<td>• Perception that household head is not fulfilling his obligation to the family.</td>
</tr>
<tr>
<td>• Minimum use of traditional strategies of labour mobilisation (e.g., reciprocal labour exchange)</td>
</tr>
<tr>
<td>• Minimal use of hired labour</td>
</tr>
</tbody>
</table>

Return to labour

Bourke (2009) defined return to labour as the amount of money growers expect to receive in return for the work they do to produce a commodity for sale. If they believe that their return for the work they do is inadequate, they will stop producing a commodity and switch production to another commodity that they think will produce a better return. Bourke (2009) notes that motivation to work for income is a key factor in such decisions. The main cash crops produced in PNG provide return to labour that ranges from K100.00 to K200.00 per person per day (Table 2.1). For a comparison, the minimum rural labour wage in Papua New Guinea is K20.00 per day.

Curry and Koczberski's study (2001) revealed that the market for the smallholder oil palm sector had not developed because of uncertainty over payments for labour services. The main reason was attributed to the reluctance or inability by the block owners to pay for the hired (or family) labour. Guaranteeing the payment of labour reduced disincentives to the mobilisation of labour, and monthly smallholder production rose from 75% to a monthly average of 113% in production of smallholder cocoa. Apart from commodity price influence on labour supply to smallholder productivity, crop characteristics have equally significant influences on small
labour behaviour. Curry and Koczberski (2009) observed that the age of the cocoa stand was an important determinant in smallholders’ decisions leading to labour inputs and management techniques. This particular study observed that from the age of zero to 8 years, the care and attention required for cocoa blocks was high, and labour was provided by both men and women. Curry and Koczberski (2009) note that beyond this age, the crop yield of this particular hybrid clone declines, pests and diseases are high, and harvesting regimes decline.

Table 2.1 Gross return on labour input for selected cash crops

<table>
<thead>
<tr>
<th>Crop</th>
<th>Mean yield [a] Kg/ha</th>
<th>Price [b] Kina/kg</th>
<th>Gross return [c] Kina/ha</th>
<th>Labour inputs Mandays/ha</th>
<th>Return Kina/per/ day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irish potato</td>
<td>20,000</td>
<td>2.00</td>
<td>40,000</td>
<td>400</td>
<td>100 [f]</td>
</tr>
<tr>
<td>Oil palm</td>
<td>15,000</td>
<td>0.25</td>
<td>3750</td>
<td>70</td>
<td>54</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>14,000</td>
<td>0.8</td>
<td>11,200</td>
<td>350</td>
<td>32</td>
</tr>
<tr>
<td>Cocoa (wet beans)</td>
<td>800</td>
<td>1.0</td>
<td>800</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>Arabica coffee</td>
<td>900</td>
<td>4.50</td>
<td>4,050</td>
<td>275</td>
<td>18</td>
</tr>
<tr>
<td>parchment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vanilla (cured</td>
<td>240</td>
<td>15.00</td>
<td>3,600</td>
<td>290</td>
<td>12</td>
</tr>
<tr>
<td>bean)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubber (cup lump)</td>
<td>650</td>
<td>1.60</td>
<td>1,040</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>Coconut (copra)</td>
<td>500</td>
<td>1.30</td>
<td>650</td>
<td>65</td>
<td>10</td>
</tr>
<tr>
<td>Robusta coffee</td>
<td>900</td>
<td>1.6</td>
<td>1,440</td>
<td>275</td>
<td>5</td>
</tr>
<tr>
<td>(parchment)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice (paddy)</td>
<td>1300</td>
<td>0.8</td>
<td>1,040</td>
<td>215</td>
<td>5</td>
</tr>
<tr>
<td>Pyrethrum (dried</td>
<td>650</td>
<td>1.50</td>
<td>975</td>
<td>430</td>
<td>2</td>
</tr>
<tr>
<td>flowers)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

At this point, growers switch from a ‘farming’ to a ‘foraging’ production strategy in which the labour input is provided mainly by women who collect small quantities of crops for sale as wet bean to meet immediate consumption needs. The authors argue that the quantity of accessible healthy ripe pods must be above a minimum threshold before smallholders will adopt a ‘farming’ strategy. If the quantity of ripe cocoa pods fell below this threshold, smallholders switch to a foraging harvesting strategy. It should be noted that a variation in labour supply associated with the conditions of the cocoa blocks also have their parallels in labour strategies in subsistence food production (see Section 3.3.1 for details).
The other argument associated with labour distribution is that cash crop activities compete with subsistence food crops for labour for the subsistence food production. I have discussed this issue in preceding sections.

2.7 Behaviour in consumption

In this section, I examine the role of food in PNG society and how it influences land use decisions of the smallholder. Food production for personal consumption, exchange or for sale to generate cash income is an overarching goal in livelihood strategies, and thus in adoption decisions (Bourke and Harwood 2009; Kanowski et al. 2008; Morauta 1983). The role of food produced for home consumption has diminished in consumption patterns in three ways: through the introduction of imported food, the purchase of local goods, and increased use of incomes for non-food consumption (Morauta 1983). Table 2.2 provides some indication of consumption patterns in the types of food consumed by household in rural and urban PNG. The consumption of imported food is noteworthy; for example, rice is consumed by 87 per cent of urban households, and tinned meat by 51 per cent.

Table 2.2 Proportion of population consuming different foods during the 1996 PNG Household Survey (%)

<table>
<thead>
<tr>
<th>Source: Gibson (2001: 47)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rural</strong></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Greens</td>
</tr>
<tr>
<td>Sweet potato</td>
</tr>
<tr>
<td>Rice</td>
</tr>
<tr>
<td>Banana</td>
</tr>
<tr>
<td>Coconut</td>
</tr>
<tr>
<td>Biscuit/bread/flour/scone</td>
</tr>
<tr>
<td>Taro and Chinese taro</td>
</tr>
<tr>
<td>Sago</td>
</tr>
<tr>
<td>Tinned meat</td>
</tr>
<tr>
<td>Legumes</td>
</tr>
<tr>
<td>Tinned fish</td>
</tr>
<tr>
<td>Yam</td>
</tr>
<tr>
<td>Fresh fish, shellfish</td>
</tr>
<tr>
<td>Chicken</td>
</tr>
<tr>
<td>Pork, beef, other meat</td>
</tr>
<tr>
<td>Cassava</td>
</tr>
<tr>
<td>Lamb and mutton</td>
</tr>
<tr>
<td>Bush meat</td>
</tr>
</tbody>
</table>

Bourke et al. (2009) estimated that in 2006 83% of energy and 76% of protein food consumed in PNG was domestically produced, and the balance was imported. Bourke (2009) also notes that locally produced food represented 80 percent of all consumption. The data in Table 2.2 illuminate household consumption behaviour in several ways. Firstly, they show the
changing patterns in the types of food consumed. Rice and other imported food items have increased from a base of zero around 1880's to over 26 percent and 87 percent, for rural and urban households respectively in 1999. The zero bases are taken from the fact that prior to formal colonial beginnings in 1884, PNG staple food consisted principally of tuberous crops, vegetable, and sago starches in certain parts and a wide variety of fruits and nuts (Denoon 1981; Lacey 1981). Similar trends in the pattern of consumption are observed for wheat, lamb, mutton and other consumer goods including clothing, appliances and tools needed by households. Secondly, while there are some changes in the types of food consumed by households, it does not necessarily suggest that the proportion of imported food has completely displaced subsistence food production by the proportion indicated. The third aspect of data in this table provides some indication on the use of money and its significance as a motivational driver in land use decision processes of rural people.

2.8 Behaviour in exchanges

An important part of smallholders' activities is maintaining social relationships with relatives and friends, thus strengthening social networks and social relationships and maintaining social harmony. Morauta (1983) observes that Papua New Guinean societies are face-to-face societies and interpersonal relationships are conducted largely within the framework of kinship relationships. Morauta (1983) notes that the characteristic features of interpersonal relationships are embedded in the traditional culture; they require feelings of affection, pity and friendship to be expressed and amplified by material transfers and gifts. The indigenous economy consists of various exchanges that take place between kinship groups and related individuals. These include exchanging of goods, services, labour, traditional wealth items and cash. The aim of these exchanges is to foster, forge and maintain individual and group networks of social relations and obligations. Customary exchanges can be made in the form of daily or regular gifts of cooked or uncooked food, items of value, labour for garden/house-building, or cash cropping activities, various services and cash contributions to signify major events like initiation, death, marriages, adoptions and dispute settlements. For example, Epstein (1962) explains that under the pre-colonial economy, the Tolai people of East New Britain Province used tambu shells as a medium of exchange in paying bride wealth and mortuary rites. In addition to tambu, Tolai people also used rats, and pigs, as money. Boyd (1975) observed behaviour among the Ilakia people of Eastern Highlands Province, where relatives had to look after families (for example, make gardens, build houses) of those who had been hired to work as indentured labour on plantations in other parts of the country. Upon return, the returning relatives would then pay carers with tools and other items of value, including pigs, and even provide labour.
2.9 Land-use decisions and implications for small-scale forestry plantations

In the previous sections, both theoretical underpinnings and empirical studies on the land-use behaviour patterns within range livelihood strategies of landowners were reviewed. This is in order that the relationship between motives and choices in land-use decisions is understood. Factors appearing to have a strong influence on the adoption and production decisions were: labour availability and supply at the household units; farmer education, awareness and extension services; land availability and ownership; expectations of the return to labour; risk and uncertainty in investment decisions; and infrastructure and accessibility to markets. Part of answering the question of ‘why’ was to describe how the embedded institutional processes and environmental conditions (social, political, economic and physical environment) affected smallholder choices in their land use adoption decisions. In this section, I examine the question of ‘how’ - how motives, behaviour and land use decisions might affect decisions about commercial tree growing. To answer this question, I examine behavioural patterns and attitudes of small-scale tree growers in general, globally, and as well as experience in adoption and production behaviour of PNG landowners, provide an assessment on how this information can assist understanding of decision relevant for commercial tree growing. The main emphasis in this section is to provide a general synopsis on the development of current trends and patterns in small-scale tree growing activities for commercial products, and its role and significance in the socio-economic and environmental developments at local, regional and national levels. The second aim in the review is to illuminate the factors affecting decisions associated with tree growing. From this general synopsis, I then provide a position in terms of implications for PNG by proposing a research question for research investigation in this study.

2.9.1 Importance of small-scale forestry globally

Demand for forest product and services has been increasing trend with global population growth over the last several decades. For example, FAO (1997) estimated that between 1960 and 1995, world population almost doubled in size and the world economy increased 3.5 times. In that same period production of sawn timber tripled and production of paper products more than tripled. This has been attributed to the combined impacts of economic growth and increasing population size on demand for forest products. The increased demand for forest products influenced increases in efforts towards forest plantation development. In some countries, this has led to increased production of industrial wood products from farm forestry or agroforestry system (FAO 1997).

The Global Forest Assessment 2000 (FRA 2000) reported that the global forest plantation area increased to 187 million hectares in 2000 from an estimate of 124 million hectares in 1995 (FAO 2001). The annual rate of tree planting is reported to be 4.5 million hectares globally. Although accounting for only 5 percent of global forest cover, plantation forestry represents 35
percent of global wood supply (FAO 2001). This figure is expected to increase to 44 percent by 2020 (FAO 2001). Of this area, 34 percent is publicly owned, 29 percent is privately owned and 37 percent represent other unspecified owners (FAO 2001). Blyth (2007) observes that privately owned industrial and small-scale plantations (including farm forests) are rapidly becoming the dominant sources of wood resources for many countries. In addition, private forests will make significant contributions to the environment and social benefits at local, national and global levels. Blyth (2007) notes further that the role of governments will shift from establishing and managing plantation to ensuring that markets operate efficiently, providing supporting and attractive investment climate and facilitating access to knowledge and technology to enhance productivity and development. The role of small-scale forestry in terms of poverty alleviation and addressing environmental degradation is also important (Harrison et al. 2002).

The growing significance of the role of small-scale forestry in terms of its relative contribution to social, economic and environmental development globally is also reflected in the proliferation of definitions of the concept. Harrison et al. (2002) note that, because small-scale means different things in different countries, names like non-industrial, smallholder, small-scale, farm forestry and family forestry have also been used to describe the types of forestry practices, based on the purpose, role, scale of operations and ownership arrangements, and the purposes for which tree growing interests and activities are represented. In the next section, I will focus my attention on the question of what small-scale forestry is, and on the challenges and opportunities it faces.

2.9.2 What is small-scale forestry?

FRA 2000 (FAO 2001: 24) defines ‘forest plantations’ as forest stands established by planting or seeding in the process of afforestation or reforestation. These processes are either of introduced or indigenous species which meet a minimum area requirement of 0.5 ha., tree crown cover of at least 10 percent of land cover and total height of an adult tree above 5 m. However, this definition represents conventional forest plantations only and does not fit with types and characteristics of forestry activities currently practiced under the banner of small-scale forestry. Despite its growing importance, there is no universally defined and accepted definition of the concept of small-scale forestry. For example, Harrison et al. (2002) note that small-scale forestry systems differ in many ways from industrial forestry systems, in such aspects as motivation for establishment and management, the bases for species selection, social and economic objectives of key stakeholders and the likely market for forest products.

On the basis of comparison between experiences with small-scale forests in USA, Europe, Japan, India, Philippines and Australasia, Harrison et al. (2002) demonstrate that the concept of small-scale forestry means different things in different countries. The main denominator that emerged from the review by Harrison et al. (2002) of the definition of small-scale forestry is ownership. Ownership clearly distinguishes small-scale forestry from corporate, industrial or
government forest plantations. Reid (2005), in emphasizing this aspect, observes that ownership does not only include land or trees but also includes ownership of the decision to do it and how it is done. He notes further, especially in the case of farm forestry and agroforestry, that it is about choice - farmers choose to commit their resources to the development and management of forests for, among other things, commercial return. In some literature, this type of forestry activity is referred to as a component agroforestry system (Beer 2005; Raintree and Warner 1996).

Beer (2005: 151) defines agroforestry as a term for land use practices where trees are integrated into farming, as well as for the multidisciplinary subject area embracing land use systems, from field to global levels, involving interactions among trees, people and agriculture. Raintree and Warner (1986) define agroforestry as a system of land use that entails the deliberate association of tree with herbaceous field crops. Over time, the term was also attributed to shifting cultivation as one of the most ancient, widespread, and until recently, ecologically stable forms of agroforestry. There has been growing interest in research and development on agroforestry systems. Beer (2005: 1) notes that the emphasis in research focus in agroforestry has shifted in four major ways:

- from description of systems to understanding how they function;
- from a simple mixture of a few component at field level to more complex considerations of diversity at landscape and regional levels;
- from researcher-designed practices to farmer-designed practices; and
- from the quantification of their productivity to economic valuation of the environmental services they provide.

For the purpose of this study and for consistency, I will use the term ‘commercial tree growing’ to describe all forms of growing trees for commercial wood production. For my purposes, this includes the related term “agroforestry”, used to describe production strategies that involve a mix of annual and perennial crops, as is the case for various introduced cash tree crops grown in PNG. I next explore factors affecting motivation and adoption decision in the tree growing activities.

### 2.9.3 Factors affecting smallholder motivation and adoption-decisions to grow timber trees

As observed in Section 2.3, factors affecting smallholder motivation to engage in commercial tree growing activities can be broadly categorised into two groups. The first are farmers’ internal ‘push’ factors (including attitudes, needs and aspiration), and the second externally influenced ‘pull’ factors (including market, economic and social norms). Within these boundaries, many combinations of factors influence the motivation and adoption decisions of farmers. Schirmer et al. (2000), in the case of Australian tree farmers, observe the following requirements as pre-requisites for farmers to be convinced in order to adopt tree planting: viable
markets for end products; viable links to the market for farmers; the availability of expertise to advise on the growing, managing and selling of wood products; appropriate government policies and regulation; adequate returns; and adoption decisions compatible with farmers’ values, attitudes and goals in a review of agroforestry adoption decision notes also that landowner’s decision to engage labour, land and other capital resources is greatly influenced by the expectation of increased profit at the end of the investment period. As noted throughout by the review, the adoption and diffusion decision of PNG landowners are characterised by a set of factors similar to those noted elsewhere, including by Schirmer et al. (2000) and Byron (2001). However, the attitude in the rate of adoption and diffusion processes; including decisions about of new cash crops, farming technologies, and their management differed from that described for tree growers in Australia, reflecting the vastly different contexts.

While economic reasons may become important determinants in the decision processes, other reasons are equally important decision determinants. For example, Mercer (2004) notes that farmer will invest in agroforestry or farm forestry when expected returns from the new investment exceed those from current and other alternative uses of land, labour, and capital resources. However, profit maximisation is not the only motive for adoption and production decision in small-scale forestry plantation or agroforestry options as noted elsewhere in the review. For example, the review by Pannell et al. (2006) of research on the adoption of rural innovation observed that adoption decision also depends on a range of personal, social, cultural and economic factors, as well as on characteristics of innovation itself. According to the theory of livelihood strategies (Chambers and Conway 1991), and as examined throughout earlier sections of this chapter, decisions are made to maximise household welfare or utility, concepts which embody multiple household objectives such as food security, and provisions of other subsistence goods, shelter, cash for important purchases, social security and savings. Similarly, the landowners in PNG focus on wide range of livelihood outcomes, that includes provision for food, cash income, social and cultural obligation, risk management and opportunities to engage in small scale business opportunities when considering option in the land-use decisions (Koczberski and Curry 2005; Thompson 1986).

As demonstrated in this review there is a clear link between the different needs of the households and the choices landowners make about their options in the land-and- resource-use decisions. Decisions concerning options for commercial tree growing must be considered with the understanding of and aligned to the different categories of the household needs. The tree crops provide range of goods and services that meets the need for food, for shelter, for fuel, for fibre and medicinal and other uses. Timber tree crops, unlike other time-bound food crops, fits very well with the different time frame and uses for the different livelihood-goals of the decision-makers. Furthermore, the Pannell et al. (2006) study of ‘understanding and promoting adoption of conservation practices by rural landholders’ concludes that adoption occurs when the landholder perceives that innovation in question will enhance the achievement of their
personal goals. This suggests that 'personal or group values are important to examine also when planning for and making decisions connected with small scale forestry and agroforestry investments' Allen et al. (2006: 1). This conclusion mirrors that drawn by Allen et al. (2006) in relation to management of US national forests. By understanding the forest values that people hold — whether as individuals or as political influence, special interest or activity user groups — forest planners and managers are better equipped to refine or establish policies, programs and goals; mitigate potential conflicts among stakeholders; and plan effective implementation strategies (Allen et al., 2006). Thus, while Rogers (1995) model of adoption and diffusion appears to apply in general terms, the literature suggests that a more complex and encompassing range of factors determine adoption and diffusion in practice.

In the next section, I examine how some of these factors in a greater detail to understand how they affect motivations for tree growing.

2.9.4 Farmers' internal factors

Needs of the farmer and decision about tree growing

Rural people in developing countries pursue a diverse range of livelihood strategies to improve their quality of life. As observed throughout the review in this chapter, livelihood strategies tend to follow the general assumptions postulated by Maslow's (1954) needs theory. Labour, land and other resources of the people were directed primarily at addressing deficiency needs such as need for food and water. Food production and cash cropping activities were directed to satisfying the household needs for food, clothes and shelter. Once these needs were met, then strategies were then re-directed to household exchanges mainly in the form food fostering social relationship and security. A decision to grow trees for industrial end uses is one of the several livelihood strategies of the farmers that seek to provide particular goods and services to meet these needs and household goals. These goals ranges widely, but are contingent on personal circumstances, including but not limited to income-related, fuelwood needs, food, prestige, social acceptance, stability and conflict-minimisation (Byron 2001; Predo 2003; Pannell et al. 2006). For example, Van der Poel and Van Dijk (1987) observe, in a study carried out on household economy and tree growing in upland Central Java, Indonesia, that production systems (crops, trees and livestock) are strongly related. That study observed that interventions in tree production systems would only be successful if they can be integrated into farming systems by farmers and if they give sufficient returns. FAO (2003) acknowledges the role of planted forests in rural people's poverty reduction in two ways. The first is the role of non-wood forest products (NWFP) as a safety net in providing a wide range of goods for domestic use and for markets, among which are game, fruits, nuts, medicinal herbs, forage, fuelwood and thatch. A second is that agroforestry can help people to lift themselves out of poverty (FAO 2003). This potential is often unrealised because high value timber tends to attract powerful competitors and because certain characteristics of timber make this option relatively inaccessible to the poorest
people. However, for this potential to be realised, as reported (FAO 2003) a suite of socio-political changes are necessary: including decentralisation; more secure forest tenure; democratisation and better governance; withdrawal by concession holders; access to growing urban markets; market deregulation and liberalisation; access to new technologies; and a greater societal willingness to pay for environmental services.

**Attitude**

Schirmer *et al.* (2000) observe that landholders evaluate economic cost and returns perceived to be associated with farm forestry when making land use decisions. Byron (2001) also notes that farmers are readily willing to grow trees whenever they perceive that expected net returns per unit of labour input are higher than the alternative activities (in agriculture, forestry or non-farm activity) with their land, capital and labour. If the perceived total expected value outweighs the perceived costs, farmers are more likely to move to and retain tree-growing activities. Farmer attitudes towards risk are important because of the time lag between investment decisions and returns, and the uncertainty of future market prices. This is a concern to the farmers when making decisions about whether or not to grow trees. For example, Predo’s study in the Philippines (2003) on tree-based land use systems observed that tree-growing options provided the highest net present value in terms of return, but it also had the highest level of risk. Factors that reduce uncertainty and risk have direct bearing on the attitude towards adoption decisions and must be accounted for. This may include; size of the household labour supply, level of education of the household-head, farm characteristics, contact with extension services, years of farming experience, security of land tenure, distance to nearest town or mill and quality of the road conditions that enables accessibility. The size of household labour supply, farmer education and age influences attitude and affect adoption decision in different ways. For example, the size of the household labour supply had a direct bearing on productivity while the level of education affected quality and accessibility to information from which a decision can judged by (Curry and Koczberski 2009; Pannell, *et al.* 2006). Curry and Koczberski (2009) observe that labour shortages had a significant constraint affecting choices in the adoption and production decision of smallholder cocoa producers in East and West New Britain provinces. On the other hand, the process of learning and experience to inform adoption decision was important, particularly in respect to collection, integration and evaluation of new information to allow better decisions about the innovation. Pannell *et al.* (2006) observe that most farming innovation require a certain level of knowledge and skill for them to be applied in practice, and there can be wealth of choices in the method of implementation. Through learning-by-doing, as well as by reading, listening and watching, the necessary skills can be established and enhanced (Pannell *et al.* 2006).
2.9.5 External Factors

External factors for farmers include market, infrastructure and production inputs (land and labour). These are described further below.

**Market, economic and infrastructure issues**

Many studies suggest that economic and other market-related objectives are important considerations in smallholders’ decisions on whether or not to cultivate trees for industrial end uses (Van Der Poel and Van Dijk 1987; Godoy 1992; Byron 2001; Preda 2003; Godoy 1992) observes that for farmers to participate in tree growing for commercial fuel wood production, they need both favourable markets and to be persuaded that fuelwood cultivation is financially and technically a feasible option. In that study, the output price played a key role in smallholder tree cultivation decisions. That study observes that price influences the decision to grow trees, but the mechanisms through which the influence of price on tree growing was not fully understood. As noted by Godoy (1992), the decision arose from relative price movements, or the movement of the prices of trees relative to the movement of the prices of other crops or other activities. In addition, because of the time lag in the investment and return relative to annual crops, uncertainty in the future price was a major concern which also influenced their decisions. For example, Preda (2003) conducted a price risk analysis and observed that high price variability in timber prices versus those of other cash crops was a factor deterring tree growing decisions of smallholders in Philippines. Preda (2003) found that, because tree-growing systems were risky as well as promising high returns, farmers’ tree growing decisions also depended on prevailing market price levels, forecast price changes, and relative price variability.

The uncertainty of future market prices, market structure and access is an aspect that also affects attitudes to growing of trees, hence their decisions to engage in tree growing. Byron (2001) observes that in Central New South Wales, Australia, smallholder plantation development ceased because timber from small private plantations could not gain access to pulp mills, particleboard factors or sawmill factories. Similarly, Vermeulen and Nawir (2008) observe that market access and development and starting-up costs are often significant barriers. Van Der Poel and Van Dijk (1987), in a study in Central Java, Indonesia, observed that interventions in tree production systems would only be adopted by farmers if they give sufficient returns. The presence of a market outlet can provide an impetus to more intensive land use, if the return is judged to be sufficient and the risks sufficiently low.

In addition to market and economic issues, another major concern affecting motivation for tree growers is that of infrastructure. This includes transportation systems and processing facilities. For example, Byron (2001) observes that a well-established mango-producing orchard in Dinajpar, Bangladesh, was clear-felled due to transportation difficulties. That particular project became non-viable, as the road and river transportation system on which the project
depended for its viability deteriorated so badly with the result that perishable goods like mango fruit could not be delivered to markets in urban centres (Byron 2001).

2.9.6 Ownership and tenure issues

Another aspect affecting motivation in tree growing is the concern about land and crop tenure by smallholders (Godoy 1992; Byron 2001; Predo 2003). Many studies suggest that smallholders must enjoy security over the land or the trees before they can grow and manage those trees. Uncertainty over future benefits arises from insecurity of tenure over land, trees, or tree products (Godoy 1992; Byron 2001). It is self-evident that security of tenure is a prerequisite for tree farming, especially in cases where a State government has control over and regulations of land resources. For example, Pasicolan et al. (1997) observe that Filipino farmers, with knowledge that an unclear tenure situation can negate any possible benefit in the future, are reluctant to plant perennial crops on land areas that are expropriated by the government for public projects. Similarly, the security of land affects the spontaneity and sustainability of farmers’ tree growing efforts (Pasicolan et al. 1997).

On the other hand, the process of clarifying the tenurial status of land paved the way for communities to acquire new land areas and so secure individual user rights within a communal tenure system. For example, Vermeulen and Nawir (2008) observe for cases in Indonesia and South Africa, where partnership arrangements between tree growers and forestry companies indirectly led to the recognition of long-term user rights and establishing clearer boundaries between community members’ land and mechanisms for settling community land disputes. They also observe that individual rights are far easier to claim and build on than the communal rights. That study observes that in South Africa women who joined an outgrower scheme were motivated by opportunity to assert rights over the land in the event of their husband’s death. The question of ownership and tenure also influences the second party in the tree growing business. Vermeulen and Nawir (2008) observe that forestry companies find it easier, legally and operationally, to sign deals with individuals than with organised community groupings. While the question of security is a prerequisite condition in farmer motivation, the perception of security may bear no relationship to the legal status. A sufficiently high price for the output of a tree product may induce smallholders to cultivate trees even if he or she is not sure of obtaining the harvest. For example, Godoy (1992) observes that many smallholders in Bolivia cultivated coca shrubs despite the lack of secure tenure and the attention of drug enforcement agencies. Byron (2001) also notes that in parts of northern Thailand, people have no legal rights to occupy, use and benefit from forests, yet behave as if they did because they are confident the King would never allow them to be evicted.
2.9.7 Commercial timber tree growing experiences in PNG

Smallholder farmer motivation and attitudes about growing trees for food and other subsistence uses have been explored in Sections 3.2 to 3.4. In the section preceding this, literature review explored factors affecting farmer motivation in growing trees for timber and other industrial uses including fuel wood. In the next section, I contrast these experiences and consider the question of the implications for commercial tree growing options in PNG.

Experiences from small-scale tree growing activities elsewhere suggest that economic and other market-related objectives are important considerations in smallholders' decisions to cultivate trees for industrial end uses (Vermeulen and Nawir 2008; Nawir et.al. 2007; Byron 2001; Godoy 1992). Farmers are willing to participate in tree growing for commercial and industrial wood production provided that the following prerequisite conditions are met. There should be favourable markets with proven evidence that the option for fuel or timber tree cultivation is financially and technically a feasible option. The output price also plays an important part in smallholder motivation for tree growing, especially in terms of the return on the unit of labour input into tree growing activities (Byron 2001; Godoy 1992). A transport infrastructure adequate to facilitate sales and marketing of products is necessary (Byron 2001; Godoy 1992). In addition, there should secure tenure over the rights of land and tree crops (Nawir et al. 2007).

While some of these concerns are generic and have implications that are relevant for PNG, the question of resource tenure, both of the land and of the crops, is of negligible consequence to the perceptions and attitudes of would-be commercial tree growers. This is because most of the country's land resources are held under uncontested customary ownership. In this case, the decision to grow trees and their subsequent ownership remains ultimately with the landowner. In Madang, for example, the landowners grow Acacia trees on their customary land and sell them as logs to JANT Limited, where they are processed into chips and sold on the export market.

Types of partnership arrangements - Madang experience

There are two types of partnership arrangements between the landowners, state and the private company. In the first one customary land is leased to the state with agreement and consent of its owners and then sub leased to Gogol Reforestation Company, a subsidiary company of JANT, to carry out reforestation on the customary land. JANT pays a fee of K1.00 per ha per year (This has been raised recently to K6.00 per ha per year) as rent to the landowner for use of the land. In addition, the company also pays the landowners a royalty of 2.5 percent of the standing value of each the trees harvested (Hunt 2002). However, fifty percent of the land held under leased arrangement will be returned or has already been returned back to its owners at the end of the current lease. The main reason being that land rental fees paid to the
landowners are too low. Given the looming problem with resource security, JANT has now moved into an alternative arrangement that is as follows.

The second form of partnership arrangement between the Gogol, Naru and North Coast landowners and JANT involves direct agreements between the landowners and JANT Limited. In this arrangement, the interested landowners within the 50 kilometre radius of JANT woodchip processing plant, sign agreement with the company who then provide seedlings, equipment and labour to assist the landowners to plant trees and maintain them on the customary land. When the trees reach maturity JANT harvest and collect them. In return, the company pays the landowners factory door price minus the cost (planting, maintenance, harvesting and transportation). In addition, company also pays land rental fee of K1.20 per ha, and tree farm levy of K10/ha to the landowners.

This example offers a number of important lessons of value to the opportunities for commercial tree growing in PNG. Firstly, from landowners’ perspective, in this arrangement the ownership of the land continues to remain with its customary landowning group. Secondly, commercial tree growing as an option in the livelihood outcome is well adopted and integrated together with other livelihood strategies of the landowners and it is likely to continue. Thirdly, market and other infrastructure and employment are fully established or available. Fourthly, communication and extension services, to which the tree growers could access and receive assistance, are already established. From the company’s perspective, JANT have both a guaranteed access to the customary land and timber resources for its needs. From the company’s perspective, the question of resource security may be a significant risk factor, which in turn may have bearing on the company’s decisions about future investments and continuity in the long run. However, in this case, JANT has been in operation for some 20 years now without any problems as a result of resources security (pers. com. Mr Jeffry Sapak, JANT Limited).

Other non-state forestry plantation development scheme are also based on the ‘lease, lease back’ arrangement. For example, Open Bay Plantations in East New Britain Province grows 10,000 ha of *Eucalyptus deglupta* for log export market under this arrangement (Hunt 2002). However, where alternatives crops such as coffee, cocoa, oil palm, or sugar cane are feasible, landowners are more likely to be in favour of these, because of the earlier and more regular returns.

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**Subsistence and cash crop agroforestry systems in PNG**

Subsistence-focussed agroforestry is widely practised in PNG (see, for example, Kennedy and Clarke 2007). Kanowski *et al.* (2011) describe four broad customary agroforestry systems, based primarily on differences in geographic factors. These are:

- Highlands agroforestry systems - characterised by sweet potato and *Casuarina oligodon* and cash crop as coffee, tea and *Eucalyptus*;
• Lowlands to mid-montane agroforestry systems - characterised by combinations of annual and perennial food plants and trees including breadfruit (Artocarpus altilis), pandanus, betelnut palms and bananas and coffee;

• Coastal agroforestry systems - characterised by fruit and nut tree species including breadfruit and Canarium species in combination with cassava, sweet potato and bananas; and cash crop including cocoa, coffee and coconut

• Island agroforestry systems – characterised by banana, fruit and nut tree species including Canarium, Barringtonia, breadfruit and coconuts, in association with numerous species of annual and perennial food crops and cash crop including cocoa, coconut, oil palm, and balsa (East New Britain).

While there have been few cases of commercial tree growing through instruments such as lease, lease-back arrangements, mostly by private investors, the potential for commercial timber tree growing has not been explored in contrast to number of other tree crops. Kanowski et al. (2011), in a preliminary scoping study for ACIAR project FST/2004/050, observe that because there has been little incentive to date for landowners to focus on species of commercial value, there have been only limited attempts to grow timber trees. They note that, if a critical mass of resources can be established, the prospects from tree growing appear good for landowners with limited alternative income generation alternatives. Jenkin et al. (2009), in a subsequent study for ACAIR FST/2004/050, observe that the selection and development of tree species regimes to deliver benefits to small-scale tree growers must be driven by the needs of the individual, families and local communities involved. In addition, timber tree growing effort of smallholders should be aligned with market demands and economic considerations, if such strategies are to be of maximum benefit to growers. Some of the key elements identified in this study as relevant to commercial tree growing were the perception, attitudes and motivation of smallholders; institutional and legal factors; financial or economic factors; social and community factors; and psychological and biophysical factors (Jenkin et al. 2008). Midgley et al. (2010), in a study on balsa cultivation from both estate-based and smallholder agroforestry farming systems in East New Britain, observed that this provides a high return over a relatively short time period, thus offering a profitable land-use option for its owners.

2.9.8 Conclusions and implications for tree growing in PNG

Smallholder production, consumption and exchange behaviour analysis revealed that the motivational drive in land use decisions differs greatly among individuals and within and across different PNG communities. Use of various theoretical constructs in the analysis of smallholder behaviour (Maslow’s hierarchical needs theory, the sustainable livelihood framework, and the farmer adoption decision framework) reveals five thematic areas of motivation relevant to smallholder land use decisions. These are subsistence food production, cash cropping/income diversification strategies, strategies to minimise risks, opportunities for investment in business
activities, and efforts in maintaining social relationships. Within each of these themes, the choice of livelihood strategies and the corresponding degrees of persistence differ greatly between individuals and within communities depended on personal values and preferences.

According to the theory of livelihood strategies (Chambers and Conway 1991), landowners' land-use choices are made to maximise household welfare or utility; these concepts embody multiple household objectives such as food security and provision of other subsistence goods, provision of shelter, and generation of cash for important purchases, social security and savings. As observed throughout the review in the chapter, the land-use choices reflected various needs as felt by the households. As predicted by Maslow's (1954) hierarchical needs theory, those that satisfied the basic physiological needs redirected their energy and effort towards achieving higher order needs. In terms of attitudes towards adoption decisions, especially with opportunities in cash cropping activities, there is strong evidence suggesting that new ideas or new crops can be adopted, if these ideas/innovations are compatible, have some relative advantage within the livelihood strategies or overall household goals, and do not prejudice subsistence food production. Types of food consumed, or sold at local markets or exchanged, play a significant role in land use decisions. There are also changing patterns in food consumption, especially with regard to imported consumer goods; the increasing consumption of imported food signifies the growing importance in the use of money. Furthermore, while there is an increase in the proportion of household consumption, particularly of imported food items, this does not necessarily mean that imported food has displaced subsistence food. The organisation of labour and its distribution in cash cropping activities is greatly influenced by commodity prices and also by the productive life of the crop. The rate of return to input labour is a strong determinant of labour organisation and distribution decisions.

There are, however, a number of limitations to the conclusions that can be drawn from this research. Firstly, smallholder behaviour descriptions are inferred from farmer observations or from farmers' stories and experiences, and as such are likely to have biases. Secondly, the behaviour observations are 'snap-shots' of farmers' behaviour in a particular time; there is a need for reliable time series of data based on a standardised methodology. Most of the research studies cited in PNG were carried in the 1970s and 1980s; since then significant changes have taken place with communication, education, infrastructure and this will have also affected social, cultural economic conditions for smallholders. These changes have influenced smallholder thinking and perceptions about the given opportunities.

It was also observed that traditional knowledge of agroforestry system formed a critical role in the subsistence production of small-scale producers. Although this knowledge base has served a pivotal role in adoption decisions in cocoa, coffee, coconut and oil palm smallholder production, the application of these knowledge systems to production opportunities for commercial tree growing has lagged. Literature review suggests that there are three principle assets rural people in Papua New Guinea own and access for a wide range of livelihood
provisions. According to the theory of Sustainable Livelihood Framework (Chambers and Conway 1992), land, labour and financial resources are important asset of the landowners. These, combined with critical decisions about their use, determine security, prosperity and robustness of the asset owners. The review results suggest that household seek to mobilise these resources and opportunities associated with them through mix of strategies; these include subsistence food production, cash-income generation opportunities, participation in labour markets and social networking in order to secure their members’ livelihoods. A realistic understanding of these assets and decisions about their use is necessary to identify what opportunities they may offer, and where the constraints may lie, for new activities such as commercial tree growing in PNG. Decisions concerning options for commercial tree growing must be considered within the framework of these hypotheses.

The next chapter presents the methods this study adopted to develop such an understanding.
Chapter 3: Research Design, Conceptual Frameworks, and Research Methodology

3.1 Introduction

In this chapter, I describe the research design, conceptual frameworks and methodological approaches applied in this study. The overarching aim is to describe how the research design draws from the theoretical background to the study, and provide a clear explanation of the logic that links that background, the data collected, and the conclusions that can be drawn to address the research questions.

The chapter is organised and presented in four main sections. In Section 3.2, I present the research strategy, based on the following components: the aim of this study; rationale for and justification of choice of theoretical constructs guiding this study; ethical issues and measures factored into the research design to achieve credibility; and choices of methodological approaches adopted in conducting the study. Leading on from this, in Section 3.3, I describe fieldwork procedures, including choice of sampling strategy; data identification; cases and participants selected and involved in this study; and methodological procedures applied in collecting data. In Section 3.4, I present various methods involved in the process of data analysis, data reduction and data display, and in Section 3.4.4 I set out the conclusions for this chapter.

3.2 Research design

A research design describes how a research study is planned, organised and executed. It accounts for theoretical propositions, ways in which data are obtained, how data were analysed, and provides others with instruction as to what to do in order to replicate the results. Yin (1994) notes that research design seeks to provide, as its primary focus, the logic linking data to the research proposition. In other words, the foremost aim of a research design is to maximise the credibility of the conclusions. This perspective requires thoughtful planning and organisation that involves bringing together several components of research activities in a coherent manner. According to Yin (1994), these different components may include research questions, the intellectual traditions or theoretical constructs guiding the study and the procedures and choices used in the process of identifying, selecting, gathering, processing and presenting data in a manner that links to the proposition. According to Bradshaw and Stratford (2000), a dependable research design takes into account the research questions asked, the cases and participants involved in the study, and the level of willingness and participation in the way actual research work is performed.

Central to the design of this research investigation is the question of how PNG rural smallholders consider and make choices in their livelihood strategies. The study focuses on rural households and village communities as the target unit of analysis; in this context,
smallholder motives, behaviour and perceptions relating to land-use decisions are assessed and interpreted. The assessment involves a thorough examination and analysis of the interplay between various constituent elements in the household economy, cultural norms, and how the different categories of individual needs affect land-use decisions and other livelihood activities of PNG landowners on both a daily and a longer-term basis. General trends and behaviour patterns that emerge from this analysis provide the basis for responding to the research question and sub-questions.

**Mixed Method Research**

While the primary methodology is qualitative, use of quantitative data in this process was both unavoidable and desirable. The study recognises the importance of both qualitative and quantitative data as complementary in gaining insight and understanding of the research question and sub-questions. The qualitative data consist of responses to open-ended inquiry through, primarily, individual interviews. The quantitative data comprise information such as that describing households’ labour allocation and consumption behaviour. In recognising of the importance of the complementary roles of qualitative and quantitative approaches in research investigations, Creswell et al. (2007: 5) characterise this approach as “mixed methods research design, which they define as “a research design with a philosophical assumption as well as methods of enquiry”. As methodology, such an approach involves philosophical assumptions that guide the direction of the collection and analysis of data, and the mixture of qualitative and quantitative approaches in the phases in the research process. As a method, a mixed approach focuses on collecting, analysing and integrating both quantitative and qualitative data in a single study or series of studies. The utility of this approach is that the use of quantitative and qualitative approaches in combination provides better understanding of research problems than either approach alone. In other word, an approach to knowledge (theory and practice) that attempts to consider multiple view point, perspectives, positions, and standpoints (always including the standpoints of qualitative and quantitative research (Johnson et al. 2007). Given the scope of this research study, and the research question, on what basis do Papua New Guinea landowners make land-and-resource-use choices, require both qualitative and quantitative data. For this reason, data collection, analysis and presentation were approached with mixed method research. These methodologies are described throughout here.

This study adopted and modified the conceptual research design framework by Maxwell (1996), as it matched well with the overall scope and purpose for this investigation (Figure 3.1). Figure 3.1 illustrates the linkages between each of the design components, and how they related to each other in complementary ways, to support the overall aim of answering the research question asked in this study.

There are five main components in the Maxwell’s (1996) conceptual design: the goal or objective of the study; theoretical constructs adopted in analyses; the research question
investigated by this study; methods for collecting data; and the credibility measures that are built into the data collection and analysis process. The relationships and linkages between each of the main components in the research design are indicated in Figure 3.1 by the arrow directions. The heavy-line arrow indicates direct linkages between each component of the research design, while the dotted-line arrow illuminates an underlying or indirect relationship between each of the components. The research question is the central hub in the research design and links all the components in terms of scope, direction, and implementation of the research investigation. Specific details including theoretical propositions, units of analysis, choices of methods applied in the process of data collection and analysis, and measures to address ethical issues and enhance credibility; these are presented in subsequent sections of this thesis.

3.2.1 Study goal

The goal of a research design is to provide a clear descriptive statement of the objective as to why a particular research investigation is being carried out (Maxwell 1996). It specifies what the research intends to achieve as the outcome of the study, and also serves to assist the researcher in remaining focussed throughout the research study investigation process. In this study, my primary concern is to gain an understanding of how PNG smallholders assign meaning to various activities that comprise livelihood strategies and how that influences their choices in the land- and resource- use decisions process. This is based on inferential analysis observed and interpreted from motives in the land-use behaviour and perceptions of the PNG smallholders. On the basis of literature reviewed in Chapter 2, the study situates itself in the hypothesis that relationships between farmer motives, behaviour and perceptions must be fully understood as the basis for informing interventions directed at promoting the adoption of commercial tree growing by PNG smallholders.

A consequent concern for this study, therefore, is how to articulate and promote the options for commercial timber tree growing in ways that are complementary to the livelihood strategies of smallholders. This issue is discussed in the concluding chapter. An outcome from this element of the work is the identification of strategies that assist PNG smallholders in diversifying and improving their livelihood strategies. The longer-term goal associated with this element of the study is the potential contribution resulting from the fulfilment of the first and second goals to the long-term sustainability of forest resources, and the role it might plays in the economy of smallholders and for national development. A fourth goal of the study is contribute to the gap in the literature on smallholder behaviour, motive and land-use decisions, by providing information on these topics for Papua New Guinea landowners.
Research Questions

On what basis do PNG landowners make land and resources use choices?

1. What are the households' livelihood strategies?
   This requires assessment of relevant components of the household livelihood assets, household engagement in subsistence and cash income generating activities, household patterns if consumption and expenditure, and household allocation of labor.

2. How do these strategies influence landowners' household land and resources use choices?
   The thesis also considers the implications of the answers to these questions for the decisions landowners

Study methods
Purposeful sampling strategy
(2) Case study
- semi structured interviews &
- group meetings

Credibility measures
- Principle of theoretical saturation of data
- Principle of data
  Triangulation
  Socio-cultural & personal experience of the researcher

Figure 3.1 Research design (adapted from Maxwell 1996)
3.2.2 Research Question

The research question acts as ‘glue’ by integrating all the other components in the research design to achieve the common goal of the research investigation (Maxwell 1996). It not only defines the topic being studied, but also serves two other important functional roles in the research investigation. Firstly, it tells in specific terms what the problem is that is being investigated, and why it should to be investigated. Secondly, it shapes thinking in the research design (or strategy), especially on the question of how to accommodate and incorporate theoretical propositions and appropriate methodological approaches in conducting the research (Patton 1990; Maxwell 1996).

In this research study, my concern is in gaining an in-depth understanding of how PNG smallholders assign meaning to the elements of their livelihood strategies, and how this influences their land- and resource- use choices. In Chapter 1 and again in Chapter 2, I hypothesised that there has been limited study in the understanding of relationships between smallholder motives, behaviour, perceptions and land-use decisions relevant to commercial tree growing. I also argued that the relationship between farmer intention and behaviour must be fully understood as a basis for informing intervention decisions directed at promoting the adoption of commercial tree growing by smallholders in PNG. This being the premise of my research, I posed as the primary research question and focus for this study:

*On what basis do Papua New Guinea landowners make land- and resource-use choices?*

This was investigated through the following subsidiary questions:

1) *What are the landowner households’ livelihood strategies?*

This requires assessment of relevant components of households’ livelihood assets, household engagement in subsistence and cash income generating activities, household patterns of consumption and expenditure, and household allocation of labour.

2) *How do these strategies influence landowners’ household land and resource use choices?*

This requires assessment of households’ decision processes about use of their land and other resources.

The thesis also considers the implication of the answers to these questions for decision landowners might make about the adoption of commercial tree growing.

The next section presents the theoretical constructs that were considered relevant and why and how they are used as conceptual frameworks in this study.

3.2.3 Conceptual models for analysing PNG smallholder land-use decision-process

The review presented in Chapter 2 suggests smallholder farmers’ land-use motives, perceptions and behaviour are functions both of the innate capacities of individuals and also of
social and environmental influences. In other words, it is a conscious process of a decision-maker during which a ‘preferred choice’ is selected from a number of given options. The preferred land-use choice or decision is formed or visualised as a result of a process in a chain of events. The process of this choice commences with a particular intended outcome visualised and registered in the mind of the individual decision-maker. It involves series of subjective evaluations based on perceived expected values judged to be yieldable from a particular option and terminates with persistent manifestation of specific behaviour performance.

The decision-behaviour phenomenon regarding the PNG smallholder land-use decision process is complicated by various causal and interacting factors, including contemporary economic paradigms, social and cultural norms, and the biophysical and environmental conditions in which smallholder’s land-use decision is practiced. As such, an objective description of the extant relationship between motive and behaviour is difficult to visualise and define. Because of this complexity, the use of a single theoretical construct alone was not feasible to account for all the variables attributed to a particular choice of behaviour in a PNG smallholder’s land-use choices. In the next section, by drawing on the insights from the relevant components of a number of theoretical constructs presented in Chapter 2 (Sections 2.2 and 2.3), a simplified model was developed to provide a structure for interpreting how land- and resource-use choices are made by PNG landowners.

From data reduction and categorisation (discussed further in Section 3.4) in the literature review, a number of themes emerge as major factors influencing smallholder choices and the land- and resource-use decision process. These include personal perceptions, attitudes and motives, institutional and legal factors, financial and economic factors, social and community factors, and biophysical factors. Given the great variety of factors that a PNG smallholder must consider in the land-use decision process, a simplified model of the decision process was developed. A summary of the relevant theoretical constructs in this model is presented in Box 3.1; these are reflected in a model developed to describe the decision/motive/behaviour relationship (Figure 3.2), as a methodical approach to enable objective and systematic assessment of choices in land- and resource-use decisions.
Box 3.1 Theoretical constructs applied in analysing smallholder land-use decision-making processes

# The Sustainable Livelihoods Framework (SLF) (Ashley and Carney 1992) provides analysis of the livelihood system of smallholders, including various capital assets, the underlying institutional processes (social, economic and environmental factors) and visualises the relationship (usage, access) between smallholders and the range of capital assets smallholders have and how their land-use choice are affected by it. It also assists to tease out what kind of risks people are exposed to and therefore are influenced by in the process of their land use choices.

# The Hierarchical Needs Theory (Maslow 1954) assists to explain how the various needs of smallholders influence land-use choices. These theoretical constructs also help to explain the various levels of needs landowners have and how land-use choices are strategized in order to meet these sets of needs.

# Farmer Adoption Decision Framework (Roger 1995; Pannell et al. 2006) is used to expand understanding of how two main production inputs - land and labour - are used in relation to adoption decisions, especially about why certain innovative opportunities are adopted while others are not; also used to explain labour household organisation, division and distribution.

# Theoretical Construct in Adoption/Decision Processes (Rogers 1995) is used to describe perceptions, attitudes and behaviour to adoption decisions and diffusion processes in the uptake of new crops, techniques, and ideas about newly introduced land-use opportunities.

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**Figure 3.2** A model to provide qualitative analysis of smallholder land-use decisions process

Source: Modified from Ajzen (1991)
The model and its features

The conceptual model to guide qualitative interpretation of PNG smallholder land-use decision-making processes is modified from the theory of planned behaviour (Ajzen 1991). The underlying assumption of that theoretical construct is discussed thoroughly in Section 2.3.2. In essence, the smallholder land- and resource- use ‘decision-behaviour phenomena’ can be thought of as a multiple chain reaction event or process, in which the manifested behaviour is dependent on the motive. The subsequent series of behaviours is dependent on what values or expected outcomes were motivating or inspiring necessary action in the first instance. To describe this as a chain reaction process, an imaginary division is made in the order transect describing the main steps involved in the decision-behaviour phenomena. The specific components and the processes involved are represented in Figure 3.2. The main feature of the ‘smallholder land-use decisions-framework’ is a circular process in character, as illustrated by the ‘left-to-right’ arrow direction.

This process has three main components: the first consists of an internal or mental element of two parts. The first of these comprises perceptions, attitudes and subjective norms that are formed by the embedded, social, cultural and environmental institutional norms that control and influence behaviour. The second consists of drivers of the chosen behaviour, and includes motives, needs, intentions and aspirations of the decision-maker. This has been discussed in detail in Section 2.3.1. The ‘left to right’ flow to the arrow-point indicates the direction in which a conceived decision is pursued. The external component of the decision-process step consists of an external manifestation of the land- and resource- use decisions; this is expressed either implicitly or explicitly by actions, deeds and conduct. This ‘stage’ in the decision process is referred to as manifested behaviour and represents the behaviour-inclination towards a particular choice or a decision preference. This is what Mitchell (1982) refers to as ‘degree of persistence’, that is, the force that keeps a particular set of behaviours sustained in a particular direction. The third component is the feedback loop that communicates back to the internal component, the knowledge, information and experiences that may become internalised (in the mind of the decision-maker) to assist evaluation and judgement for future decision process.

Using this ‘step-wise’ process, together with theoretical constructs presented in Box 3.1, each behavioural action in the livelihood strategy is traced in the reverse direction (red coloured arrow) along the decision-process chain to predict motives, needs and aspirations of smallholders. In addition, analysis is also conducted on how the embedded social, cultural, economic and environmental norms affect land-use decisions. These processes and their theoretical constructs, presented in Box 3.1, enable an objective evaluation of land-use decisions of PNG smallholders. This model is intended to reveal the relationships between behaviour, motives, perceptions and land-use decisions of PNG smallholders.
3.2.4 Rationale and limitations in the methodological approaches

**Rationale**

The rationale for this model is the objectivity it provides: firstly in linking (along the reverse direction) land- and resource-use behaviour or activity to the motive that is driving a particular performance; and secondly, to unpack perceptions and attitudes that influence particular land- and resource-use behaviour. In other words, each land-use choice is objectively assessed at each step in the sequence of the decision-process chain to identify motive/s driving a set or sets of behaviour and how it is influenced as a result of the ‘pull forces’ exerted by the socio-economic environment and by cultural norms. The model or simplified decision-process chain shown in Figure 3.2, combined with the theoretical constructs from Box 3.1, serves to:

(i) provide a structured and rational methodical approach for analysing and interpreting smallholder farmer perceptions, attitudes and behaviour;
(ii) identify beliefs that form attitudes or perceptions and motivations;
(iii) relate behaviour to its underlying belief system;
(iv) identify the types of capital assets smallholders have and how these are organised (processes), managed and used; and
(v) following on from (iv), focus on how the major production factors, such as land and labour, financial resource are organised and used in maintaining PNG smallholder livelihood outcomes.

**Justification**

As alluded to earlier in Chapter 2 and the preceding sections in this chapter, it is difficult to visualise relationships between PNG smallholder land-use decision-making processes from a single theoretical framework. Each of the theoretical frameworks adopted in this study is individually recognised as having inherent limitations. For example, at one end of the needs spectrum, smallholder land- and resource-use decisions involve internally-driven motives that include basic physiological needs (Maslow 1954) such as the need for food, shelter, clothing and need for money to provide education and health services required by the family. The other end of the need-spectrum or hierarchy is concerned with higher-order needs such as a sense of belongingness, security, need for love and self-esteem, all motivated by socio-psychological factors. While the basic physiological needs are motivated by hunger and thirst for food and water, the need for clothes and the need for shelter - the higher-order needs - are motivated by the forces of contemporary underlying economic paradigms, social norms, political and cultural beliefs and the biophysical conditions of the environment. These factors interact with each other in complicated ways to influence farmers’ land-use decisions. Thus, the use of the needs motivation theory construct alone cannot fully explain the motivation and behaviour of smallholders. Similarly, perceptions and attitudes of smallholders in their land-use behaviour
choices cannot be fully explained and understood from using single theoretical constructs such as rational choice theory or the theory of planned behaviour. The understanding of these interactions could be better achieved by use of a livelihood framework that provides analysis through a holistic approach, or from adoption and decision behaviour. Perceptions and attitudes are ‘why questions’ and rooted in the beliefs and cultural norms.

The combination of a number of analytical approaches, as described in Box 3.1, collectively enables a more rigorous and informative methodical framework to be used in the process of data collection and analysis. In addition, the use of these frameworks also enables a means of verification and validation of analytical approaches across and between each of the theoretical methods. For example, the farmer adoption decision framework (Pannell et al. 2006) was used principally in this study to provide explanations of the heterogeneous behaviour of farmers between the choices made in land- and resource-use options, under particular circumstances. On the other hand, the individual differences are also linked to individual motivational factors and this could be best described using the hierarchical needs theory (Maslow 1954). By using both methods, the individual differences between smallholder farmers can be explained; if there is a difference between the two analytical approaches, the extent of similarities and differences in the smallholder between each analytical approach can be established.

Limitations

Qualitative research methods involve the systematic collection, organisation and interpretation of textual material derived from conversation or observations. They are used in the exploration of the meaning of social phenomena as experienced by individuals themselves in their natural context (Patton 1990; Malterud 2001). As such, these methodological approaches are influenced by the nature and assumptions applied in the data required to answer the specific research questions asked (Patton 1990; Malterud 2001). They are subjective in nature and often the challenge for the qualitative researcher is to design research that has procedural approaches which are appropriate and logically suitable to minimise such subjectivity. For example, Malterud (2001) notes that the effect of an investigator on a study, the principles and consequences of sampling, and the processes of organisation and interpretation during analysis all affect research and are closely related to different aspects of validity. Recognition of limitations in the theoretical propositions and the adopted methodical approaches assists a researcher to be conscious of and engage in devising strategies that minimises or avert serious credibility issues.

Primary concerns associated with the credibility and limitations in the design methodology in this study include informant-related (or research participants) biases, investigator-related biases so that the case study analysis in this work represents a only a ‘snap-shot’ description of farmer behaviour in time, and, finally, the inherent limitations of the theoretical propositions
adopted to guide the study. The concern relating to the inherent limitations of the theoretical constructs is discussed elsewhere in this section. Here, I consider participant-related biases, investigator-related biases and snapshot analysis.

**Participant-related biases**

This category of bias refers to the subjectivity of the person who is supplying data in qualitative research. Since smallholder land-use decision motivation is derived by inferential analysis from the stories they relate and the activities they perform, it is very subjective. What research participants say may or may not necessarily correlate with their actions and performance. Analysis from story-telling accounts - such as feelings, thinking, perceptions, beliefs and experiences - is based on participants' own worldview. As such, the stories they tell carry a certain degree of subjectivity in their judgements, attitudes and perceptions. For example, Beedell and Rehman (2000), from a study using a social-psychology model to understand farmers' conservation behaviour, conclude that the behavioural measures used in that analysis were based on farmers' own estimates of their behaviour and therefore are open to acquiescence biases. In recognising this limitation, a number of credibility measures to increase the trustworthiness of methodological approaches were instituted (Section 3.2.5). Also, in Section 3.3.3, I describe the purposeful sampling principles adopted in designing the sampling strategy for this study.

**Investigator-related bias**

Malterud (2001: 484) observes that the researcher's background and 'research stance' affects what he/she chooses to investigate, the angle of investigations, methods judged most adequate for the purpose, the findings considered most appropriate, and the communication of the conclusions. This perspective assumes that a research investigator always enters a field of research investigation with a certain opinion about what it is about. From that assumption, qualitative research acknowledges the need that during all steps of a research process, the effect of the researcher should be assessed. Malterud (2001) describes this research behaviour phenomenon as 'reflexivity'; this involves identification of preconceptions brought into the research investigation by the researcher from previous personal and professional experiences, pre-study beliefs about how things are and what is to be investigated, motivation and qualifications for exploring the issues in question, and the perspectives and theoretical foundations and interest.

Recognizing this preconception research-behaviour phenomenon, I made an undertaking to myself to have an objective attitude to the way I conducted myself at every step along my research journey. Specific details of these measures are discussed at length in relevant sections. For example, in Section 3.2.5 and Appendix 2, I describe the ethical and credibility issues. Given my familiarity with the socio-cultural and socio-economic background of the research participants, on one hand, and the expectations of my educational and professional experience
on the other, I was well-placed for the research investigation task. I brought these two contextual viewpoints with me into the study.

Given this exposure, I was at ease, consciously sensitive and very objective in the way I conducted myself throughout the process of the research investigation. Because of my socio-cultural background as a PNG citizen, I was always sensitive to issues that bordered on taboos and other issues that could cause social displeasure to my research participants. Again, with my background understanding of the socio-cultural attitudes of the people who were under the scrutiny of my research analysis, I managed and conducted data-gathering activities in such a way that did not affect the results of my study and at the same time did not subject the participants to any duress as a result of my study. This helped, firstly, by easing the situation at interview meetings for both the participants and me in a way to be objective in the research investigation. Once that initial ease was created in the initial stages of the meeting, the rest of the subsequent data gathering (through conversation) flowed smoothly. At the same time, I was also conscious of my research purpose, and gently directed the conversations at these meetings to ensure my research goals were pursued. Secondly, the survey instrument attached as Appendix 1 provides both open-ended and closed ended questions and was designed to be objective in its focus and so ensure that questions were free from leading hints. This was developed as a result of data categories identified in Table 3.1 survey instrument.

Furthermore, questions relating to commercial tree growing were ordered towards the end of the interview questions. This was done deliberately so that participants would not be obligated to tell stories to please me as the interviewer, given that I was their guest who also had a professional background in forestry. The assumption of this approach is that engaging participants to talk about their livelihood activities in the earlier part of the interview process would naturally draw them away from their cultural-obligatory protocols of me as their guest. In this way, they would respond to the questions asked in more objective ways.

'Snap-shot' analysis

The concern about 'snap-shot analyses' arises from the view that this research study is drawing conclusions from observations of land-use behaviour that took place sequentially between 2007 and 2009. The period of time spent in actual field studies was about 2 months for each of case study regions. As such, the data collected represent only a cursory (snap-shot) account relative to smallholders' entire farming life; for most of those interviewed, this ranged from 18 to 40 years' full time involvement. Furthermore, most farming activities the landowners follow seasonal pattern and it is possible that the land-use behaviour described here may only reflect activities of particular season. The conclusions drawn from the study carry that limitation. In recognising this kind of limitation, Patton (1990) suggests that reliable time series data analysis could address this issue.
Although the study design did not factor in the element of time in the smallholder land-use behaviour, attempts are made to canvas general trends from similar research that has been carried in the past. For example, as Maxwell (1996) notes, a small sample that has been systematically selected for the typicality and relative homogeneity provides more confidence that the conclusion adequately represents average members of the community. In this case, the selected sample is 'observation time' as part of a smallholder's entire farming life. Secondly, the conclusions drawn from this study will be stated or presented with that qualification.

3.2.5 Measures to achieve credibility in the research design

Graneheim and Lundman (2004) observe that research findings should be as trustworthy as possible and every research study must be evaluated in relation to the procedures used to generate the findings. ‘Credibility’ refers to confidence in how well data and process of analysis address the intended focus (Graneheim and Lundman 2004).

A challenge for this study, as for others, was how the methodology adopted in this research investigation might go wrong and not able to answer the research question. This question shaped the thinking in considering the research design for this study, and also helped in making decisions and in the choices of assessment methods. The primary focus for this study was to develop a credible investigative procedure and at the same time enable data collection and analysis to provide answers to the research questions, within the constraints of time and resources.

Two fundamental aspects underpin these theoretical or logical propositions. The first is the question of relevance in the choices of method adopted in relation to the original questions raised in the study. This aspect focuses on the question of what should be done and how it should be done in the research investigation in order to answer the research questions. These questions are addressed throughout in the discussion presented in this chapter. The second aspect relates to the question of what should be the adequate size of the sample for this study. The question of what size the sample should be in order to achieve credibility depends on the purpose and the characteristics of the population being studied. This aspect is discussed further in Section 3.3. Based on these considerations, the following principles are factored into the research design and methodology as measures to achieve credibility.

The principle of purposeful sampling (Patton 1990) was adopted as a strategy in the selecting sampling units in this study. A detailed discussion about the strategy and how it was adopted and applied for the purpose of this work is presented in Section 3.3 of this chapter.

The principle of theoretical saturation of data (Glaser & Strauss 1967; Strauss and Corbin 1998) was applied throughout the interview process at data collection stages. That is, the same questions were asked of different interview participants in each of the different case study until no new information was forthcoming for each category of question. The same approach
was applied for each category of data set. How the methodological approach was applied in this research fieldwork is described in Section 3.3.3 of this chapter.

The principle of data triangulation (Denzin and Lincoln 1998; Yin 1994). I crosschecked the interview results with my observations to the extent that I was able. Many of the research participants discussed important information and experiences about their choices in the land-use decisions. In this way, smallholder experiences and information were validated by triangulation. For example, I cross-checked what one smallholder farmer said against the crops actually cultivated in the field, or what was consumed with what was actually grown in food gardens. The process was ongoing either in the form of field notes or in the form of mental note taking and writing memos as a daily diary after each field visit.

Interviewee confirmation

At the end of every interview, I read the summary of the notes that I made of the interview sessions and asked participants for confirmation of my notes. In this way I made sure that my note taking and records of interview were interpreted as intended from the participants. Specific details are described in the relevant sections in the methods for data collection (Section 3.3.5, method for collecting data).

Other strategies adopted to increase credibility

While the strategies described above provide universal measures to increase credibility in qualitative research, certain social and cultural peculiarities of Papua New Guinean societies have implications on the outcomes of this research study. For example, many rural communities in PNG are generally illiterate and highly dependent on learning, understanding and making judgements and decisions based on observations, oral communication and various other social and cultural interactions. As a result, people have developed attitudes of curiosity, eagerness, and keenness not to miss any opportunities in face-to-face meetings, listening, and talking, and often are readily willing to engage and participate in verbal communication with others. This social behavioural attitude unconsciously also extends to any visitor arriving in their community. Often the tendency is to congregate around a visitor to find out answers to a whole range of questions - such as who they are and why they are visiting - is far greater with unfamiliar visitors, just as the innate urge for a news-hungry person is to hear the daily news. This is a reflection of people's curiosity.

The main drawback, however, of such socio-cultural peculiarities (especially in relation to this kind of research study) is a two-fold effect on both the interviewer and interviewee. It has an inhibitive effect on the person or participant who is being interviewed, and also for the one who conducts the interview, of 'getting lost' in the process. The presence of other community members eagerly listening to every word is not conducive for an objective interview outcome, as it can prevent the interviewee from relating his/her life experience story or world views in
detail, for the fear of being heard by other attentively-listening members of the community. The interviewee knows that once his/her story is told and heard, it is retold to another member and continues until it becomes public knowledge in the community. This can become the subject of gossip and sometimes brings negative outcomes.

Other implications of group interviews include intrusions or distractions by other members of the community with comments that derail the theme of the message in the story telling, or negative remarks that distract the person being interviewed. Such a dynamic could lead the person conducting the interview to get lost in the account and theme of story telling. Under such circumstances, there is a strong tendency for the participant to be selective in the stories being told. In most circumstances, the interviewee’s stories may dwell on aspects that follow the general behaviour trend in the community. As a researcher, you may not access detailed descriptions and the underlying personal meaning or ‘world-views’ of the storyteller as this are often concealed in the generalities. To avert a likely compromise in the quality of data from such a situation, I devised a number of strategies to overcome these challenges, including:

**Initial communication strategies**

To ease the community’s curiosity, I made an announcement at the group meetings of who I was and what I was doing in the community. I also engaged in other discussion that the communities raised and about which they expected some responses from an outsider like me. I provided advice to specific questions on whatever was raised at the meetings. This is discussed in detail in Section 3.3.4.

Where possible, field and household interviews were conducted separately for each of the individual participating members. This meant visiting participants and conducting interviews at their place of work, such as gardens, cash crop blocks, roadside or other such location where the environment was conducive for an unhindered interview to take place. At times, an interview took place in a car if an opportunity presented itself, for example, in the event that an interview participant took a lift with me.

For household and family (husband and wife) participants, I conducted interviews in the family home. The best timing for these were during mid-morning (9-11 am) or early afternoon (2-4 pm), while other members of the community were already preoccupied with their usual daily activities (garden, fishing, or hunting) or otherwise away from the household. Arrangements for this kind of meeting were organised a day or two in advance, with advice that my arrival for the subsequent interview should not be announced to the community. Usually with in-house interviews, I realised that other members would normally not bother coming to the interview scene if it were conducted in the house. On the other hand, there was a high tendency for people to congregate around the interview scene if it was conducted in an open space.
**Ethical considerations in the research design**

Harsanyi (1995) observed that ethics attempts to answer two basic questions. The first concerns the question of what one should do to have a good life from his/her own personal point of view. Harsanyi (1995) calls this a question of prudence value. The other observation is concerned with the question of what one should do in order to have a good life from a moral point of view; this he calls the question of morality (Harsanyi 1995).

Since my study involved the scrutiny of other people's lives and their behaviour, I took the onus of responsibility in conducting this research study in such a way so as not to affect those who were studied, both from a moral and prudence point of view. The details of this responsibility are specified in Protocol # 2007/2198 (copy attached as Appendix 2), which was approved by of the Australian National University Human Ethics Committee, as an independent third party. The protocol provides an explicit description of my approach to the participants (case study communities in the case study regions) and how I conducted myself in the field interview process. The main objective was not to undermine or put any one of my research participants at risk, under duress or with any negative implications in whatever way as a result of my research activity. I gave an undertaking to conduct my research investigation within the boundaries of the ANU Human Ethics Protocol No. 2007/2198.

**3.3 Methods for data collection**

Methods for data collection involve a number of activities from planning of fieldwork, data identification, sampling strategies and actual methods of interviews and collecting data in the field. Each activity process is discussed below.

**3.3.1 Planning and organising research activities**

Planning, organising and carrying out of fieldwork took place in several stages. The first stage involved office-based activities and involved decisions regarding the design of the research, planning and taking decisions on the methods of the survey to be adopted as appropriate in answering the research question at hand. This focussed on a literature review with problem identification and development of the research question as its primary outcomes. This involved reading and reviewing of a wide range of literature on PNG smallholder land-use behaviour and the relevant theoretical constructs to the topic. It assisted the identification of relevant theoretical constructs, relevant data and development of appropriate methodical approaches required in data collection and answering the research question. Specific details of these activities are discussed throughout various sections of this chapter as well in Chapter 2. Following on from this, a decision was reached on the question of what should be appropriate sampling strategies to enable a defensible method of data collection. This stage also involved obtaining approval from the Australian National University Human Research Ethics Committee to undertake studies as this involved human participant.
The second stage involved making important contacts in the field with relevant government agencies, research participants, and partner organisations in the case study regions in Papua New Guinea. A copy of this letter is attached as Appendix 3. Pilot work to test the survey instruments (the final version of which is attached as Appendix 2) was also conducted at this stage.

3.3.2 Pre-field work data identification and categorisation

A wide range of literature relevant to PNG rural people’s livelihood systems was reviewed. Topics included production systems and livelihood strategies, including production, consumption and exchange activities of PNG smallholders, as presented in Chapter 2. Among other considerations, the primary purpose of a literature review and analysis was to identify and categorise various prominent themes emerging from land-use behavioural activities.

At the same time, the process enabled the development of field survey instruments for gathering relevant and representative data in drawing conclusions to the initial research question. Graneheim and Lundman (2004) note that creating categories is the core feature of qualitative content analysis. Strauss and Corbin (1990) describe the procedural operation as ‘coding’ of data. The essence of categorisation is identifying a unit of data as belonging to, representing, or an example of a more general phenomenon (Spiggle 1994). Categorisation involves naming or giving labels to instances of phenomenon found in the data (Spiggle 1994). Graneheim and Lundman (2004) refer to categorisation as a descriptive level of content and thus seen as an expression of the manifest content of text. The challenge for this study was how to identify and categorise data from the relevant literature into themes that would enable a clear focus for field data collection and analysis. As commented above, PNG smallholder motives, behaviour, perceptions and land-use choices involve a complex decision process. This has to be understood in terms of basic human physiological needs to social and psychological needs of the decision-maker.

Furthermore, choice in a particular land use decision is also motivated by the underlying social, economic and environmental norms. Taking these perspectives as the presumptive lead, and using various theoretical constructs presented in Box 3.1, the literature on PNG smallholder land-use behaviour, perceptions and attitudes was synthesised with a view of visualising dominant trends, patterns and themes. This involved a continuous process of reading, critiquing, note-taking and abstracting while at the same time asking myself at each step the usual question of what?, how?, where?, and why? From these analyses, the themes presented in Figure 3.2 emerged as prominent features. The word ‘theme’ in this context refers to the regularity in the behaviour of smallholders in the various livelihood strategies being performed. From this, again using the relevant theoretical constructs (Box 3.1), I then categorised them based on the meanings that were attached to those performed activities. Figure 3.2 was developed from this process and this was further expanded and developed into the content presented in Table 3.1.
It became evident from the literature review that, to understand decision/behaviour phenomena in more objective ways, there was a need to define a parameter for data collection, categorisation and evaluation. This required clear definition within the context of the PNG landowner land-use decision environment. Figure 3.3 was developed on the basis of this consideration. For convenience I call this construct, represented in Figure 3.3, as 'Papua New Guinean landowner land-use decision environment'. The construct involved logically dividing interacting factors influencing smallholder land-use decisions into their unitary components or constituent parts; that assisted greatly in visualising the relationship and the functioning roles of the individual data categories within the whole system. This formed the basis for data identification, categorisation, collection, retrieval and analysis in this study.

There are three important features to note in the framework. First, each of the pentagons shows the cyclic direction of interacting relationships between each unit of the decision factors within the system. Each pentagon within the decision-environment represents a particular unit of data category. The interaction and influence of each factor within a data category is shown in the assessable variables; that is, the data that will be collected, interpreted through inferential analysis and will then form the basis for drawing conclusions. How each of the factors is influenced or interacts in the decision environment to yield a particular decision outcome is discussed further in Section 3.3.3 B. The second feature is that each of points from the centre pentagon is in 'contact' with each and every other peripheral pentagon, suggesting connected relationships between the hub and the periphery pentagons in the decision environment implying underlying interactions between each category of components within the system. The construct attempts to illustrate the fact that smallholder decisions are the core underpinning the hub that links together all the data systems within which a farmer evaluates and makes farming decisions. The smallholder decision environment construct illustrates the functional relationship as well as the cyclic processes involved in the PNG smallholder land use decision-making process.
In the previous paragraph, I addressed the critical question of defining a boundary within which critical and important data were identified, categorised and collected. In this section, I deal with the question of what data are relevant and appropriate to the process of answering questions raised by this study (Section 3.2.2). Table 3.1 expands each of the data categories further by providing specific details on data variables that are required to inform insights into smallholder land-use decisions. It provides a succinct list of data required in answering the set of research questions raised by this study. This table provides the basis on which to link data to the propositions hypothesised in the research question, and hence provides a rationale for the conclusions subsequently drawn from the data. It also provides a focus by which the efforts in field data gathering activities were directed and conducted. It provides the means to link data identified to the research question. A field data collection instrument ( Appendix 1) was developed on the basis of the details in the data variable provided in the table. Furthermore, it shaped and increased the efficiency of efforts towards data gathering strategies (sampling strategies) and appropriate methods to apply in obtaining field data. The table also provides the
means of crosschecking, codifying and reduction of data that are appropriate and critical to answering the research questions. This assisted the effort of achieving overall credibility in the research investigation.

Table 3.1 Data identification and categorisation

<table>
<thead>
<tr>
<th>Data Categories</th>
<th>Knowledge &amp; skill</th>
<th>Institutional Systems</th>
<th>Livelihood assets</th>
<th>Outcome pursued</th>
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</thead>
<tbody>
<tr>
<td><strong>Farmer motives</strong></td>
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<tr>
<td><strong>Needs:</strong> food, shelter, clothing, social services (health/school fees), security, love &amp; sense of belongingness,</td>
<td><strong>Knowledge:</strong></td>
<td><strong>Economic:</strong></td>
<td><strong>Human:</strong></td>
<td><strong>Subsistence:</strong></td>
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<tr>
<td></td>
<td>Crop agronomy, crop management, skills, climatic factors, soil harvesting, marketing, cultural system, politics of community, life experiences, hunting, fishing</td>
<td>trade, marketing, transportation</td>
<td>village network, community groupings, household labour</td>
<td><strong>Gardening</strong></td>
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<tr>
<td></td>
<td></td>
<td><strong>Social:</strong></td>
<td></td>
<td><strong>Hunting</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>kinship and family system, trading pattern, clan system (patrilineal/matrilineal), structure of local organisation, parishes or wards</td>
<td></td>
<td><strong>Types of crops grown &amp; consumed</strong></td>
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<tr>
<td></td>
<td></td>
<td><strong>Political:</strong></td>
<td></td>
<td><strong>Cash cropping:</strong></td>
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<tr>
<td></td>
<td></td>
<td>Leadership, followers, cultural: payments &amp; dues, ceremonial activities, land tenure system</td>
<td></td>
<td><strong>Types of cash cropping</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Manner and style of production</strong></td>
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<td></td>
<td><strong>Sales point</strong></td>
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<td></td>
<td></td>
<td><strong>Cultural exchanges</strong></td>
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<td><strong>Bride prices</strong></td>
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<td><strong>Compensations</strong></td>
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<td></td>
<td></td>
<td><strong>Various ceremonies</strong></td>
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<td></td>
<td></td>
<td><strong>Risk-coping strategies</strong></td>
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<td></td>
<td></td>
<td><strong>Adoption strategies</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Business opportunities</strong></td>
</tr>
</tbody>
</table>

Having identified various categories of relevant data needed to answer the questions raised in this study, the next series of concerns for the study is how to collect data in the field, how much data in each category of land use behaviour is sufficient to draw defensible conclusion to the research question. This involved a number of questions including how to collect, how much data is needed, and what level of data representation is sufficient to be able to draw defensible conclusions based on literature evidence and theoretical propositions, I identified the Purposeful Sampling Strategy as a method for collecting data. In the next section, 3.3.3, I focus the discussion on purposeful sampling as methodological strategy to collect data.

3.3.3 Purposeful sampling strategy

Time and resource constraints often dictate decisions on how research investigations are carried out. The challenge for a would-be researcher is a decision that settles for a partial account of the population through which to provide credible and supportive conclusions from...
the study, at a minimum cost. One of the main issues often associated with this challenge is the question of adequacy of sample size. This, in turn, affects the purpose or relevancy of the enquiry and nature (characteristics or variable) of the population being studied. In this research investigation, a decision was reached to adopt the purposeful sampling strategy (Patton 1990) as a basis for gathering data. This decision was influenced by the fact that the principle of purposeful sampling strategy is highly relevant to the purpose of this study. This section presents the concept of purposeful sampling strategy and at the same time describes the consideration and methodological procedures applied in the selection of sample size and unit of analysis in this study.

The logic and strength of purposeful sampling lies in the intentional selection of information-rich cases for an in-depth study (Patton 1990; Maxwell 1996). Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of a study and Patton (1990) terms this approach of sampling as 'purposeful sampling'. In purposeful sampling the aim is to select information-rich cases whose study will illuminate understanding of the question explored in the study inquiry. This is a strategy in which particular settings, persons, or events are deliberately selected in order to provide important information that cannot be obtained as well from other choices. Patton (1990) argues, however, that the logic of purposeful sampling is often wrongly judged on the basis of logic, purpose and recommended sample size of probability sampling. Instead, like all other qualitative inquiries the sample should be judged on the basis of the purpose, and rationale for the study and the sampling strategy used to achieve the purpose of the study. In other words, a sample should be judged in context; the same principle that underpins analysis and presentation of qualitative data.

Maxwell (1996) identifies four possible goals for purposeful sampling in qualitative research. The first is in achieving representativeness or typicality of settings, individual, or situations selected. A small sample that has been systematically selected for typicality and relative homogeneity provides more confidence that the conclusions adequately represent the average members of the population. The second goal that purposeful sampling can achieve is contrary to the first and that is to adequately capture heterogeneity in the population. The argument is that the conclusion adequately represents the entire range of variation, rather than only typical members of some subset of the range. This is achieved by defining the characteristics of variation in the population that are most relevant to the study and systematically selecting individuals, times or settings that represents the most important possible variation dimension on these characteristics. The process may require stratification in sampling. The third goal in selecting a sample is to deliberately examine cases that are critical for the theories that one began the study or that were subsequently developed from prior study. The fourth goal for purposeful sampling is to establish a particular comparison to illuminate the reasons for differences between settings or individuals.
In the next three sub-sections, I present a discussion on specific aspects of the sampling procedure used in this study. They include sample size, sampling units and the process involved in the selection of research participants and the variables assessed in the survey.

[A] Sample size

Glaser & Strauss (1967) and Strauss & Corbin (1998) observe that the primary aim of sample size in qualitative research studies is to generate enough in-depth data that can illuminate patterns, concepts, categories, properties and dimensions of the given phenomena. The second consideration is the theoretical saturation of data. According to Glaser & Strauss (1967) and Strauss & Corbin (1998), theoretical data saturation is a situation in the data gathering stage (interviews) where:

a) no new or relevant data seem to emerge regarding a category;

b) the category is well developed in terms of its properties and dimensions demonstrating variation; and

c) the relationships among categories are well established and validated.

In other words, the researcher continues expanding the sample size until the data collection reveals no new data. Given these considerations and the opinions of others experiences in qualitative research in rural PNG (R. M. Bourke, pers. comm.; H.A. Holzknecht, pers. comm.) as well as my own experience in the pilot study, I decided on a sample size of 20 interviewee participants (households), the 20 participants (or households) as the likely theoretical data saturation point for this kind of research investigation in a typical PNG rural village community population or setting. However, in the course of fieldwork, I learnt that people often shift location regularly, especially in the Upper Ramu and Western Province. In such situations, people typically move closer to the main transport access point along main roads or river route systems. This meant that the originally planned target number of households was not available in some case study communities. In these cases, the current villages comprised less than 20 households; usually around 15. In this case, my intention was to survey all households. However, I found in the initial stages of fieldwork that the same data kept emerging after about the 15th interviewee, i.e., that this lesser number represented the point of data saturation. There was no sampled village in which there were fewer than 15 households, so I was satisfied that saturation was reached in each case.

[B] Unit of analysis

The research question this study intends to answer is a component of the overall ACIAR FST 2004/050 project activities, and as such the choice of case study regions was predetermined by the larger project. Relevant project documents (Kanowski et al. 2008) provide specific details on these issues. In this section, I confine myself to a description of the processes involved in defining the unit of analysis and the selection of participants for the study.
The unit of analysis refers to the entity being examined in the analysis. In this study, the primary focus of the analysis is on the PNG smallholder household economy and how this influences smallholder choices in land-use decision processes. It includes a qualitative interpretation of the smallholder land-use behaviour in production, consumption and exchange activities. The study focuses on how motives in relation to land-use decisions influence household social, economic and environmental behaviour of PNG smallholders. In other words, all entities or variables contributing to the household economy and other social and environmental livelihoods of the individual and the smooth functioning of a given unit is analysed to determine the connections between behavioural performance and the motives originating this behaviour. In addition, analysis will also include individuals within groups versus activities between groups. Before defining what these variables are, I provide a description on how individuals and sample unit households were selected.

The question of sample size is described in the preceding section (3.3.3[A]). The next question for this research investigation is the selection of participants or the focal individuals (as units of analysis) for the social survey interviews. This stage in the data collection process is described here. Selection of interviewee participants involved a number of strategies, including initial community group meetings, calling for and selecting interview participants, and the scheduling of interview sessions. In every community attended to during the fieldwork, my first activity was to organise a community meeting. This particular activity served the important role of telling individual members of the participating community as to who I was and what I was doing in their community, who I will be working with, and where and for how long my engagement would be in the community. That meeting also offered me the opportunity to make an assessment of the context and raise questions on any cultural issues overlooked in the earlier planning process, but of importance to my research or to the research participants. Recruitment of individuals or households as participants for the further in-depth social survey was conducted at this stage.

After the group meeting and initial enquiries, I normally requested volunteers who could become focal individuals or focal households for in-depth interviews. Since most of the communities in the case study regions were relatively small, with the number of hamlets averaging no more than 15 houses in each of the village settlements, I was not required to make selections. In the PNG context, not being selected could be misinterpreted by community members or individuals as not being good enough for the purpose, and could have negative connotations. The smaller size of the village settlements saved me such misinterpretation of negativity in the community. Selection involved seeking to ensure representatives of men and women (usually couples), young people, children and senior (elderly) members within the community. In some situations where I came across a member of the community who was not present at the initial group meeting, but wished to talk about his/her farming experience, I also included them as interview participants and carried out interviews with them.
[C] Data variables and parameters for assessments

In the preceding section, I defined the unit of analysis and described how research participants within the given population of village communities were recruited for this study. In this section, I describe variables and assessment parameters for the types of data identified, categorised and presented in Section 3.3.2.

Quantitative and quantitative data

As observed in Chapter 2, resultant-choices in the land-use decisions of the landowners are outcomes of many interacting factors. These factors are heterogeneous in nature but generally include personal motives, aspirations, production factors, ideas about social, cultural, economic and environmental values, mending of and maintaining social and cultural relationships, and risk aversion strategies. From the literature review discussion in Chapter 2, five broad categories or themes emerged as the main drivers motivating and influencing choices of the landowners in their land-use decision processes. These categories were subsistence food production, cash cropping activities, social and cultural activities, business opportunities and risk management strategies. These drivers define the parameter range in which data variables for this study are assessed, identified and collected for analysis. The method of participant interviews, assessments of land-use behaviour and the processes involved in data collection are described in Section 3.3.5, below. For the purpose of this study, the focus is to collect, analyse, interpret and provide both qualitative and quantitative data that describes the basis on which Papuan New Guinean landowners make choices between different land-and-resource-use decisions. This involves mixed methods research. As Johnson et al. (2007: 1) argue that mixed methods research is becoming increasingly articulated, attached to research practice, and recognised as the third major research approach or paradigm, along with qualitative research and quantitative research. As Dellinger and Leech (2007) note, the term qualitative research and quantitative research grossly oversimplifies what are rich and complex tradition, ideas approaches and techniques of research. However, one of the challenges with mixed research methods is the increasing number of terms for evaluating and describing validity of a research study (Dellinger and Leech 2007).

Quantitative data

The quantitative data collected the process of data collection included; ‘time-use’ analysis in measuring labour division and distribution, subsistence food production strategies, amount of money earned and spent, consumable and non-consumable goods, material good produced and exchanged.

Qualitative data

Qualitative data included, social and cultural systems and processes, perceptions and attitudes, household exchanges, observations and interviews, risk management strategies,
reports and other documents, socio-cultural beliefs and underlying stories, social and cultural dynamics within the communities. Most of other data were qualitative in nature and were expressed as parts of their speeches story telling conversations. These are discussed below.

**Time-use analysis**

Decisions about labour and its use are very critical for landowners. It is an important data variable in the understanding of land-use behaviour patterns of landowners. For the purposes of this study, 'time–use' analysis (Grossman 1984) or, more accurately, 'time-duration per activity' was adopted as a variable to assess the rhythm of work and various activity patterns in the production, consumption and exchanges that take place at the household level. The methods used to collect data were those followed by Moulik (1983), Shand and Straatmans (1974) and Wadell and Krinks (1968, cited in Morauta 1983).

On this basis, it is presumed that the significance of an activity task is proportional to the amount of time allocated in performing that activity. The underpinning assumption of this notion is found in the motivational theories (see Maslow 1957; Deci and Ryan 2000). This study adopted 'duration of time spent' performing a particular activity task as variable to assess labour division and distribution at the household level. The informants provided mix of days, hours and relative proportion of household time. I adjusted these to correspond to a hypothetical week of 105 hours, i.e., from early morning, about 6 a.m., to 9 p.m. at night, corresponding to 15 hours per day. In the rural PNG context, this is the assumed average period of time-duration per given day in which people are awake and actively engaged in production, consumption and social activities. Other studies, for example Moulik (1983), used an 11 hour/day to analyse activity pattern between subsistence, economic, and non-economic activities of 67 men from the same households in Milne Bay, Madang and Eastern Highland provinces. Shand and Straatmans (1973), on the hand, used 13 hours/day to assess activity patterns of Kapore villages in Western New Britain Province. However, as noted by other researchers (Grossman 1984; Moulik 1983; Morauta 1983), there are many problems in measuring time spent on various activities in the village situation, since many activities are of a sporadic nature as well as the fact that in many cases the activity tasks are non-exclusive or are all occurring simultaneously, especially if the place of work is within the same unit space. This study used 15 hours/day as its basis, since night-time visiting of friends and conversations regarding the previous day's activities or planning for the next day's work, or to find out the latest developments in the community, were considered as important parts of the livelihood strategy. For women, for example, making bilums [TP: woven netbags] or washing dishes after the evening meal are still part of the livelihood activity. The 'daily active hours' is then multiplied by seven days to give a total theoretical active number of hours per week, in this case 105 hours in total. This is the total notional time available in a week, and the significance of an activity task is determined according to the allocated proportion of that time spent performing a particular activity task in
question. The total available time includes non-engaged time such as rest and time spend in travelling from one activity site to another.

This approach to defining time enabled the study to visualise the various connections that exist between land-use choices and the bearing these have on the decisions made about the use of labour. First, it showed the relationship between household labour and various tasks performed by household members. Second, it provided an insight into the relative importance of a particular activity in the household economy. Relative importance refers to the allocated proportion of ‘total active hours’ spent performing that activity. The greater that proportion the more important that activity is in the household economy. Third, it draws out how household labour is divided between various tasks; fourth, it assists in visualising any overlaps and connections between adjoining or related tasks.

(1) Food production activities

The main production factors of land and labour are the primary parameters by which the smallholder land- and resource- use decision-behaviour phenomenon of the smallholders will be assessed. Land will be considered in terms of availability, accessibility and biophysical condition in relation its usage for food production. Labour availability, distribution and division, relate to various activities in household food production and consumption. This information related to questions such as: what types of food (including their production methods, sequencing and timing of production in relation other calendar items of the household activities) are grown and consumed?; what other sources food are there and how are these collected, processed and consumed? what proportion of household labour is directed to maintaining social and community relationships and what sorts of activities are involved in these engagements?

(2) Behaviour in cash cropping activities

The main production factors in cash cropping activities are land and labour, although financial resources may also be relevant in some cases. Variables include availability, accessibility and usage of land in connection with household cash income generating activities of smallholders. Labour variables include availability, division and distribution to cash income generation activities. This information related to questions such as: what are some of the perceptions and attitudes influencing - either positively or negatively - the adoption decision in cash cropping activities?; are households adequately equipped with the skills and knowledge about introduced cash cropping activities?; how are existing institutional and infrastructure conditions influencing smallholder land-use decisions?; what are landowners’ sources of income and what is the money used for?

(3) Consumption behaviour

Consumption behaviour was divided into two main categories, food consumption and non-food consumption. For food consumption, the study examined the types of food consumed, their
sources, and how these foods were gathered and consumed. The focus in these assessments was to establish a connection between food production, exchanges, and the land- and resource-use choices of the landowners.

The second focus was the assessment of household behaviour in the non-food consumption category. This particularly examined other types of livelihood consumption by the household and how much of the household income earned was spent on those commodity items. This assisted the study to visualise drivers motivating the land- and resource-use decisions of the landowners.

(4) Behaviour in the social and cultural activities

Households and their relationships within the communities, various transactions and exchanges that take place within this web of relations, meanings and symbols are fostered in this kind of context, and the frequency and hosting of ceremonial events that take place in and between household units are all part of a household’s cultural activities. Research sought to understand what sort of underlying cultural institutions are dictating and influencing such social behaviour.

(5) Behaviour in risk management strategies

Households are exposed to various types of risk, and develop strategies to manage such uncertainties. Information on this topic focused on how households predict and manage such risk situations; and, in the event of a calamity, what sort of support is available?

(6) Behaviour in business opportunities

Many households are engaged to some extent in business activities. What are some of the existing operationally functional business activities? Information on this topic focused on what motivated these activities and how they were initiated, how the capital for such activities was organised, whether they had been successful, and why (or why not).

3.3.4 Fieldwork

Fieldwork was carried out in two stages. The first fieldwork stage involved a pilot study and this was carried out during the months of November 2007 and parts of January 2008. The second stage involved a series of extended fieldwork periods of up to two months duration at each of the selected case study sites between June 2008 and January 2010. Specific details for each of the fieldwork sites are described below.

[A] Pilot study

Between November 2007 and January 2008, a pilot study was conducted in the upper Ramu area of Madang Province. This survey included Mari sugar cane farmers, Ramu Agri Industries staff and other government extension officers in the district. The purpose of
conducting a pilot study was twofold; firstly, to test out the draft social survey instrument for any shortcomings that might have been overlooked and, second, to gain an initial feel for and gain confidence in conducting such a research enquiry in preparation for a later much longer fieldwork period. A revised field survey instrument resulting from this process and used later in the field data collection work is attached as Appendix 1. The social survey questionnaire was tested purposely to assess how farmers/respondents coped with the questions in terms of translation and interpretation of the questionnaire. This included an assessment of the accuracy in translation of meaning, level of difficulty or fluency in the interpretation of questions by both the participants and me in terms of administering questions. The questions were prepared in English and then translated to the lingua franca language, Tok Pisin; this was then translated again to the local language by the appointed translators if need be, and vice versa to translate back into English.

The primary focus of the preliminary study was to assess whether or not questions were understood as intended, without ambiguity, any difficulties often associated with language problems, literacy issues, cultural issues and any other ethical issues. The secondary aim of the pilot study was to assist with the planning for the subsequent and longer fieldwork periods. For example, I needed to know how long an interview would take, what other equipment and interview instruments would be required for the fieldwork. Furthermore, if there was an oversight in any of the ethical issues not adequately addressed prior to commencement of my work, I would use the opportunity to rectify this in addition to building up the necessary confidence and rapport with farmers in the course of conducting fieldwork.

[B] Major fieldwork

Fieldwork drew from combination of methodologies involving semi-structured interviews, case studies, workshops, focussed group meetings, participant and field observations. The multi-method approach enabled a comprehensive data gathering process that assisted in achieving the aim of increasing and achieving a greater understanding of various factors influencing farmer land-use decisions. This approach also provided a means of crosschecking and validating information across farmers as well as providing leads into important areas of enquiries.

3.3.5 Methods employed in the process of gathering field data

A number of strategies were adopted when collecting data in the field. These included household interviews, group meetings, participant observation and workshop meetings. The procedures and type of data gathered in the process of gathering data in the field are described below.

Field data collection was carried out with the aim of elucidating a clear, precise and complete picture of the processes involved in smallholders’ land-use decisions. This meant collected data variables were relevant and consistent with the overall aim of providing answers
to the research question. Accordingly, the main concern for the field work was in collecting data that were relevant to the unpacking of motives, perceptions and behaviour of PNG smallholder in the choices and preferences relating to land use and other social and economic activities. Analysis of the smallholder's land-use decision processes is described below.

Evaluation was based on the inferential content analysis from the stories told by smallholders and observation of performance in the production, consumption and exchange activities that took place in the household economy and village community settings. Each of the study units (households and community groups) were asked question relating to agronomic practices, social and cultural practices, social and cultural relationships, trading and exchanging, division of labour and time allocation to various production activities and attitudes responding to, and accommodating new initiatives in their production systems.

[A] Interviewing of participants

The main purpose of the daily survey and household interviews was to access the inner perspectives or world-views of the person/s interviewed. This focussed on answering the following research questions discussed above. The main focus in the participant interview was to reconstruct, from their stories, how the matters of everyday life affected and influenced their land- and resource- use decisions.

The daily visit to smallholder communities combined semi-structured interviews and a short standardised quantitative survey. The survey instrument (see Appendix 1) formed the basis of interview discussions. Before I commenced with the actual interview process, I explained who I was and what my purpose of doing the research was. This was done with the aim of eliminating any unintentional hopes and, secondly, for the participants to feel at ease about my engagement with them. The interview survey recorded data on basic information like demography, education, resource base and accessibility. This data provided basic information on the social, economic and environmental conditions of the communities. The next category of data set corresponded with matters concerning land ownership and decision-making processes, production (food, clothing, shelter), consumption and exchange activity strategies, livelihood outcomes, social relationships, attitudes and perceptions in terms of the adoption of new innovations, vulnerability and security issues, and the engagement of labour and time for various activities including paid employment. The next and final category of data set concerned opportunities concerning options for commercial tree growing.

The questions were not administered in the order as they appear in the questionnaire, but rather in response to how participants conversed. Survey questions usually were interspersed in general conversation. In responding to and iteration of questions, participants were not discouraged from digressing to related issues or other important matters that had arisen earlier in the discussion. This often uncovered new information that would not have been revealed through the standardised survey and so provided insights what people themselves felt were
important issues. If I felt that they had completed telling a story on a particular sub-theme, I would then introduce another one not discussed earlier. The interview would continue in this manner until all the questions in the interview questionnaire are exhausted. The process continued for each interview groups and communities until there was no new information emerging from any of the subsequent interviews. This stage in the data collection is process is known as data saturation stage (Glaser & Strauss 1967; Strauss and Corbin 1998). From my fieldwork experience, data saturation stage was reached after 15th interview. Towards the end of each interview, I summarised the discussions and general findings and sought the interviewee's feedback on my summary. This process helped ensure the data collected were accurate reflections of the situation and discussion as well as concerns of the farmers and their communities. In general each interview took between 45 minutes and two hours. This allowed for three to four interviews per day.

[B] Group meetings

Apart from daily household interviews, I also organised and conducted group meetings. The purpose of conducting group meetings was to gather group views about particular aspects of the land-use decision-making process and general views on the underlying social, environmental, cultural and economic systems operating within the case study regions. The second purpose was to observe the dynamics of group behaviour in terms of attitudes about tree growing and other livelihood systems with a particular case study region. The opportunity within focused group meetings enabled me to crosscheck and so validate data through triangulation. Every group meeting was open to everyone, particularly the interested members of the community and was usually conducted near the community leader's residence. Men, women, youth and children attended these meetings. The same themes raised in the interview questionnaires were also used as foci for deliberations at group meetings. My role included control of the meeting and the direction of the discussions. All the conversation and discussion were recorded using a digital voice recorder.

[C] Observation of land-use behaviour

Altman (1973) notes that social behaviours may be regarded as events or as states, where 'events' are instantaneous, and 'states' have appreciable duration. In reality, performance of any kind of behaviour takes some amount of time. Altman (1973), in describing animal behaviour, refers to the question of frequencies in the behaviour occurrence as events. On the other hand, a question involving duration of behaviour, or the percentage of time spent in some activity is a question about state. The primary concern for this study was the recording of behaviour variables that assisted in answering the main research question. Important variables that needed observation included smallholders; these variables included sequences of events or states of activities that contribute to food, clothing, shelter and cash income production, consumption and exchange of the smallholders), their time of occurrence, their time of onset and termination. In
addition, observations also recorded contextual data, such as habitat, production areas (food gardens, cash crops, hunting/fishing grounds, sources of resources), weather, predominant group activity, distances to or identities of neighbours, or the size and membership of the sub-group in which the behaviour occurred. Recordings included photographs, visual noting of events, field notes and taking necessary measurements. All of these activities combined with participant interviews, group meetings, and workshops provided the basis for drawing conclusions to the research questions.

[D] Workshops and meetings

A series of workshops were also held between 2007 and 2009 with various stakeholder partners, including researchers and landowners, both in Australia and PNG. The purpose of such workshops was two-fold; the first was to inform other researchers of the progress of the research work; the second was to provide an opportunity for a review and to fine tuning strategies for ongoing and future activities of the study.

3.4 Methods for data analysis

The presentation in Section 3.3.3 detailed the methodological procedures and strategies applied throughout various stages in the processes of collecting relevant data. Large quantities of field data representing various aspects of smallholder land-use decisions processes were collected. The collected data included smallholder land-use behaviour in the production strategies, risk management strategies, personal aspirations, organisation, deployment and management of resources such land, labour, cultural and customary exchanges. This required a procedure for organising and managing these data. An option was to provide data analysis throughout the data collection stage in order to reduce the data in the field and at the same to make some sense of the story themes that were emerging from the early data. Miles and Huberman (1984) describe data analyses as having four continuous interactive cyclic processes throughout the life of a research investigation. This process involves data collection, data reduction, data display and conclusion drawing or verification. The relevant aspects concerning the methods for data collection method was presented above in Section 3.3. The primary objective for this section is to provide a description of the procedures relating to data analysis and presentation.

3.4.1 Data reduction - coding, memo writing and summarising field data

The need for systematic organisation and analyses of a large volume of data collected from various sources in the field was immediately realised during the early stages of fieldwork. In this section I describe procedures applied in the reduction and management of the field data in order to produce relevant findings. Data reduction refers to the process of selecting, focussing, simplifying, abstracting and transforming the ‘raw’ data that appear in the form of written field
notes (Miles and Huberman 1984). This process is a continuous process throughout the life of the qualitatively oriented research. In this study the actual data reduction work commenced very early from the research study proposal development phase and continued throughout to stage of writing the thesis. The process concerned very important decisions regarding research questions and adoption of the relevant theoretical concepts to guide this study. These decisions influenced and shaped the methodological approaches to the research. Miles and Humberman (1984) describe this phase as an anticipatory data reduction stage that involves decisions about the conceptual framework, in which locality to situate the study, which research questions to focus on and which data collection approaches to choose.

In Section 3.2.3, I described how various theoretical frameworks (presented in Box 3.1) were applied in analysing the relevant literature to tease out motivation and meaning of behaviour from the various livelihood strategies that are pursued. Again drawing on the insights of the theoretical assumptions, the underlying meanings forming perceptions and attitudes of smallholders to various land-use opportunities were assessed and evaluated. These theoretical constructs enabled an objective and systematic manner to be followed to carefully assess, evaluate and reduce large chunks of data to identify the relevant themes emerging as factors influencing land-use decisions. The data reduction process involved sorting out or coding, discarding, organising and categorising relevant data that helped in the shaping of and providing a sharper focus to the visualisation of emerging themes/stories. These processes are described as follows coding, memo writing and summarising.

**Identification, categorisation and coding of data**

Data coding refers to the 'key words' used as a way of identifying, categorising and presenting types of primary data needed by this research investigation to answer the study's research question. From this process Table 3.1 was developed and the need for various types of data were immediately identified and listed according to each type and data category listed in the table. The 'coding' or type of data required in the study was identified from the review presented in Chapter 2. This was the first step this study undertook in the process of data reduction, categorisation and identification. From this process the study was able to immediately develop and prepare the necessary field survey instruments (see Appendix 1). The instrument provided the basis and direction to which the relevant questions pertaining to needed data were raised and retrieved from research participants at the interviews that were conducted.

Apart from maintaining an important role of keeping a steady focus on the process of the field survey work, this study also found other benefits from data coding, namely the role it played as a check-list on the types of data that were collected. If the needed data was not collected or the responses to the question asked were not clear, the checklist provided the opportunity to ask alternative or iterative questions to clarify the feedback provided from the questionnaires. The coding of data assisted greatly in the management and administration of the
survey questions and in the retrieval of data that followed. In this way I was able to trace stories to meanings and motivations driving choice and behaviour in land-use decisions. A similar process was applied for data reduction at group meetings. The data reduction at group meetings was conducted in the same way as for the interview process except that during group meetings, the dynamic atmosphere of discussion is different from that at household meetings, with more domineering speakers often taking the lead to influence direction and flow of the discussion. One of my main tasks at meetings was to manage the dynamics and atmosphere of the meeting in such a way that I, as a researcher, could achieve maximum benefit to the research goal from the opportunities presented by the meeting. Again, using the coded data and data categorisations in Table 3.1 as a basis I was able to direct the flow of discussion and outcome of the meetings, by appointing who to speak, guiding what to say by prompting or asking specific questions, iterating specific points that were mentioned and needed further exploration by the group. In this way I managed and organised discussions in a more objective manner for the research study and also reduced the amount of data to focus on the scope of the research topic. This didn’t mean that I rejected other data. In fact all the data, either in the form of story-telling, speeches, questions that preceded or occurred at focussed group meetings and household interview, were captured by electronic voice recorder.

Data reduction and coding

Over 4 gigabytes of stories, meeting proceedings and interview scripts, were recorded and collected. These were all recorded in pidgin with no English translation. In this way original data were kept for their authenticity and later referral where necessary. The data set were then replayed and key messages emerging from the landowner household stories were then translated, and transcribed from Tok Pisin to English, and listed or categorised according to various aspects of the livelihood strategies of the household that were identified. If new meanings and messages emerged, these were then given new codes. Electronic software packages were not used in this work as lot of translation from local vernacular to Tok Pisin and then to English meant distortion and the potential for misinformation.

For each question that was asked, a different colour was assigned to the emerging themes. If there was new theme or message, a different colour not previously used was assigned. The process continued in this way until all the data for a particular question were completed. This process continued for all question and data categories. Table 3.2 below, as example illustrates how the rich raw data was reduced and coded. The process firstly involved transcribing the response from a question that raised about the food production strategies of the landowners to English, and then secondly categorised these into different themes or mode of obtaining food that were emerging. These were then coded by allocating different colours. The column on left is the coded or reduced data for this particular question.
Table 3.2 Illustration of data reduction and coding

Part 3. Livelihood and adoption strategies from the questionnaire instrument, Question # 1. Where do you obtain your food?

<table>
<thead>
<tr>
<th>English</th>
<th>English translation raw data</th>
<th>(Tok Pisin) Messages emerging from landowners stories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coded data</td>
<td>English translation raw data</td>
<td>Tok Pisin version of the raw data</td>
</tr>
<tr>
<td>-Self produced food</td>
<td>As a household we get most of our food from the food gardens we make. We have four different types of food garden; we grow food on hilly slopes (mostly banana and taro) for wet season. We grow sweet potato, banana and vegetables in our valley floor garden. We also gather vegetable from our kitchen garden. Food from fruit and nut trees</td>
<td>Mipela save kisim kaikai long garden; Mipela l gat fopela kain gaden; garden long monten; em save giving kaikai long taim bilong ren; mipela kisim taro, banana long dispela garden</td>
</tr>
<tr>
<td>-garden</td>
<td></td>
<td>Garden long kunai (ples daun), i save givim kaikai long taim bilong san. Mipela kisim sweet potato, kumu, taro, banana long dispela gaden</td>
</tr>
<tr>
<td>-garden for different food types</td>
<td>We also buy food from trade stores (salt, oil, flour, and biscuit. Consumer food cannot be produced</td>
<td>Yam garden; Yam em spesel kaikai bilong mipela</td>
</tr>
<tr>
<td>-food security</td>
<td>Sometimes we buy food at the market when we are late to go to the garden, or when garden is not ready for harvest.</td>
<td>Sampela taim mipela baim kaikkai long stoa. (sol, wel, flaua, rais).</td>
</tr>
<tr>
<td>-different food types cultivated</td>
<td>Our friends also provide food to us, when there is shortage of food, due to bad weather, or when we have to host some important ceremonies.</td>
<td>Sampela taim mipela baim kaikai long market sapos garden ino redi yet, o longwe tumas o wara pasim rot.</td>
</tr>
<tr>
<td>-annual and perennial food crops</td>
<td></td>
<td>Tu, sampela taim ol pren na wantok save givim kaikai long mipela, taim mipela nogat inap kaikai long taim bagarap i save bungim mipela, o helpim mipela long taim bikpela wok i save kamap insait long haus</td>
</tr>
<tr>
<td>-Food purchased at trade stores</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Food that cannot be produced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Food purchased at the market</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-shortage of food</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-late to collect food from garden</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-food given by friends</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-ceremonial events</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In terms of observation, the code provided in Table 3.1 also assisted in giving hints about what to look for and what to make notes on. Recordings for this involved photographs, field notes that included records of peoples’ behaviour in terms of time spent daily in the gardens and on other livelihood activities, household labour organisations and distributions, types of food produced and consumed, types of shelter built and used, what materials were used and the
supply and accessibility of resources used. Through the process of triangulation (as described in Section 3.3) data were critiqued, evaluated and sorted or discarded for the conformity and consistency within the overall scope of this research questions as well within overall contemporary perceptions and attitudes.

**Memo-writing and summarising data**

Raw data do not constitute the findings of the research (Miles and Huberman 1984). Findings in this context refer to the messages and themes emerging from the data after some process of analysis. Analysis is an important step in the research investigation since it provides initial evidence (Miles and Huberman 1984). For this reason, I listened repeatedly to digital voice records of all the interviews, group meeting discussions; at the end of every field day, by combining these together with the field observation notes, and the data reduction and coding process described above and summarised in Table 3.2, I was able to visualise and attach meanings and themes to the landowner household land-use behaviour. This assisted and clarified progress by making the landowner stories become more familiar and also assisted me to see if participants were responding to the research question as intended. In this way, I was able to write the main findings and summary of what the smallholder choices were, the factors affecting and influencing these choices, drivers motivating and getting people to engage in a particular land-use options, what the perceptions and attitudes towards particular adoption and production decisions were in certain cropping or production practices, types of household exchanges and commodities involved in the process of exchange, how risks were managed in households, and who made the decisions in land choice processes.

From these analyses the main themes were scrutinised, selected, described and interpreted against the theoretical constructs presented in Box 3.1, and described in Chapter 2 and in Section 3.4.2. This analytical process assisted me in examining the meanings of people's words or actions in terms of land-use practices and choices to understand their aspirations and motivations. These observations and findings were written as memos and kept separately for each different interviewed group. Each of the daily memos were summarised and filed as a case study regional summary.

**3.4.2 Tools used in data reduction process**

This section discusses how the theoretical concepts - presented in Chapter 2 and summarised in Box 3.1 - were applied in the data analysis process.

**Maslow's Hierarchical Needs Theory**

In this section, I use the human needs concept as a basis for integrating and organising the differences in PNG smallholder motives that drive and regulate choices in land-use decisions. In Sections 3.4, based on the psychological theories of Maslow (1954), I present some insights into smallholder behaviour in production. The review reveals smallholder behaviour in household
labour organisation and distribution pattern as following Maslow’s (1954) ordering of needs. That is, physiological needs such as food, water, shelter, take priority in terms of production decisions. This was strongly evident with the mixed cultivation of annual and perennial cropping system (Boyd 1975; Powell 1976) encountered during fieldwork. The annual cropping provided the immediate food needs of the household while perennial crops were planted for longer-term needs such as fruits or nuts, or for medicinal uses or other uses. Other strategies satisfying needs such as security, love and social relationships followed the primary needs. Such behavioural patterns are discussed further in the following sections.

**Sustainable Livelihood Framework**

In Sections 2.3 - 2.8, and drawing on the Sustainable Livelihood Framework (SLF) (Ashley and Carney 1992), I describe that range of activities that are pursued under the smallholder livelihood strategies. Evidence suggests that the subsistence system enables a greater flexibility in terms of risk minimisation, security and social relationships of the smallholders. In terms of security, the SLF model provided an insight into behaviour in adopting different food-getting strategies. An example of these includes different types of gardens such as ‘mountain garden’ or ‘valley garden’ as practiced in the Upper Ramu Valley of Madang Province. Mountain gardens provide food during the wet season when the valley becomes too wet and food crops drown in the waterlogged soil conditions. In some regions, people turn to sago tree as the main source of food during droughts. Sago is also considered a staple in some regions while in others it is seen as a food that people can fall back in times of need (Kesavan 1983). These farming strategies are the food security measures people have adopted as part of their livelihood strategies in the event that they face natural calamities such as drought, flood and frost. It also provided an insight into the behaviour by which smallholders maintain social relationships to draw from and exchange in times of need. In Section 3.3.3 [C], I presented the role of food and how this influenced the behaviour of smallholders. The SLF model (Chambers and Conway 1992) assisted in visualising the relationships between behaviour and how it rooted into the embedded social and cultural institutional processes. The model enabled me to explain the question of ‘why’ in their behaviour, especially with respect to attitudes and perceptions of smallholders. It also helped to depict a reasoned view on how individuals defined themselves, their status and prestige, through the behavioural conduct, actions and deeds such as production, consumption and exchanges in food and the accumulation of wealth.

**Farmer Adoption Decision Framework**

The concept of ‘relative advantage’ (Pannell et al. 2006) provided insights into how behaviour choices were made between cash cropping and subsistence production. The obvious example is the sensitivity associated with price fluctuations in commodity prices. Bourke et al.
(2009) explain how people switch production from one cropping activity to another in response to these fluctuations.

### 3.4.3 Data display

The second data analysis activity is the displaying of data. Miles and Huberman (1984) describe data display as organised assembly that permits conclusion drawing and action taking. Looking at data displays assists the researcher to understand what is happening and informs decisions on what course of action to take next. The data display in this study included narrative text, matrices or tables, charts, diagrams and photographs. Important data and their analyses relevant to the research question are described and presented in Chapters 5 to 8. The presentations in Chapters 5 to 8 provides case study-specific analysis in a form that is condensed, in order that emerging trends or patterns in land-use behaviour of the PNG smallholders can be understood. Chapter 9 discusses the implications of these results, both generally and for commercial tree growing, based on the assessments reported in Chapters 5 to 8.

### 3.4.4 Conclusions and verification

Conclusions and verification involves deciding from the beginning what the data mean, noting regularities, patterns, explanations, possible configurations, causal flows, and propositions (Miles and Huberman 1984). The key findings relevant to the main research question are presented in Chapters 5 to 8. These were verified within the context of the theoretical frameworks described above, through reference to the relevant literature from studies in PNG and elsewhere, and through triangulation of results within and between case study regions. The overall conclusions from these results chapters are discussed in Chapters 9 and 10.
Chapter 4: General characteristics of the study regions and locations of field survey work

4.1 Introduction

Literature review evidence suggests that people's attitude and behaviour patterns are formed, shaped and influenced by the environmental - economic, cultural, and biophysical - setting in which they live (Hanson et al. 2001; Brookfield and Hart 1971). The conditions in these environmental settings also affect choices people make about land- and resource-use decisions and their modes of production. Firstly, the environments in which people live provide both opportunities and challenges for livelihood and production systems. This in turn influences the choices people make between different cropping and other land-use options and their modes of production. The second form of influence on the land- and resource-use choices of people arises as a result of social interactions and their experiences of the other places and behaviours from these interactions. Through exchanges such marriages and other trading systems across different societies, people tend to also exchange ideas and other material goods. These exchanges can cause uptake and diffusion of new ideas and production systems between different groups of people. In this way, new ideas and practices can influence the way people make choices in their land and other resource-use decisions.

This chapter therefore provides a brief description of the biophysical conditions, population, transport and accessibility, land potential, agriculture and economic settings for each case study region. It sets the stage for the discussions on how the environmental, social and market conditions of each influence the choices of the landowners in their land-and-resource-use decisions. These are described and presented for each case study region in Chapters 5 to 8. The characteristics of the sampling conducted in each case study site are summarised in Section 4.6.

The case study regions are presented in the order in which the fieldwork was conducted, viz. the Mari villages in the Upper Ramu Valley region of Madang Province; part of the Amari communities, especially the Ragigumpuan and Marawasa villages, of the Upper Markham Valley region of Morobe Province; Yeteni, Obo and Kasa villages in the North and Middle Fly regions of Western Province; and the areas of Trans-Gogol, Naru and part of the North Coast region of Madang Province. Figure 4.1 shows the approximate locations of each of the field study sites.

The Papua New Guinea Rural Development Handbook (Hanson et al. 2001) is the main source for the biophysical and socio-economic data presented in this Chapter.
4.2 Upper Ramu Region

The description provided here of the Upper Ramu Region presents general characteristics of environmental setting in which the Mari households make choices between various livelihood strategies, such as subsistence practices, cash income options, household consumption and expenditure, and household allocation of labour.

The fieldwork in this region took place at two different stages. The first of these was a pilot study conducted between November 2007 and January 2008. The subsequent main fieldwork was conducted between November 2008 and January 2009. The Mari village communities included in the study were Bumbu, Bopirumpun, Sangkiang and Musuam. The process of data collection involved a number of strategies, including field observations, group meetings, interviewing of individuals, and household surveys. The procedure for selecting interview participants, and the process and types of data collected, are described in detail in Chapter 3.

4.2.1 General Characteristics of the region

Biophysical conditions

The Upper Ramu Valley is part of the Usino/Bundi District of Madang Province. This district is located south east of Madang and is one of the more diverse districts in PNG. It covers the rugged mountains of the Bismark Fall, including the remote Simbai Valley, and the extensive plains of the Ramu Valley with its surrounding hills (Hanson et al. 2001). The
average annual rainfall ranges between 2,200 and 4,500 millimetres (Hanson et al. 2001). The altitude varies from 100 m on the flood plains to over 4000 m on the upper slopes of Mt Wilhelm (Hanson et al. 2001). Figure 4.1 locates the case study region and the province in general.

**Population**

Based on the estimates contained in the 2000 census, the district has a moderate population density of some 38 persons / km². The population density in the Ramu and Sogeram valleys are generally low, at 7 persons/km², while the upper Simbai Valley and the Upper Ramu Valley, including the areas around Bundi, Brahman, and Wallium, have moderate populations with significant out-migration (Hanson et al. 2001). Much of the regions around the Bismarck Fall is unoccupied apart from isolated villages, with densities of 7 persons/km².

**Transport and accessibility**

In terms of accessibility to services, most people on the northern part of the Bismark Fall, the Middle Ramu Valley and the Sogeram Valley require up to 8 hours to travel to reach the nearest service centre (Hanson et al. 2001). Outboard-powered canoes are used to travel along the Ramu River to the Brahmin Bridge from where there are road links to the Ramu Highway, to Bundi and to the main highway linking Madang, Morobe and the Highland provinces. The areas in the southeast regions, including Usino, Dumpu and the Mari villages are up to four hours travel from Madang and between five and three hours to Lae and Kainantu, respectively.

**Land Potential**

The land potential in the Sogeram and Upper Ramu valleys is moderate and is constrained by high rainfall and frequent flooding. The potential for agricultural development is constrained by poor access to markets (Hanson et al. 2001). Areas around Dumpu have less rainfall and a longer dry season (Hanson et al. 2001) than other areas. The Bismarck Fall has very low to low potential because of steep slopes, high rainfall, poor soils, frequent cloud cover and low temperatures at higher altitude (Hanson et al. 2001). The choice of the Ramu Valley as the potential area for sugar cane cultivation was made because it had well-drained soils with gentle gradients (Chartres 1981).

**Agriculture and economy**

People living along the Highlands Highway earn income from the sales of betelnut, fresh food and other products at roadside markets. Allen et al. (2002) note that the road link between Madang and Morobe provinces had greatly facilitated transportation and marketing of smallholder produce (e.g., coffee from the Tauta area) and also allowed sales of vegetables at the Ramu Sugar markets. Those villages associated with Ramu Agri Industries Ltd. (RAIL), and with the recent oil palm development in the region, have very high incomes derived from wage
employment on the estates (Hanson et al. 2001). The Sogeram forestry activities and the Ramu Nickel mine also provide wage employment and royalties to a small number of people (Hanson et al. 2001).

In terms of subsistence agriculture, the wide altitudinal range (from 100 metres above sea level (a.s.l.) on the valley floor to 4000m a.s.l. at the slopes of Mt Wilhelm) means that a wide variety of food crops are able to be cultivated. Allen et al. (2002) described three main types of agricultural systems based on fallow type, fallow period, cultivation intensity, staple foods cultivated, garden and crop segregation, and soil fertility maintenance techniques. The dominant staple food crops in these systems are characterised by low intensity sweet potato and taro, banana and sweet potato, and yam and sweet potato (Allen et al. 2002). In the Simbai Valley there is a well-developed agroforestry system where Casuarina trees are planted in fallows to maintain soil fertility (Hanson et al. 2001). Soil potential in the Sogeram and Upper Ramu valleys is moderate and constrained by high rainfall and frequent flooding (Hanson et al. 2001). Commercial agriculture is an important land-use activity in the Upper Ramu District. It provides employment and contributes to the district and national economies. The main commercial agricultural activities include cattle grazing for beef production, cane cultivation for industrial sugar production and, recently, the introduction of oil palm cultivation for the production of palm oil. These activities are carried out on the leasehold land held by RAIL in the Dumpu, Ramu and Gusap plains of the upper Ramu region.

4.2.2 Study Site and participating communities

The case study region comprised four Mari village communities: Bumbu, Bopirumpun, Sangkiang and Musuam. Figure 4.1 shows the general location of the case study region.

The Mari villages are located on the periphery of the RAIL estate in the Upper Ramu Valley of Madang Province. These communities live along the Upper Ramu River channel and occupy the divide between the north side of the Bismark Fall and the south-side edges of the Finisterre Range. Four villages - Bopirumpun, Bumbu, Sangkiang and Unasinkiang - are located on the eastern side of Ramu River, while Musuam is located on the western side. Administratively, this group of villages are placed under the Madang Provincial administration. Being located on the borders of Eastern Highland, Morobe and Madang provinces, they share some attributes of socio-cultural and trading ties with the neighbouring people from these three provinces. For example, the language they speak, Mari, which is also the name by which they identify themselves, is related to the Adzera language of the upper Markham Valley region in Morobe Province (S. Holzknecht 1989). They also share some aspects of socio-cultural ties with Kamano and Agarabi speakers in Eastern Highland Province (S. Holzknecht 1989). According to the field interview notes, historically the Mari and the neighbouring Naho people, also living along the lower southern slopes of the Finisterre Mountains, participated in a major trading link between the Vitiaz Straits, the Rai Coast and the Eastern Highlands trading system.
Dalton (1988: 71-75) describes how Rawa people living on the slopes of the Finisterre mountain range provided this important link between the two trading systems. Dalton (1988) notes further that the Rawa people exchanged items such as clay pots, tobacco, bows and arrows with the people on the northern side of Finisterre Mountains for shells and lime. They also exchanged shells, clay pots, and wooden bowls for dog’s teeth, salt, feather headdresses, stone axe blades and women with people from the Eastern Highlands. Dalton (1988) notes that Rawa people traded with Naho people for wooden bowls and disc beads made from dog’s teeth and pig tusk. The trade items Mari people produced and exchanged are similar to those their neighbouring Naho people produced and exchanged during such trading, or merely acted as intermediaries or middlemen for the goods that flowed from either side in the trade link.

The land-use behaviour pattern of the Mari communities, discussed further in Chapter 5, is situated against this general background geophysical, infrastructure, agriculture/economic and cultural information.

4.3 Upper Markham Valley Region

As in Section 3.2, the descriptions provided here present general characteristics of environmental setting in which the Ragigu1npuan and Marawasa households of the Upper Markham Valley region make choices between various livelihood strategies.

The initial fieldwork in this case study region, mainly in the villages of Ragigu1npuan and Marawasa, was conducted between the months of October 2007 and January 2008. This was followed by subsequent visits in August 2008 and again in January 2009. As with other case study regions, fieldwork involved a qualitative assessment of land-use behaviour patterns among the smallholders in these two communities. These two village communities are part of the larger group of people known as Amari, located in the upper Markham Valley region of Morobe Province (Figure 4.1). The villages are located about 100 kilometres north west of Lae, the provincial centre. The Ragigu1npuan and Marawasa people inhabit the edge of the valley corridor where the Owen Stanley Ranges foothills meet with the Markham Valley floor. The land-use behaviour patterns adopted and currently practiced are underpinned by both the unique mountain/valley agro-ecological zone and by the cultural interaction between the Amari and Highlands peoples; the two groups speak totally unrelated languages. Land use patterns are also influenced by wider factors including economic opportunities and the availability of infrastructure such as roads and bridges.

4.3.1 General characteristics of the region

Biophysical conditions

The upper Markham Valley is located northwest of Lae, Morobe Province. The boundary of Morobe Province extends from the Owen Stanley Range in the west and extends across the Markham and Leron valleys to the coastal ranges and offshore island such as the Umboi Islands.
The Saruwaged mountain ranges dominate the northeastern part of the region; this includes mountain ranges in the Huon Peninsula (Hanson et al. 2001). The plains of the upper Markham Valley dominate the Markham Valley region (Hanson et al. 2001). The average rainfall here ranges between 1,600 and 2,300 mm, with a long dry season. Altitudes vary from 150 masl in the Markham Valley to over 3500 m in Saruwaged Range (Hanson et al. 2001). Figure 4.1 locates the case study region and the province in general.

**Population**

Based on the estimates of the 2000 census, the Markham District has a population of 41,000. Densely populated regions are Wantoat, Yasuru and Imane, with an average population density of 80 persons/km² (Hanson et al. 2001). The Markham Valley has a population density of 47 person/km², while the Leron, Wantoat and Ikwap valleys have some 33 person/km² (Hanson et al. 2001).

**Transport and accessibility**

The Highlands Highway runs through the centre of Markham District (Hanson et al. 2001). As a result, people in the Markham and Leron valleys are within four hours of Lae (Hanson et al. 2001). People in the mountains and valleys to the north are within eight hours travel to Lae.

**Land potential**

Land potential in the Markham Valley is moderate to high, limited by a long dry season. The valleys in the Saruwaged Range have low to moderate potential constrained by steep slopes, a long dry season and frequent cloud cover (Hanson et al. 2001). The Wafi and Wanton valleys have very low to moderate potential due to steep slopes, a long dry season, poor soils and frequent cloud cover (Hanson et al. 2001).

**Agriculture and economic opportunities**

The Highlands Highway runs through the district, making access to services relatively easy for the people in the Markham Valley. This enables people to bring their produce to the market in Lae or to other centres accessible by the road network. People in the Markham Valley have excellent access to markets in Lae and the Highlands and consequently earn relatively high incomes from sales of fresh food (Hanson et al. 2001). People in other parts of the district have very low to low incomes, derived mainly from sales of betelnut, fresh food and, at high altitudes, coffee. Major crop production includes banana, coconut, peanut, and a variety of other vegetables and fruits (Hanson et al. 2001). There is potential for agriculture development in some areas of the Markham and Ramu Valleys, given the moderate to high land potential and good access to markets. Betelnut and fresh food marketing are established smallholder cash-earning activities in these areas (Hanson et al. 2001).
4.3.2 Study site and participating communities

Ragigumpuan and Marawasa communities

The communities covered in this case study comprise Ragigumpuan and Marawasa villages; these are located by the red triangle in Figure 4.1. These village communities are part of the larger group of people known as Amari who populate the Upper Markham Valley region. The villages are about 100 kilometres from Lae, the provincial centre. The Ragigumpuan and Marawasa people inhabit the edge of the valley corridor where the Owen Stanley Range foothills meet the Markham valley floor. The land-use behaviour patterns adopted and currently practiced are underpinned, firstly, by the unique mountain/valley agroecological zone and, secondly, by the cultural interaction between the highlands people on mountains and the valley people. They are also influenced by wider factors including economic opportunities and the availability of infrastructure such as road and bridges.

The understanding of the land-use behaviour patterns of the Ragigumpuan and Marawasa communities described and presented further in Chapter 6 are contrasted against this background and geophysical, infrastructure, agriculture/economic and cultural context.

4.4 Western Province Region

The descriptions provided here present general characteristics of environmental setting in which members of the Yeteni community in the North Fly District and Komovai and Kasa villages in the Lake Murray District make choices between various livelihood strategies. The fieldwork was carried out in the months of July and August 2008, and the methodical approaches described in Chapter 3 were applied in gathering the relevant data.

4.4.1 General characteristics of the study site

Biophysical conditions

Western Province is the largest province in Papua New Guinea; it forms part of the international border with Indonesia on the west and with Australia in the south. The province is characterised by high and rugged mountains in the North and deep valleys of the Upper Strickland, Murray, Wok Feneng and Ok Tedi rivers (Hanson et al. 2001). Approximately 40 km north of Kiunga and Nomad, the landscape flattens into flood plains, plains of hills of the lower Fly, Ok Tedi and Strickland rivers (Hanson et al. 2001). South of Lake Murray, the Strickland River joins the Fly River (Hanson et al. 2001). Figure 4.1 locates the case study region and the province in general.

The Fly River delta and its island cover the southern part of the province. The altitude varies from sea level to over 3000 metres on the Hindenburg Range but most of the province is below 150 metres. Annual rainfall varies between 1500 mm to 8000 mm. Vegetation is generally dry savannah and swampy rainforest in the south and dense rainforest in Hindenburg.
ranges up north (Paijmans 1976). The region is sparsely populated by people who are shifting cultivators, with small groups of predominantly hunter/gathers. The population density ranges between 10 persons per square kilometre in the least populated regions to 26 persons per square kilometre in the south coast plains (Hanson et al. 2001). Traditionally, the majority of people lived along the Fly and Strickland rivers and their tributaries, with the main population densities occurring in the North Fly area around Kiunga where a large area of relatively flat land is well suited for agriculture. The rivers provided much of the subsistence diet and continue to be the main transport route in the province.

The Middle Fly District covers the extensive plains, flood plains and hills of the Fly and Strickland rivers from Nomad in the north to the Fly River Delta in the south (Hanson et al. 2001). The eastern part of the district covers the plains and hills of the Aramia, Soari, Wawoi, Gama, Bamu and Guavi rivers (Hanson et al. 2001). The average rainfall ranges from 2100mm in the Fly Delta to over 4000 mm north of Lake Murray (Hanson et al. 2001). There is long dry season south of Lake Murray (Hanson et al. 2001).

**Accessibility to services**

Accessibility to services is greatly constrained by the limited level of infrastructure development in the province. In the south of the province, Morehead is connected by road to the coast near Daru, but the road is in poor condition and there are few vehicles in the area (Hanson et al. 2001). In terms of transport, an all-weather road built and maintained by Ok Tedi Mining Limited links Tabubil to Ningerum and Kiunga. Outboard motorboats and canoes provide people with transport along the major rivers and on the South Coast.

**Population**

The estimated rural population for North Fly District in 2000 is 35,000. The highest population density is the East Awin Refugee Relocation Area (EARRA), east of Kiunga, with 20 persons/km² (Hanson et al. 2001). This is a camp that opened in 1988 for refugees from Irian Jaya Province in Indonesia (Hanson et al. 2001). Population density in other parts of the district is very low with average of 5 persons/km² (Hanson et al. 2001). In the Middle Fly District, the rural population in 2000 was 42,000. The district has very low population density is 5 persons/km² (Hanson et al. 2001).

**Land potential**

Land potential is moderate to high in the Balimo area, where frequent flooding and poor soil constraints have been reduced by land improvement practices such as drainage, tillage and mound building (Hanson et al. 2001). In the North Fly, land potential is very low to low on the flood plains and plains around Ningerum, Kiunga and Debepare (Hanson et al. 2001). Common constraints are high rainfall, poor soils and frequent inundation. Land in the hills north of Ningerum has moderate potential. Land potential here is low to moderate with steep slopes.
(Strickland Gorge and the Hindenburg Range), high rainfall, and frequent cloud cover as the main constraints (Hanson et al. 2001). In the Kiunga and Nomad areas, land potential is low to moderate with high rainfall, poor soils and frequent inundation as the main constraints. In the Balimo area land potential is low to moderate with similar constraints as other regions of the province (Hanson et al. 2001).

**Agriculture and economy**

While some of the largest resource extractive (mining and logging) activities are taking place in the province, the income and economic opportunities for local people are very limited. People around Lake Murray and along the Fly River earn moderate incomes from sales of crocodile skins, fish and fresh food (Hanson et al. 2001). The people north of Kiunga, around Morehead and along the south coast between the Oriomo and Pahoturi rivers, have low incomes derived from the sale of betelnut, animal skin, fish, crocodile skin and rubber (Hanson et al. 2001). Those in the mine impact area receive income from both royalties and wage employment. Many of the Ok-speaking people who live in the mountains north of Tabubil receive remittances from relatives working at the mine. More recently the mine-impact area has been extended and people living along the Ok Tedi and Fly Rivers below mine site have received compensation payments for the damage caused by mine tailings deposited in the river system (Hanson et al. 2001).

In subsistence food production, sago and coconut are the most important sources of food for many people in the province, and are supplemented by low-intensity mixed staple cultivation.

**Damage to the environment**

The condition of the physical environment in the Western Province, particularly along the Fly River system is affected by the mining activities up steam and at Mt Fubilan. Of particular concern is the major environmental risk associated with the discharge of both acid rock drainage and high concentration of copper in the water system by Ok Tedi Mining limited. This has negative bearing on the land and agriculture potential of the region. As the Ok Tedi Mine Report, Part 4 of the 2006 notes, the environmental and social impacts from these activities were more severe and longer lasting than previously anticipated. Kirsch (2006) also observed that the socio-cultural, economic and environmental impact of these activities on the livelihood systems of the people is enormously great. The Ok Tedi Mining Report Part 4 (2006) notes that increased inundation along the North and Middle Fly regions, affects sago, forest and marine and aquatic lives, thus affecting supply of food and causing food security issues.
4.4.2 Study site and communities

Yeteni (North Fly district)

Research participants in this case study area belong to the Yonggom tribe who live in Yeteni village. The villages are located about one hour downstream from Kiunga township and a further 45 minutes along one of the many tributaries that flow into the eastern bank of the Fly River system. Yonggom people live along the eastern bank of the Ok Tedi and along the banks of Fly River system (Kirsch 2006). This group of tribal people are known to be mobile, moving from village to town, to temporary residences in the forest, or back to their villages or between villages (Kirsch 2006). Kirsch (2006) observes that when people get tired of the limited range of food available in the village, they temporarily retreat to secondary dwellings in the forest where game animals and other wild resources are readily available. Once the wild resources or bush foods become harder to find, people return to the village or move again to a new temporary resident location where new food sources are available (Kirsch 2006; Roscoe 2002). Sometimes the mobility is caused as a result of flooding and meandering of the river system on which they also depend heavily for livelihood necessities such as fish and other aquatic resources. People move to new locations or to higher ground on hilltops during floods and back to the riverbanks during dry seasons.

Between the 1950s and 1960s, the colonial administration and Christian church agents in Western Province pressured these groups of people to abandon their hilltop and swamp land settlements to move them to lower and firmer ground, often consolidating people in large villages along river banks or newly constructed roads (Sir Warren Dutton, pers. comm.; Roscoe 2005), where they could more easily and conveniently be provided with essential services. This led to a range of interactions between the customary owners of the land and those who were relocated, referred to here as landowners and land-users, respectively. As a consequence of extending distances between settlements and traditional foraging reserves, people are beginning to move towards more sedentary agriculture (Roscoe 2002). However, this also meant increasing population pressures on land for cultivation. This is already causing conflicts between landowners and land-users among the villagers, and is likely to affect production and consumption activities in the future.

Komovai village - Lake Murray District

Komovai Village is located near Obo Government Base Camp in the Lake Murray District, Western Province. Komovai people belong to the larger tribal group known as the Boazi. Culturally they share similar production and consumption behaviour as the Yonggom people (Kirsch 2006; Buse 2005; Roscoe 2002). Prior to interventions by the colonial administration, people lived a semi-nomadic life style. Hunting and gathering food from the wild was the mode of production and consumption, with some or limited sedentary agriculture (Kirsch 2006; Roscoe 2002). They moved between temporary bush camps and semi-permanent village
settlements, the movement behaviour is linked with bush-food ripening periods (Roscoe 2002; Kirsch 2006). Settlements were small and they tended to be semi- to fully nomadic, spending most of their time in small, dispersed bush camps but every few months congregating in central large settlements (Roscoe 2002). Sometimes the settlement were larger, typically one hundred to several hundred people. Located for defensive purposes on ridges, hilltops, or small tributaries just off major waterways, these settlements were relatively permanent, with settled periods of at least three years and, more usually, a generation or more (Roscoe 2002).

**Kasa village - Lake Murray District**

Kasa Village is located along one of the many tributaries of the Strickland River, about forty minutes by motorised dinghy from the junction where the Strickland and Fly rivers meets. Culturally, this group of people belong to the Zimakani tribe and they share similar cultural attitudes and behaviour to food production and consumption as the Yonggom and Boazi people.

**4.5 Madang Region — Gogol, Naru and North Coast**

The descriptions provided here present general characteristics of the environmental setting in which the landowners in the Trans-Gogol, Naru and Wasab case study communities in Madang Province make choices between various livelihood strategies.

The fieldwork for this study was carried out between November 2008 and January 2009. Similar strategies and methodologies as described in Chapter 3 were applied in collecting the field data. The village communities involved in the survey included several villages in the Trans-Gogol area, three villages in the Naru area and several villages in the Wasab area (Figure 4.1). The Gogol/Naru case study region lies about 45 minutes drive southwest of Madang town. Wasab is located about one hour’s drive northwest of Madang town.

**4.5.1 General Characteristics**

**Biophysical conditions**

Madang province has a diverse range of environments, from the top of Mt. Wilhelm, the highest peak in PNG, to the coast. Areas include mountains of the Adelbert, Finisterre and Bismark ranges, and the extensive areas of flood plains of the Ramu Valley (Hanson et al. 2001). Figure 4.1 locates the case study region and the province in general.

This case study region covers two districts of Madang Province; Madang and Sumkar districts. Madang District surrounds Madang Town and covers the mountain hills of the Adelbert Range, the Gogol Valley, the upper Sogeram Valley and the coastal limestone plains. The average rainfall ranges between 3200 and 3600 millimetres. The altitude varies from sea level to 1200 metres at the top of Adelbert Range. Sumkar District covers Karkar Island, Bagabag Island, the mountains and hills of the Adelbert Range, and the flood plains of the
Malas, Gilagil and Surumarang rivers. Average annual rainfall ranges between 3000 and 3500 millimeters.

**Population**

The estimated rural population of Madang district in 2000 was 34,000 (Hanson et al. 2001). The coastal plains and Gogol Valley have high population densities, of 68 persons/km² (Hanson et al. 2001). The coastal hills have an average density of 14 persons/km², while the Adelbert Range and upper Sogeram Valley are sparsely populated with 7 persons/km². Coastal hills along the north coast have an average density of 14 persons per square kilometre (Hanson et al. 2001).

**Transport and accessibility**

Madang is connected to Lae, Goroka and Mt Hagen by the Ramu and Highlands highways. The road from Madang to Lae is sealed and a partly-sealed road runs north along the coast from Madang to Bogia and to the Ramu River. Other road systems are running off from the Ramu Highway to Bogadjim and to Saidor along the Rai Coast, but numerous rivers are not bridged and are too dangerous to cross; Bundi to Madang from the Ramu Highway and from the Trans Gogol to Sogeram. People travel from the Islands to the Mainland by sea and air. The road system provides easier access and people in the case study areas require less than one hour travelling to Madang Town for services. People on the coastal plains require less than one hours travel to reach Madang Town, while those in the coastal hills and the Gogol Valley are within four hours travel of Madang (Hanson et al. 2001). The north coast road runs from Madang to Bogia and connects to numerous branch roads that run into the coastal hills (Hanson et al. 2001). The road to Lae passes through the low saddle between the Adelbert and Finisterre ranges into the Ramu Valley (Hanson et al. 2001). Road access in the Gogol and Naru valley is good as a result of regular repair maintenance provided by Jant Pty Limited which has logging concession rights in the area.

**Land Potential**

Land potential in the coastal hills is high, but restricted by steep slopes. The coastal plains have moderate land potential that could be improved through better management of drainage and soil fertility (Hanson et al. 2001). The Gogol and upper Sogeram valleys have low to moderate land potential due to poor soils, high rainfall and annual flooding along the flood plains. The Adelbert Range area has low to moderate potential caused by steep slopes, frequent cloud cover and poor soils (Hanson et al. 2001).

**Agriculture and economic opportunities**

Agriculture in the province is diverse. On the Rai Coast and on Karkar Island, people cultivate low intensity mixed staple gardens. Common cultivated crops include taro, Chinese
taro, yam, banana, sweet potato and coconut (Allen et al. 2002). Agriculture on the coastal plain is dominated by moderate intensity taro and yam cultivation. A wide range of soil fertility maintenance techniques is used, including tillage, raised beds, mounds and legume rotations (Allen et al. 2002). In terms of income, people in the coastal plains have relatively high income derived from sales of copra, cocoa, betelnut and fresh food. In the coastal plains, the fallow period is between 1 and 4 years. Smallholder cocoa production is a strong possibility given that the cocoa industry is already established in the province and is supported by research and extension activities (Hanson et al. 2001). At Gogol and Naru, the industrial tree farming for pulp wood production purposes has been well established due to good access roads, and extension and marketing support provided by JANT Pty Limited.

4.5.2 Study sites and communities

The map in Figure 4.1 shows the study site locations. The case study region comprises three areas; several Gogol villages, several Naru villages, and several villages in the North Coast region. Survey participants from Gogol area comprised villagers from Som, Asikan, Jobtau, Augan, Baisarik, Amaimon, Sundubu and Dogia. At Naru, people from Gonowa, Garim, Barum and Tadup villages were surveyed. North Coast villages surveyed comprised Nagada (Harihaven), Wasab and Matukar. The villages included in this study were mostly commercial tree farmers, who grow Acacia and Eucalyptus trees for industrial wood pulp.

Gogol / Naru

Gogol and Naru case study areas are located 45 kilometres west of Madang town. The study site is linked by all-weather feeder road from the main Madang - Ramu Highway. Participating communities are part the Trans Gogol people. Most of the villages are easily accessed by road. Villages are scattered throughout the valley plain of the Gogol and Naru rivers, living on their traditional land for food, cash and other livelihood outcomes. The case study area has a long history of forestry activities. In 1971, the national forestry administration negotiated the Timber Rights Purchase (TRP) arrangement from the traditional landowners to clear fell primary forest in the Gogol/Naru TRP. A permit was granted to JANT and clearfelling logging operations began in 1972. Logs were processed into wood chips and exported to pulpwood markets. Various studies were conducted to investigate how the Gogol and Naru Timber Project impacted on the livelihood system of the local people within the project area (De' Ath 1980; Lamb 1990). Forestry activities in the area made the Gogol and Naru valleys with road and bridges, and provided meant new opportunities in social and economic activities in the area. In addition to employment, there were opportunities with logging activities, and this also meant increased consumption of store-purchased goods. However, Lamb (1990) notes that socio-economic progress was much slower than anticipated by the planners of the project. Lamb (1990) observes that although many changes had take place, of which some were beneficial, the original assumption that economic benefits would automatically follow the creation of the roads
and the distribution of royalties was simplistic and misplaced. The current land-use patterns, opportunities in different land-use options are now greatly influenced by the historical logging and forestry activities within this region, including tree farming in the region. These aspects are explored further in Chapter 8.

North Coast

The north coast study areas are located along the North Coast Road of Madang Province. The village communities included in the study were Nagada, Wasab and Matukar villages. The north coast study area is similar to the Gogol and Naru study areas. Land-use activities are strongly influenced as a result of past logging and forestry activities within the area.

4.6 Summary of the case study site characteristics and sample populations

4.6.1 Site characteristics

The site locations and general characteristics described above set the stage for the detailed analyses of the land-use decisions processes presented in chapters 5 to 8. While the choices in response to the land-uses were driven by and reflected human elements, the environment in which people live has an important bearing on the decision outcomes between different options, production strategies and the levels of production. As observed throughout this chapter, agricultural and economic opportunities are greatly influenced by factors such as biophysical conditions, population, transport and accessibility, land potential, and agricultural and economic opportunities. These factors were very important determinants in the land-use decision-making processes of the landowners. While human elements regarding physiological and psychological needs as motives in land-use decisions were similar, the environmental conditions determined the decision on which particular land-use option to pursue. As an example, the choice of decision for commercial sugar cane growing in the Ramu Valley was greatly influenced by the biophysical conditions such as good drainage, adequate rainfall, and the gentle gradient of the topography. Good roads and port facilities were extra bonuses in these decisions. The low population density in the area also meant a greater availability of land for commercial production such as growing of sugar. Similarly, the active participation by tree farmers in the Madang region is greatly facilitated by the provision of roads, bridges and market outlets for the trees that are grown by these farmers.

4.6.2 Summary of sample population

The study collected a wide range of field data through field observations, individual and group interviews, and secondary data sources including literature surveys and field reports. Table 4.1 and Table 4.2 provide a summary of the population sampled in this research study. The sample design for this study drew on purposeful sampling strategy by Patton (1990) as the
basis for identifying, selecting and gathering data. The actual methods used by this study are
described in Chapter 3, in particular Section 3.3.3.

<table>
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<th>Case Study Site</th>
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<th>Number of Households</th>
<th>Number of individuals interviewed</th>
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<td>Women</td>
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<td>Sangkiang</td>
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<table>
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<th>Number of people attending</th>
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<td>Western Province</td>
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</tr>
<tr>
<td>Total</td>
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</tr>
</tbody>
</table>

Although children were not included in the actual interviews, they are included here since from time to time throughout the course of interviews, attention was directed to them in order
to break the monotony of tone during interview conversations. This assisted the parents to be more relaxed, appreciative and objective in their conversation on the themes identified by the interview instruments. Secondly, having children next to their parents meant more focussed attention on the part of the parent in the interview process, rather than the nagging worry of not knowing what children are up to when the interview was going on. This behaviour was particularly common with mothers.

4.6.3 Conclusion

The four case study regions presented diverse environments and contexts for the research. In all cases, however, subsistence agriculture is the dominant form of livelihood activity. The purposeful sampling strategy meant that relatively similar size populations were sampled in each case study region. The results of each case study are presented in the following chapters.
Chapter 5: Upper Ramu Region

5.1 Introduction

This chapter presents a qualitative interpretation of evolving patterns in land-use behaviour across five Mari villages in the Upper Ramu region of Madang Province (Figure 4.1). It draws on and uses as a lens the theoretical insights described in Chapter 2, together with the qualitative interpretation framework (presented in Figure 3.1) and methodological procedure described in Chapter 3 to assess land-use behaviour patterns of the landowners. The study explores the primary research question of the basis on which Papua New Guinea landowners make land- and resource-use decisions relevant to tree growing, as part of their livelihood system. The first part focuses on ascertaining a better understanding of the livelihood systems of landowners. It firstly attempts to answer subsidiary research question 1 by describing livelihood strategies of the landowners in the Upper Ramu region. This requires assessment of relevant components of households’ livelihood assets, household engagement in subsistence and cash income-generating activities, household patterns of consumption and expenditure, and household allocation of labour. The second part investigates how these strategies influence landowner households’ land- and resource-use choices. It provides descriptive assessment of households’ decision processes about use of their land and other resources. It describes the relationships between the processes involved in land-use decisions, their connections in the context of the household economy, and other determinants in landowners’ decision environment.

5.2 Livelihood strategies

These sections examine various livelihood strategies pursued by the household to understand how these activities influence their decision about the allocation, distribution and use of their land, labour and other resources.

5.2.1 Subsistence food production strategies

This section examines the role of subsistence food production in the household economy and how it influences the land-use choice of Mari smallholder. Food is an important driver in the land-use choice decisions of rural people. This section discusses the types of food eaten, the types of food production system, and where these systems are practised.

As discussed further in Section 5.2.5 and summarised in Table 5.6, the staple food consumed by Mari households includes sweet potato, banana, yam and taro. Other food crops also grown and consumed are cassava, Chinese taro and a range of vegetables including aibika, Amaranthus spp., bean, choko tips, corn, cucumber and highlands pitpit. Fruit and nuts include mango, Marita pandanus, pawpaw, sugarcane, breadfruit, coconut and variety of other recently introduced species.
Mari people practice four main types of subsistence food gardening systems to produce the range of foods listed above. In addition to gardening, fishing and hunting (of bandicoots and other small animals) activities also form an important part of their subsistence food production efforts. Subsistence food production systems are classified by agro-ecological zones of location and discussed further in sections 5.2.1 to 5.2.4. The Mari’s subsistence food production activities are closely synchronised with the annual weather pattern in the upper Ramu Valley, and have been developed and adapted over time to both cope with and take advantage of the climatic and agro-ecological zones within which Mari people live. Valley gardens provide food during the drier months, which usually comprise about two-thirds of the year, while mountain gardens provide the household food supply during the wet months of the year.

**Hill gardens – taro/ banana and other crops**

These gardens are made on the higher ground of hill slopes, either on grasslands or areas of secondary forest regrowth that has been in fallow for up to 5 years or more. The clearing activities for this type of garden commence about June/July. Grass along the proposed perimeter of a new garden is cut, usually by men, to provide some degree of fire control and the entire plot is then burnt. By mid-August, fencing and burning activities are carried out. Planting, using a digging stick to loosen the soil, commences around August and is completed by the end of September to mid-October. The planting sequence is as follows: first taro, Chinese taro and banana, followed by sugarcane and a range of vegetables including cucumber, bean, corn, tomato and others. Planting is completed over several days and the garden is left to grow; planting is done both by men and women. Subsequent visits to the garden are necessary after a few weeks in order to do weeding (often done by women) and making sure pigs have not entered the garden. Harvest of vegetables and other annual food crops commences about January/February of the following year. Taro and banana are ready for harvest around May in the following year.

**Valley gardens - mixed sweet potato and other food crops**

The second type of Mari subsistence food production system is the valley garden. These are further separated into two general categories. One is characterised by the cultivation of mixed crops such as sweet potato, other vegetables (*pitpit*, pumpkin, corn, sugarcane) and other crops such as tobacco. The other kind of valley garden is characterised by the monocropping of yam, which is seen as a prized food in the Mari culture; it is described below.

Preparation of the mixed garden follows a similar pattern to that of the mountain garden. Land preparation for this type of this garden commences with clearing of grassland and burning-off during the drier months of the year (July to August) and is usually carried out by men. Soil is tilled and prepared during the months of August-September, mostly by men. The garden is planted around November, with a range of crops. The principal one is sweet potato in very small mounds, intercropped with banana, taro, Chinese taro, cassava, highlands and
lowlands *pitpit*, sugarcane, pumpkin, papaw and a variety of vegetables. This garden is ready for harvest around April/May the following year. Mixed sweet potato, taro and other crops are replanted on the same block of land after the first harvest. This garden land is cultivated twice with the same crops before the land is allowed to fallow. The only exception is banana; this is not replanted though the young suckers from the previous cultivation are tended. The fallow period is about five years or more. The fallow period itself is not necessarily an indication of the intensity of land-use as a result of increasing population pressure (Allen *et al.*) 1985, but more of convenience; Mari people prefer to make gardens closer to their homes.

**Yam gardens**

Yam is a prized food for the Mari people. Accordingly, special gardens devoted only to yam cultivation are made. The activities of site preparation and planting for this garden follow a similar pattern of work requirements as that of the mixed sweet potato and taro gardens. Site clearing, involving slashing and burning of grasslands, is carried out by June-July. Soil is tilled and yams are planted in raised mounds or long beds. Men usually carry out site preparation and soil tillage. Gardens are planted around September-October and harvested about May-June the following year. Yam cultivation and harvesting are normally tasks carried out by men.

**Kitchen gardens**

The final type of garden in the Mari subsistence food production system is the kitchen garden, planted adjacent to the residential compounds. It is usually planted with vegetables and other essential food items that can be collected immediately at the time of food preparation.

**Tree crop integration**

In addition to the food gardens, Mari people also cultivate a variety of other important tree crops as part of their subsistence system. Tree crops are planted for a variety of end uses, of which food is the dominant one. The main tree species adopted and grown as part of the Mari subsistence system, their uses, and where they are grown in the production landscape are shown in Table 5.1. Two main types of tree crop integration or agroforestry system are found in the Upper Ramu region. The first type is located next to the homestead, with the main components being coconut, betel nut, mango, *tulip*, oranges and other fruit and nut trees. The second type of tree crop integration system is located away from the homestead and found in old garden sites, along creeks or such places where these particular plants can be successfully grown. Tree components in this system include such species as *Gnetum gnemon*, *Pandanus*, breadfruit, mango and a variety of other economically useful tree species. Tree components are planted at the latter stages of food gardens and left to grow with other bush as they move into fallows. Tending and other maintenance is carried out during this period.
<table>
<thead>
<tr>
<th>Tree/Plant species</th>
<th>% of sampled households growing</th>
<th>Uses</th>
<th>Brief description of crop husbandry and management system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coconut <em>Cocos nucifera</em></td>
<td>100</td>
<td>Coconut kernel is used as food, juice is also consumed and leaf is used for making a variety of products including mats, baskets and brooms. Coconut husk is used as fuel wood, and its wood is used as timber. Coconuts are also grown in extensive holdings as source of income (copra).</td>
<td>Coconuts are planted along village hedgerows; separately in secluded gardens or mixed with other crops, adjacent to hamlets, along tracts or old village and garden sites, in smallholding plantations for commercial copra production. Tending and grass cutting is carried out in the first three years of planting, after which the plants are left to grow. Tree bears its first fruiting five to six after planting and continues to bear fruit for up to 80 years.</td>
</tr>
<tr>
<td>Mango <em>Mangifera indica</em></td>
<td>100</td>
<td>Mango fruits are consumed as food and also sold at local informal markets for cash income.</td>
<td>Similar to coconut trees. They are grown along village hedgerows or in old garden sites. The tree also provides very good shade and therefore finds itself planted alongside residential hamlets. Tree require sufficient sunlight for fruit production</td>
</tr>
<tr>
<td>Breadfruit <em>Artocarpus altilis</em></td>
<td>50</td>
<td>Fruit and the seed are used as a food; cooked or roasted over fire before eaten.</td>
<td>Breadfruit trees are grown in old garden sites or together with coconut and other tree species. Breadfruit trees are grown as part of the food security measure in the subsistence production system</td>
</tr>
<tr>
<td>'Tulip' <em>Gnetum gnemon</em></td>
<td>50</td>
<td>Young leaves, florescence and seeds of the 'tulip' tree are an important source of vegetables eaten cooked. The tree bark is used as fibre for making bilum and other livelihood implements such as traps for catching wild game.</td>
<td>The 'tulip' tree is planted almost everywhere in the landscape; old garden sites, next to village hamlets, or intercropped with coconut, cocoa and other tree species. Young 'tulip' trees are pruned at the top when they reach about two metres in height to encourage formation of strong lateral branches. These are also pruned at 'arms length' distance from the main bole. Optimum sunlight and shade is important for a continued production at all times. Old leaves and branches are regularly pruned to encourage growth of young leaves.</td>
</tr>
<tr>
<td>Betelnut <em>Areca catechu</em></td>
<td>95</td>
<td>For own use as a stimulant; symbolic gestures in cultural exchanges; sales at local market.</td>
<td>Grown in betelnut gardens, usually beside village houses or in old garden village or garden sites. Sometimes planted together with coconut and other cash crops.</td>
</tr>
<tr>
<td>Tree/Plant species</td>
<td>% of sampled households growing</td>
<td>Uses</td>
<td>Brief description of crop husbandry and management system</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Betel pepper</td>
<td>85</td>
<td>Used as a stimulant; sale at the local market</td>
<td>Betel pepper vines are grown on <em>Gliricidia</em>, <em>Leucaena</em> and other small shade trees. These trees are intercropped with cocoa and coconut trees, sometimes along village hedgerows, old garden sites. Important requirement is to grow the trees where they receive sufficient sunlight for production.</td>
</tr>
<tr>
<td>Piper betle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marita</td>
<td>50</td>
<td>Marita fruit is boiled in water and squeezed to extract oil. Extracted oil is nutritious and used to prepare other foods.</td>
<td>Marita tree is planted along water drainages, pathways or other well-watered regions in coconut blocks or in forested hillsides. Young marita seedlings are planted from cuttings. Trees need good tending and sufficient sunlight for fruit production.</td>
</tr>
<tr>
<td>Pandanus julianettii</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avocado</td>
<td>30</td>
<td>Fruit is used as food</td>
<td>Avocado is planted along village hedgerows or adjacent to hamlets.</td>
</tr>
<tr>
<td>Guava</td>
<td>10</td>
<td>Fruit is used as food</td>
<td>Similar to <em>Barringtonia</em>, planted in village hedgerows or adjacent to residential hamlets</td>
</tr>
<tr>
<td>Psidium guajava</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>10</td>
<td>Fruit is used as food</td>
<td>Requires similar husbandry practices to <em>Barringtonia</em></td>
</tr>
<tr>
<td>Citrus sinensis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laulau</td>
<td>10</td>
<td>Fruit is used as fruit</td>
<td>Requires similar husbandry practices to <em>Barringtonia</em></td>
</tr>
<tr>
<td>Syzygium spp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rambutan</td>
<td>10</td>
<td>Fruit is used as food</td>
<td>Requires similar husbandry practices to <em>Barringtonia</em></td>
</tr>
<tr>
<td>Nephelium mutabile</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.2.2 Household cash income generation strategies

This section examines the function of cash income in the household economy and how it influences smallholder land-use decisions, in particular those that are motivated by money. The literature review in Chapter 2 suggests that the need for money in the household economy is an important driver in land-use decisions (Moulik 1973; Curry and Koczberski 2009). This section examines sources from which household income is derived, how it is generated, the number of people who earn it, and how it is spent and what goods and service is bought with it.

Rural people in PNG derive their income from non-agricultural activities (Allen et al. 2009). The agricultural activities include cash cropping and the sales of food crops and processed food products at local markets. The non-agricultural income sources include small retail businesses, transport businesses, sales of manufactured foods, trading as middlemen, paid labour, royalties, compensation, royalties from forestry and logging activities, and small technical trade contract services.

**Household income from agricultural activities**

Income generated from agricultural activities includes that from sales of livestock, cash crops, and household-surplus food and vegetable products at local informal markets (Bourke et al. 2009). This section examines household income generated through agricultural activities and how the motivation for income influences adoption and production decisions of landowners.

**Livestock and cash cropping**

This section describes livestock and cash cropping activities undertaken by the landowners within the case study region, including commercial agricultural interventions. It explains how commercial agricultural interventions were introduced, adopted and became part of the production systems in the case study region.

**Cattle ranching**

Parts of Papua New Guinea are environmentally well suited to a tropical cattle industry as they are free of major infectious and debilitating livestock diseases, and have adequate rainfall (Connell 1979). Cattle were first introduced into New Guinea by the German colonial government at the turn of the nineteenth century (Connell 1979). Most of these cattle were kept on coconut plantations where they served a dual purpose of providing protein for plantation and mission workers and in keeping the undergrowth vegetation of coconut plantations low (Connell 1979). Concern about increasing imports of beef after World War 2 called for a policy initiative to move towards national self-sufficiency in beef production (Connell 1979). A number of strategies were introduced to encourage the establishment and development of this industry. They included free advisory service in veterinary sciences, a freight subsidy scheme on importing breeding stock, establishing experimental livestock stations, and the granting of several large pastoral leases to expatriate farmers who were ex-servicemen (Connell 1979).
Papua New Guinea's Development Bank was authorised to provide loans to the nationally owned cattle projects. This led to increased participation and expansion in a number of smallholder cattle projects throughout the country (Connell 1979).

The introduction and development of smallholder cattle projects in the Mari area and more generally in the Markham and Ramu valleys was part of these policy drives. The data presented in Table 5.2 provides adoption and participation by the Mari smallholders in these cattle projects when they were first introduced. The presentation in Box 5.1 describes farmer experiences and attitudes in the adoption and production decisions relating to cattle projects.

**Table 5.2 Number of households involved in smallholder cattle projects**

<table>
<thead>
<tr>
<th>Community</th>
<th>Number of Households Interviewed</th>
<th>Number of household involved in smallholder cattle projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bopirumpun</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Bumbu</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>Sangkiang</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>Musuam</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

According to these informants, the smallholder cattle projects were owned individually or by identifiable land-owning groups and cattle were raised within completely fenced areas. Initially, cattle projects raised much interest and the expectations of the Mari people, who were motivated by the opportunity for income generation and for new ways to express prestige, fame and identity. However, this enthusiasm dissipated very quickly when the management of cattle projects proved to be very demanding, and especially when it started competing for labour with subsistence food production. None of these projects are in operation today. Many reasons were suggested for the ultimate failure of smallholder cattle ranching, but the main ones were summarized by one cattle farmer from Bopirumpun village, summarised in Box 5.1.

**Sugarcane**

The proposal to establish a sugarcane industry in PNG was first mooted in the 1930’s, with Oro Province as the likely site for a commercial plantation and processing operation (Allen *et al.* 2009; Hartemink 2002). Further proposals arose, one in the 1950s and another in the 1960s, but none proceeded. After Independence in 1975, the PNG Government implemented a plan to establish a national sugar industry for the purpose of import replacement and export diversification (Allen *et al.* 2009; Hartemink 2002). Sites at Gusap and Dumpu in the Upper Ramu Valley were selected ahead of other identified potential sites, on the basis that these regions did not require irrigation or flood protection work (Allen *et al.* 2009; Hartemink 2002). The first sugarcane plantations were established in 1979 with 3 hectares planted in the Ramu Valley. The total area planted to sugar increased rapidly to 1350 ha in 1982 and 6000 ha in 1989 (Allen *et al.* 2009; Hartemink 2002). Currently, commercial cane cultivation and the production
Box 5.1 A smallholder farmer’s experience of a cattle project

"...cattle business was very demanding on my time and labour. I had to leave behind my newly wedded wife to go for training in Sepik for two months.

You must keep the fences and paddock well maintained at all times, if don’t the cow will wonder off and eat some ones else’s garden. That meant you had a problem with the owner of the garden....

I had to bring cattle to Lae in order to sell them and at that time, however, there was no road from here to Lae. That meant I would have to wait for the agriculture extension officers to come and take my cattle to Lae for sale. My wife sometimes got angry with me for not helping her with the garden work. The bank officer was on your back all the time if you were getting behind the loan repayment schedule. Sometimes we killed a cow for a feast in the village and this was not good for the business. Also people stole cows at times. The cattle project was hard work and often no one was there to help you with your cow business work. We (including other farmers) have now converted our cattle grazing land to sugarcane field.

Outgrower schemes for access to customary land

The option for the local Mari people to participate in the growing of commercial sugarcane became available in the 1990s (Allen et al. 2009), as an initiative of RAIL to expand its sugar production. RAIL accessed customary land in two ways, initially through land leases and subsequently through payment of fees based on both land lease and crop harvest.

Under the initial land lease system, the customary landowners of land where sugarcane was to be planted were paid an agreed rate by RAIL for the use of that land. The system operated over large areas until 1998, and provided a risk-free guaranteed income to the landowner, but was perceived by landowners as yielding them a poor return. There was also some concern on the part of landowners that RAIL had complete control over field operations in the leased areas. Consequently, the area made available to RAIL under these arrangements was not as great as the company hoped.

Given these constraints to adoption of the land lease-based scheme, RAIL introduced from November 2000 a system under which receive a land rental/lease payment from RAIL for both fallow and crop growing periods. In addition, landowners receive income from ratoon crops consistent with the government’s price formula, after deducting the costs of cultivation and harvesting. A ratoon crop is the harvest from the regrowth. Several ratoon crops are harvested
from the field before land is fallowed, and are managed with other cover crops. In principle, the
landowners receive two payments per year, based on crop production under the current cropping
regime. Apart from Musuan villagers, who live on the other side of the Ramu River from the
sugar mill, nearly all households or individual members surveyed indicated that they were
participating in this outgrower scheme. However, at the time of the fieldwork, payments of
some six million Kina belonging to the outgrowers were being held by RAIL pending the
outcome of a court case over land ownership (RAIL senior staff members, pers.comm.). This
court case has been underway since 1996.

Adoption and production issues under the outgrower schemes

While the opportunity for cash income generation under the sugarcane outgrower scheme
was relatively high, the landowners could not take full advantage of these for various reasons,
including the issue of the court case noted above. Box 5.2 and Box 5.3 provide insights into the
reasons for this situation.

A number of issues arise from the dialogue reported in these boxes. The first is that of
labour availability and use; RAIL expected landowners to be committing adequate time to the
outgrower scheme, but smallholders are also concerned with subsistence food production. It is
clear from the landowners’ views that the court dispute which has held up payment from the
scheme is causing considerable disillusionment on the part of landowners, and adversely
affecting their relationship with RAIL, even if the company is not responsible for the delays in
payment.

Sugarcane plantings on customary land increased from 800 ha in 1995 to 2,200 ha in 1999.
Between 2001 and 2003, about 150 outgrowers provided land that produced about 30 percent of
the total sugarcane harvest (Allen et al. 2009). However, this area reduced to 1,200 ha and 15%
of production by 2007, because of the ongoing conflicts over land ownership (Allen et al.
2009). The exact amounts to be received by individual households could not be established at
the time of fieldwork due to the ongoing court case between the competing landowner groups.
In addition, the question of who will receive how much was highly a sensitive one to ask Mari
landowners.

The case of sugarcane outgrowing illustrates how Mari people participated in commercial
agricultural opportunities with a large vertically integrated company, and how the company
responded to more limited adoption than it hoped to achieve. It also highlights some of the
challenges that can arise in communities when substantial cash income is associated with land
ownership and use.
Box 5.2 RAIL staff member's perception of Mari outgrowers

...fields are not managed effectively by the landowners, hence the heavy involvement by the company in all aspects of the operation. Our outgrowers have high expectations regarding income from the land, but are either unable or unwilling to make the necessary commitment in terms of time, labour and capital to take full responsibility for their cane.

Box 5.3 Mari smallholder’s perception of RAIL outgrower scheme

...... the land dispute has really affected our lifestyle. We grew sugarcane on our land, looked after it well and then the Company comes and harvest. Working in sugarcane is not easy. We need to also work on our gardens to feed our children.

They pay us for our sweat and labour. We want to grow sugarcane, but we can't because we don't know when Ramu Sugar Limited will pay us our money from the previous crops.

The land is ours, we have already won the court battle over the land ownership right, but why is the company not paying us our money.

Outgrower from Sangkiang village

...... we need money to send our children to school and pickup where we left, and expand our business activities. We also want roads to be improved so that PMVs can come to the village to pick up and drop passengers and goods.

Outgrower from Bopirumpun village

...... we no longer see our attachment with Ramu Sugar Limited anymore. We know RAIL is a friend in the neighbourhood, but we feel as if it is too far for our reach. What can we do?

Outgrower from Bopirumpun village

Oil palm

In terms of value, oil palm is now the most important agricultural export crop in PNG (Allen et al. 2009). Oil palm production expanded at a much greater rate than other export tree crops and now represents about 30% in value of the agricultural crops (Allen et al. 2009). Although oil palm has been grown in PNG since the 1920’s, commercial development did not
begin until 1967 with the establishment of a private/government joint venture at Hoskins in West New Britain Province (Allen et al. 2009). This is still the largest oil palm project in PNG. Other project areas are Bialla (West New Britain Province), Popondetta (Oro Province), Gurney and Sagarai (Milne Bay Province), along the coast south-east of Kavieng (New Ireland Province), and the Ramu and Markham valleys in Madang and Morobe Provinces (Allen et al. 2009). All these development are based on a nuclear estate and smallholder (NES) model, in which a commercially operated estate produces oil palm and also provides a market, processing and technical services for smallholder producers who cultivate oil palm on the land adjacent to the nucleus estate (Allen et al. 2009).

**Opportunities for growing oil palm**

Adoption of oil palm as a cash crop activity by the smallholders is motivated principally by the need for household income and driven by the opportunities associated with established processing facilities, marketing and technical service provided by the nucleus estate (Allen et al. 2009; Curry and Kozeberski 2001). Nationally, the production from smallholder producers represented about 33 percent of the total of 2,171,430 tonnes of fresh fruit bunch (FPB) produced in 2007 (Allen et al. 2009). In the Ramu and Markham valleys, commercial oil palm planting began in 2003, following RAIL’s successful initial trial planting of 14 ha in 2002 (Thomas 2010). The plantings had increased to 7,688 ha by 2009 on the state agricultural leases held by RAIL. (Thomas 2010). These plantings are designated as plantations and are owned by RAIL. RAIL also operates an outgrower scheme for smallholders in the Upper Markham, Upper Ramu and Dumpu regions. RAIL supplies oil palm seedlings to the smallholders and assists them with co-ordination and management of possible pest and disease outbreaks. It also facilitates soft loans to its smallholders through an arrangement with Papua New Guinea National Development Bank.

Similar opportunities exist for the Mari landowners, with substantial technical and infrastructure support (in the form of market and extension information, technical advice provided by RAIL, and the provision for financial assistance from PNG National Development Bank). However, landowners have not responded much to this opportunity. The possibility of landownership conflict among the rival factions is the main deterrent constraining adoption of oil palm. Mari people are still enduring the upset of bitter conflict over land ownership with neighbouring tribes occasioned by the sugar outgrower scheme, as discussed above. This is reaffirmed with recurring comments such as that below, when households were asked about the options for growing oil palm: ‘we wait and see what happens first [referring to the ongoing court battle]. We will do what our clan leaders say’.

Some respondents did view the option of growing oil palm in a positive light, if the financial returns were good, and work was not as intensive or demanding as previously required for growing sugarcane. However, there has been very little adoption by the Mari to date.
Growing and selling peanuts

Growing and selling of peanuts is a major source of income for Mari households. Introduction, production, utilisation and marketing of peanuts as an economic crop in PNG date back to the early colonisers and missionaries (Wemin et al. 2006). Peanuts are an important cash crop among settlers, peri-urban gardeners and remote villagers. Farmers in remote villages appreciate peanuts as a lighter crop to transport to markets compared to other bulky and highly perishable vegetables such as sweet potato, banana and yam (Wemin et al. 2006). Peanuts generate a major portion of the household income in the Highland and along the Markham Valley. Women, in particular, recognise the potential of the crop and devote much time and effort to the production and marketing of peanuts (Wemin et al. 2006). Peanuts are an important cash crop for smallholders because they have a high market value, short growing period to maturity and harvest, and ease in transportation compared to other popular crops like sweet potato (Ramkrishna et al. 2006). The production and demand for peanuts will increase with population increase and the intensification of agriculture (Wemin et al. 2006). In the Highlands, peanuts are mainly grown as a subsistence crop either in rotation with sweet potato or cassava or in mixed cropping with maize (Ramkrishna et al. 2006). Nearly all peanuts produced in PNG are consumed domestically as food, and represent an important part of the diet as a rich source of protein, oil and vitamins, especially to the poorer sections of the community (Wemin et al. 2006).

In the Mari case study region, more than 70 percent of the surveyed households indicated they had grown peanut over the past 18 months as cash income-generating activity (Table 5.3). Prior to commercial sugarcane farming in the region, the growing and selling of peanuts was already the main household cash income activity for the Mari people. When the income from growing sugarcane ceased with the land ownership disputes in 2004/2005, people responded quickly by switching their production factors - land, labour, and capital - to growing peanuts. Some 70 percent of the respondents indicated that they grew two or more crops per year.

Table 5.3 Number of surveyed households growing peanuts for cash income over the last 18 months

<table>
<thead>
<tr>
<th>Community</th>
<th>No of households interviewed</th>
<th>No of households growing peanuts for sale</th>
<th>Percentage of households growing peanuts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bopirumpun</td>
<td>15</td>
<td>11</td>
<td>73</td>
</tr>
<tr>
<td>Bumbu</td>
<td>15</td>
<td>12</td>
<td>80</td>
</tr>
<tr>
<td>Sangkiang</td>
<td>15</td>
<td>12</td>
<td>80</td>
</tr>
<tr>
<td>Musuam</td>
<td>10</td>
<td>6</td>
<td>60</td>
</tr>
</tbody>
</table>

Peanut production

Major costs for peanut production are labour for planting, crop protection, harvest, post-harvest operations and seeds. Land preparation often involves mechanised input in cases where field size exceeds 2500 square metres or more; here, a tractor for ploughing land is hired at a
cost of K200.00 per day. Hired or household labour is used for other operations. Two or three
weeddings are carried out over the life of the crop, and this is done by both men and women. The
first weeding is done 3 or 4 weeks after planting and subsequent ones carried out at the stage
of flowering and again before harvest. Table 5.4 is adopted from Wemin et al. (2006), and
provides data on the production costs of growing peanuts commercially by smallholder farmers.
Observations made by this study are consistent with the data provided in Table 5.4, other than
for the cost of tractor hire.

Table 5.4 Unit costs of peanut cultivation in PNG
Source: Wemin et al. (2006)

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Units</th>
<th>Unit cost (K)</th>
<th>Pers./day</th>
<th>Cost/ha (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tractor</td>
<td>2</td>
<td>1</td>
<td>150</td>
<td>1</td>
<td>300</td>
</tr>
<tr>
<td>Seed (100,000 plants per ha)</td>
<td>3</td>
<td>bags</td>
<td>60</td>
<td></td>
<td>180</td>
</tr>
<tr>
<td>Labour (planting)</td>
<td>1</td>
<td>5 people</td>
<td>8</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>Labour (weed)</td>
<td>3</td>
<td>10 people</td>
<td>8</td>
<td>2</td>
<td>480</td>
</tr>
<tr>
<td>Labour (harvest)</td>
<td>1</td>
<td>6 people</td>
<td>8</td>
<td>1</td>
<td>48</td>
</tr>
<tr>
<td>Stock feed bag</td>
<td>60</td>
<td>bags</td>
<td>2</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>1138</strong></td>
</tr>
</tbody>
</table>

**Marketing of peanuts**

Peanut growers sell their produce in urban centres, and at local and roadside markets. Peanuts are sold in various forms such as fresh in bunches, fresh and loose, dried and loose, roasted in bunches, roasted and loose or dried in bags to suit customer preference. Large growers prefer to sell peanuts dried in bags while smaller growers prefer to sell peanuts in various loose forms at local or roadside markets. Sale prices are highly variable, depending on supply and demand. For example, the wholesale price in the Markham Valley is between K25 to K100 per bag in-season and off-season period, respectively, and retail prices range between K1.40 and K14 per kilogram or about K75/ha (Wemin et al. 2006). Observations from field research at Mari identified similar trends in the pattern of peanut production and sales as those reported by Wemin et al. (2006). The average weekly household income earned from growing and selling peanuts is presented in Table 5.5 provides and discussed below.

**5.2.3 Income from sale of food and other products at local markets**

Local informal markets play an important role in the household economy of rural people in PNG. These informal markets are located in the main provincial or district centres or other outstations and along major road systems. The relevance of these markets in the study of landowner land-use decision process is the influence they bring to bear in terms of the use of time, land and labour of the household.

Local informal markets are a locus for important economic activities for many rural households. People earn cash income from selling food (fresh or cooked) products, animal
products, other plant products including tobacco, firewood, betelnut, betel piper and a variety of other manufactured products including string bags, mats, brooms, clay pots and clothes (Allen et al. 2009). As discussed below, women allocate a significant proportion of their time to marketing activities. Anderson (2008), in a survey of women roadside sellers in Madang Province of PNG, observes that they earned a weighted average income of more than three times the national minimum rural wages (in early 2009, the gazetted weekly rural wage income was set at eighty kina per week).

Labour provision for marketing activities is generally provided by both husband and wife; a study covering a number of provinces in PNG reported that was the case in 58 percent of the sampled population (Fresh Food Development Agency 2008). Marketing was the responsibility of only the wife or the husband in 20 and 17 percent of cases, respectively (Fresh Food Development Agency 2008). These statistics signify the importance of the role of informal markets in the household economy. The relative economic success of informal market sellers relies largely on access to customary land and proximity to major roads (Anderson 2008), and on access to communication and to various assets such as backyard nurseries (Fresh Food Development Agency 2008).

Over 80 percent of surveyed Mari households indicated that they had participated in some marketing activities in the past two weeks. The items produced and sold by these vendors included food items (sweet potato, peanuts, vegetables, coconut, watermelon, cucumber, mango, and ripe banana), betelnut and betel piper, and animal products. These products were sold either at roadside markets or at the Ramu town market, and sometimes in markets at major centres like Lae, Madang or Kainantu. Income derived from these markets also ranged widely depending on the types of product sold and the quantity involved.

5.2.4 Cash income from non-agricultural activities

From the standpoint of the rural population, labour is often the only marketable, non-agricultural commodity that can be readily converted into cash income and so into desired consumer goods and services (Boyd 1981). Other non-agricultural sources of household income include small retail businesses, transport businesses, sales of manufactured foods, trading as middleman, royalties and compensations from land rentals, royalties from forestry and logging activities, and small technical trade contract services (Allen et al. 2009). Within the Mari communities, the main sources of household income from non-agricultural activities are paid labour and royalty payments from land fees. These two sources of household incomes are examined below.

Income from employment opportunities - RAIL

Ramu Agri-Industries Limited (RAIL) is involved in the growing, processing and marketing of a number of agricultural commodities - sugarcane, cattle, and palm oil products.
The company was initially established as Ramu Sugar Limited on state agricultural leases in the Ramu Valley in the late 1970s. From the initial sugar planting of 1350 ha in 1979, the estate increased to 6000 hectares by 1989 (Hartemink 2001). Cane cultivation extended further to 10,000 ha when RAIL successfully negotiated arrangements in 1995, to plant sugarcane on customary land (Allen et al. 2009). Extensive areas of land under cultivation also meant more labour opportunities. While most of the estate's operations (planting, weeding and harvesting) are highly mechanised, local people including Mari households are provided with opportunities to work on tasks that cannot be performed by machinery. These employment opportunities are seasonal and linked with the sugarcane cropping cycle, and are often provided through contract arrangements.

The contractors take out contracts with RAIL and hire employees within the local communities. The task usually takes several days or a week to complete, after which time the contract workers are paid and released. According to the household surveys conducted, all male participants and some of the interviewed females indicated that they had been employed in this way at some stage in the past. The amount of household income is therefore highly dependent on the season, the type of task performed and the rate that is agreed by the contract agreement.

Income from contract work is dependent on the nature of the task required and the hourly rate set for the particular task. The official minimum labour wage in PNG is currently set at K1.70 per hour, although many of the contract workers interviewed were paid between K1.05 and K1.15 per hour. The proportion of available household labour directed to wage employment is discussed in Section 5.2.7. Based on survey data, the average Mari household income from contract employment was about K31.00 per week.

Income from land fees – commercial use of land

As discussed above, RAIL extended its sugar production between 1995 and 1999 by increasing the proportion of cultivation area under outgrower plantings on customary land from 800 to 2200 ha. In return for the use of customary land, RAIL paid rental fees on a regular basis. This was another source of regular income for Mari households, dependent on the area of the household's land put under cane cultivation. However, it was difficult to establish an exact amount of money received by each household or individual during the course of the fieldwork. The court case over ownership rights was underway during my fieldwork and this proved to be a sensitive matter and so it was difficult to ask questions relating how much money households were earning from these activities. As noted previously, from personal communication with senior personal at RAIL, it is estimated that an amount of about 6 million Kina (in 2007) was being held by the company pending the court's finalization of the conflict.
**Income from rural entrepreneurial activities**

Other sources of income from non-agricultural activity include a range of rural entrepreneurial pursuits. These include small retail businesses, transport businesses, sales of manufactured foods, and trading as middleman. In the Mari communities, few of the males talked about being involving in either transport or small retail businesses. At Bopirumpun village, one participant showed me several old trucks and a utility; he said these were used as his transport business. He also owns a tractor, which he hires it out on a daily basis to other villagers in need of assistance in preparing land for growing peanuts, and to RAIL on small contract jobs whenever the need arises. The trucks no longer operate by reason of poor roads, non-payment of services provided to other village members, lack of skills and knowledge in business management, and high operational costs of fuel and mechanical repair and maintenance. This participant expressed his grave concern that, for business activities to prosper, the village economy must be strong enough to support such services. He explained that since the land ownership conflict surfaced, most business activities had collapsed; people were uncertain, and did not want to engage in business activities that did not have a guarantee of future survival. At Bumbu village, a combined liquor outlet and food shop is owned and managed by a family. Informants advised that this trade store has experienced its share of successes and problems. Similarly, at Sangkiang, three of the small trade stores closed their doors for trading, including a bar and liquor outlet. One store was in operation during my fieldwork. While there are one or two exceptional cases, many of the small business activities in the Mari area suffer the same fate as the case described for Bopirumpun. It is difficult to establish how much household income is derived from these entrepreneurial activities since most of them were not operating at the time of fieldwork; those that were operating generated very irregular and inconsistent incomes.

**Mari household cash income - summary**

Table 5.5 summarises the principal sources of income and average fortnightly earnings of Mari households. It is difficult to provide a robust assessment of the income and expenditure behaviour of rural households in PNG: partly because their production and consumption activity patterns are highly irregular and inconsistent, and partly because of low level of literacy of the informants made the gathering of relevant data on household income very difficult. Given that background, the data presented in Table 5.5 is derived from collating and interpreting data from various sources including household interviews, informant experiences, secondary sources, and from other communications and information gathered throughout the course of the study. Thus, while the data presented in Table 5.5, Table 5.7 and Table 5.8 are not precise statements of financial transactions occurring in rural households, they present a valid general impression of the household income and expenditure behaviour of the Mari people.
Table 5.5 Average fortnightly income for Mari households (Kina)*

<table>
<thead>
<tr>
<th>Sources of income</th>
<th>Kina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash crops (peanuts)</td>
<td>112</td>
</tr>
<tr>
<td>Garden produce, betel nuts and other sales (at informal markets)</td>
<td>143</td>
</tr>
<tr>
<td>Off farm employment</td>
<td>60</td>
</tr>
<tr>
<td>Other sales (animal products, but very irregular)</td>
<td>4</td>
</tr>
<tr>
<td>Remittances</td>
<td>- (3)</td>
</tr>
<tr>
<td>Land rental fees</td>
<td>- (4)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>319</td>
</tr>
</tbody>
</table>

* Notes and assumptions:
1. Income from the sale of peanuts: three crops per year; an average sale price of K65.00/bag; an average production of 15 bags per crop per ha; converted to a fortnightly basis (26 fortnights per year).
2. Income from the sale of animal products is very irregular, but treated here as a fortnightly equivalent basis.
3. The fee was a regular income source for the landowners, but due to court battle over landownership claim has been withheld. This money has now accumulated into several million Kina.
4. Land fees - This is the money payable by RAIL to those landowners who had leased their customary land to grow sugarcane. By 2007 this money had accumulated to some 6 million kina. Court resolution of a land ownership dispute is necessary before this money is able to be paid out.

5.2.5 Household consumption and expenditure patterns

This section examines expenditure and consumption patterns of the Mari households and how these patterns impinge on their land-use choices. As observed in Chapter 2, the primary goal in subsistence production strategies is associated with the consumption needs of the household (Todaro 1977; Thomson 1986; Curry and Koczberski 2009). These strategies are often dictated by the range of needs, wants and services the household unit requires for its survival and to maintain its wellbeing (Maslow 1954; MacFadyen 1986). Household consumption behaviour thus has an important bearing on a landowner’s motivation in land-use choices, especially on decisions regarding the use of time, labour and land. The study examined the pattern in food consumption, the types of food consumed, and sources from which the food is sourced, to elicit household consumption behaviour and its bearing on land-use choices. The second part of the analysis examines the spending behaviour of the household.

**Trends in food consumption**

The review presented in Section 2.7 revealed that household consumption behaviour in PNG generally had changed in number of ways over twentieth century. While locally produced food represents around 80 percent of the food consumed by rural households (Bourke et al. 2009), consumption of rice and other imported food items (e.g., wheat products, mutton) has increased from a base of zero at the time of European colonisation in the 1880s to over 26 and 87 percent, for rural and urban households respectively, in 1999 (Bourke et al. 2009). Prior to colonisation, PNG’s staple foods consisted principally of tuberous crops, vegetables, and sago
starches in most parts of the country, and a wide variety of fruits and nuts (Denoon 1981; Lacey 1981). However, the changes in the types of food consumed do not necessarily suggest that the proportion of imported food has completely displaced subsistence food production by the proportion indicated, as overall levels of consumption have increased for many households (Bourke 2009).

**Types and sources of food consumed by the household**

This study observed a similar pattern in household food consumption behaviour of the Mari people to that described above. Data summarised in Table 5.6 resulted from a survey question that asked about types of food and their sources as consumed by the Mari household in the week the survey was conducted. The results for each of the household were collated and analysed. Table 5.6 presents the proportion of total consumption that each type of food represents, and the corresponding sources from which each particular type of food was derived. The data clearly illustrate the high level of dependency of consumption on foods produced by the household, to from friends.

<table>
<thead>
<tr>
<th>Types of food consumed by the household</th>
<th>Proportion of meals in which each food type is consumed (%)</th>
<th>Source derived (self-produced, purchased or given by relatives)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greens</td>
<td>65</td>
<td>Self-produced</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>55</td>
<td>Self-produced or given by friend</td>
</tr>
<tr>
<td>Banana</td>
<td>35</td>
<td>Self-produced or given by friend</td>
</tr>
<tr>
<td>Coconut</td>
<td>25</td>
<td>Self-produced</td>
</tr>
<tr>
<td>Yam</td>
<td>18</td>
<td>Self-produced</td>
</tr>
<tr>
<td>Taro and Chinese taro</td>
<td>18</td>
<td>Self-produced</td>
</tr>
<tr>
<td>Cassava</td>
<td>15</td>
<td>Self-produced</td>
</tr>
<tr>
<td>Bush meat &amp; fresh fish</td>
<td>15</td>
<td>Hunted, purchased at the local market, or given by friend</td>
</tr>
<tr>
<td>Légumes</td>
<td>10</td>
<td>Self-produced, purchased, or given by friend</td>
</tr>
<tr>
<td>Tinned fish</td>
<td>3</td>
<td>Purchased</td>
</tr>
<tr>
<td>Rice</td>
<td>3</td>
<td>Purchased</td>
</tr>
<tr>
<td>Chicken</td>
<td>3</td>
<td>Purchased, self-produced, or given by friend</td>
</tr>
<tr>
<td>Tinned meat</td>
<td>5</td>
<td>Purchased</td>
</tr>
<tr>
<td>Biscuit/bread/flour/scone</td>
<td>2</td>
<td>Purchased</td>
</tr>
<tr>
<td>Pork, beef, other meat</td>
<td>2</td>
<td>Purchased, self-produced, or given by friend</td>
</tr>
<tr>
<td>Bush meat</td>
<td>2</td>
<td>Hunted, purchased at the local market or given by friend</td>
</tr>
</tbody>
</table>

The dominant staple foods grown and consumed by Mari households are sweet potato, greens, yam, banana and coconut; all of these are grown by the household or by others in the
community (Section 5.2). Households in Mari also obtain their foods from other sources, including foods purchased at stores or at local informal markets, and those that are transacted through household exchanges. The types of food purchased are essentially those that cannot be produced by the household; in total, they comprise only about 20 - 30% of food consumption. The cash income earned from land use activities, as described in Section 5.2, is used in these purchases. These types of food include wheat products, flour, canned protein and frozen meat; live chickens are purchased at local markets. Food derived from household exchanges is described in Section 5.2.8 and, as observed there, these transactions are most often carried out with the aim of fostering forging and maintaining relationships.

Aside from food, household consumption includes goods that are purchased from trade stores (shops), including kerosene, soap, detergents, kitchenware, tools, tobacco products, beverages and other essential services such as health, education, transport and mobile telephones that contribute to household livelihoods. These are products that cannot be produced by the households and the cash incomes derived from activities described in Section 5.2.2 are used in the purchases of these goods and services, and expenditure on them is discussed in the following section.

### 5.2.6 Spending behaviour of households

Spending behaviour characterises the types of goods and services consumed by the households, the frequency at which they are consumed, and how much is spent in acquiring them. This data set has an important bearing on the cash income strategies and links directly to the land-use choice decisions of the smallholders. For the purposes of this study the spending behaviour of Mari people is grouped into two broad categories, regular spending and spending on larger items. The former refers to goods and services for which the expenses are incurred on a regular fortnightly basis, and the latter to those items that incur irregular spending, including clothes, tools, kitchenware, building materials and school fees.

#### Regular spending

Regular spending consists of expenses that the household incurs on a regular basis to sustain itself. For the purpose of this study, a fortnightly cycle is taken as the unit of analysis for this behaviour. A household's fortnightly spending includes money spent on acquiring a wide range of goods and services. The data in Table 5.7 originates from survey question that asked households to give an estimate of the amount earned from various sources per fortnight, provided in Table 5.5, and how it is spent. The data demonstrate household spending behaviour, the kinds of goods and services consumed, and gives some indication of their relative importance in the household economy. In the Mari communities, fifty percent of the fortnightly income is spent on purchasing food from the store or market; next in relative importance are essential items such as fuel, detergents and batteries (around 10 percent each), and health and
transport (ten and seven percent, respectively), with the remainder spent on miscellaneous items such as betel nut, tobacco products and donations.

Table 5.7 Mari household fortnightly expenditure

<table>
<thead>
<tr>
<th>Mean weekly spending</th>
<th>Kina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade store: food, drinks, oil, salt &amp; other household needs</td>
<td>80</td>
</tr>
<tr>
<td>Food from informal markets</td>
<td>30</td>
</tr>
<tr>
<td>Kerosene, batteries</td>
<td>20</td>
</tr>
<tr>
<td>Soap, detergents</td>
<td>20</td>
</tr>
<tr>
<td>Health care</td>
<td>20</td>
</tr>
<tr>
<td>Transport</td>
<td>15</td>
</tr>
<tr>
<td>Phone cards</td>
<td>10</td>
</tr>
<tr>
<td>Betelnut</td>
<td>10</td>
</tr>
<tr>
<td>Cigarettes, tobacco</td>
<td>10</td>
</tr>
<tr>
<td>Church donations</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>220</strong></td>
</tr>
</tbody>
</table>

The difference between this average weekly expenditure of around K220 and the fortnightly household income of around K319 (see Table 5.5) is the amount saved towards purchases of larger items. A fortnightly saving of around K99 corresponds to an annual income of around K2575. It is this saving that contributes towards the purchases of larger items such as school fees, other livelihood needs of the households, other reinvestments such as hire of tractors and one-of-a-kind purchases such as animal products (see Table 5.8 for details).

**Spending on larger items**

In addition to the fortnightly spending behaviour observed above, many landowners also plan and budget their income and expenditure on a much longer cycle. These are items not frequently used, but are essential to the livelihood of the households, and therefore people make regular savings over time to acquire them. The study employed an annual cycle as the basis for this analysis. The types of goods and services range widely, but the listing presented in Table 5.8 characterises the kind of goods in this category and how much is spent acquiring them. This expenditure also reflects the relative significance of these items in the household economy.

Table 5.8 Mari household annual spending on large items

<table>
<thead>
<tr>
<th>Spending on large items</th>
<th>Kina</th>
</tr>
</thead>
<tbody>
<tr>
<td>School fees (per child)</td>
<td>1000</td>
</tr>
<tr>
<td>Clothes</td>
<td>150</td>
</tr>
<tr>
<td>Kitchen utensils</td>
<td>110</td>
</tr>
<tr>
<td>Tools (Bush knives, spades, axes)</td>
<td>105</td>
</tr>
<tr>
<td>House construction materials</td>
<td>100</td>
</tr>
<tr>
<td>Exchanges</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1665</strong></td>
</tr>
</tbody>
</table>
Payment of school fees for children to attend school is a very important large item cost for the smallholders. This represents 60 percent of the annual savings; all other items, comprising clothes, kitchenware, house construction materials, tools, and customary exchanges, represent only six to ten percent of expenditure each.

5.2.7 Household labour organisation and distribution patterns

Sections 5.2 and 5.3 presented production strategies of smallholders. Little reference was made there to how significant these activities are in the household economy. This section explores labour organisation and distribution patterns in the household to bring out the qualitative interpretation of how significant these activities are in the household economy. Underpinning this is the assumption that the higher the labour allocation is to a particular task the greater is the level of importance that activity has in the household economy (Deci and Ryan 2000). It also examines labour characteristics, activity patterns, and assesses how much labour is allocated to each of the activities. ‘Time duration’ is the main measure used in defining these activities.

Time-use analysis

‘Time-use’ analysis was applied in assessing household labour organisation and distribution to various livelihood activities of the households. Specific details are discussed in Section 3.3.3 (C.1). Table 5.9 is generated from responses to a survey question about what each household member did in the previous week and what was an approximate amount of time spent performing each of those activities. The responses were collated and analysed. Main tasks performed as part of the livelihoods system were then identified and grouped accordingly. This enabled a distinction to be made, firstly, in the labour division between male/female categories, and, secondly, which activity task was performed by whom.

The production strategies of smallholders were discussed in Sections 5.2 and 5.3, but the significance of these activities are in the household economy was not explored there. This section discusses labour organisation and distribution patterns in the household to explore how significant these activities are in the household economy. Underpinning this analysis is the assumption that the higher the labour allocation to a particular task, the greater is the level of importance that activity has in the household economy (Deci and Ryan 2000). It also examines labour characteristics, activity patterns, and assesses how much labour is allocated to each of the activities. ‘Time duration’ is the main measure used in defining these activities.

Tasks and labour allocation in livelihood strategies

The data presented in Table 5.9 are generated from responses to a survey question about what each household member did in the previous week and the approximate amount of time spent performing each of those activities. The responses were collated and analysed. The main tasks performed as part of the livelihood system were then identified and grouped accordingly.
This enabled a distinction to be made, firstly, in the labour division between men and women and, secondly, which activity task was performed by whom. From this analysis (Table 5.9), up to 10 percent of man’s and 13 percent of woman’s labour in the household unit is devoted to activities associated with subsistence food production. Cash income strategies are devoted with 25 and 12 percent of labour respectively for man and women. In the case of women this includes roadside markets activities. Furthermore, about 26 percent of men’s labour is devoted to off-farm employment activities. The behavioural activities of both man and woman here reflect the importance cash income is in the livelihood outcomes of the household. As such, they are readily willing to commit their labour if and when opportunities for these activities arise. Other important activities include security, house repair and maintenance for men while women include child care, meal preparations, and cleaning of homes.

<table>
<thead>
<tr>
<th>Activities</th>
<th>Women</th>
<th>Men</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsistence food production &amp; fetching firewood</td>
<td>14 hours/week (13.3%)</td>
<td>9.5 hours/week (10%)</td>
<td>Subsistence food production</td>
</tr>
<tr>
<td>Cash cropping</td>
<td>4 hours/week (3.8%)</td>
<td>23.8 hours/week (25%)</td>
<td>Cash cropping</td>
</tr>
<tr>
<td>Laundry/washing and fetching water</td>
<td>6 hours/week (5.7%)</td>
<td>26 hours/week (30%)</td>
<td>Wage employment</td>
</tr>
<tr>
<td>Marketing</td>
<td>8 hours/week (7.6%)</td>
<td>4.8 hours/week (5%)</td>
<td>Other subsistence activities including security to garden and cash crops</td>
</tr>
<tr>
<td>Cleaning (house &amp; yard)</td>
<td>6 hours/week (5.7%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparing meals</td>
<td>32 hours/week (34.5%)</td>
<td>2.9 hours/week (3)</td>
<td>Attending meetings &amp; other external activities</td>
</tr>
<tr>
<td>Minding children</td>
<td>7 hours/week (6.7%)</td>
<td>3.3 hours/week (3.5%)</td>
<td>Minding children</td>
</tr>
<tr>
<td>Other duties (taking care of seniors, sick and others)</td>
<td>4 hours/week (3.8%)</td>
<td>6.7 hours/week (7)</td>
<td>Repairs and, maintenance, House, tool, etc.</td>
</tr>
<tr>
<td>Rest &amp; socialising</td>
<td>18 hours/week (17.1%)</td>
<td>17.1 hours/week (18)</td>
<td>Rest &amp; socialising</td>
</tr>
<tr>
<td>Miscellaneous (making billums, sewing)</td>
<td>6 hours/week (5.7%)</td>
<td>3.3 hours/week (3.5%)</td>
<td>Miscellaneous</td>
</tr>
<tr>
<td>Total</td>
<td>105 hours/week (100%)</td>
<td>100 hours/week (105)</td>
<td></td>
</tr>
</tbody>
</table>

### 5.2.8 Cultural exchanges

Traditionally in PNG, commodities were transferred between individuals in a variety of relationships and contexts. These exchanges occurred in both ceremonial and non-ceremonial events. In ceremonial events, large quantities of food and items of value were assembled by a
number of people to make formal presentations to another group of people for reasons such as bride price payments, other payments to in-laws, making feasts, ceremonies to mark important life cycle events (birth, initiations, deaths), compensation ceremonies, and for making peace following conflicts. Many studies have described such behaviour in PNG society in detail (see, for example, Morauta 1983; Epstein 1962). Amongst the Mari communities, individuals and households perform various transfers and exchanges as acts of hospitality, reciprocity and obligation. These practices are described below.

**Hospitality**

The household transfer that takes place in this form is seen as act of hospitality that often does not carry any expectation of favour in return, either in kind or as services to the recipient. The transfer is conducted with goodwill and is often aimed at building, fostering or maintaining relationships and alliances, and as a gesture of unity between groups of people. The benefit accrued to the performers is recognition, political attention or leadership within the community, status-building and good-standing in the eyes of their peers and the community. The transfers signify and carry measures of maturity, success and prosperity, stability, security and self-attainment between the parties concerned. Food production and other livelihood activities often associated with land-use decision are directed at maintaining such relationships.

The items transferred in this kind of transaction are mostly varieties of cooked food and are consumed immediately. As an example, in 2007 at the same time that I was conducting my fieldwork, the Lutheran Mission Ranara Circuit annual meeting was held at Bopirumpun village. A circuit is church regional unit comprising of several parishes within a Lutheran Church District. The gathering at Bopirumpun village was a week-long event in which church elders, including church district presidents, ministers, women and youth group leaders from all over the circuit met to discuss important developments affecting the circuit and to discuss and resolve plans for the future. The Bopirumpun village community’s collective behaviour prior to and during the meeting is summarised in Box 5.4.

Gatherings of such magnitude and scale have a diversionary effect on other activities central to household livelihood strategies; hence direction and control are organised and delegated from higher order authorities – usually the village elders. Individuals are obliged to take part in the delegated tasks. The success of this planning, operation and execution is based on community cohesion and unity, and the community political system. The example described above illustrates the manner and influences these activities have on the Mari people’s decisions about use of their labour, land, time and other resources in such circumstances.
Box 5.4 Village obligations in a church-related meeting held at Bopirumpun Village

...Other operations in the village production system were temporarily suspended about one month before the actual commencement date of the meeting and the village’s production energy was redirected to the preparation and organisation of the meeting that was to take place. Labour in the village community was directed to building houses and other essential facilities for the guests. Men gathered house timber for house construction while women collected *Imperata* sp. grass as roofing thatch. The amounts of food required for the meeting was planned and gardens were planted some 6 months earlier.

As the countdown proceeded towards the final days, foods (banana, sweet potato, taro, yam) and firewood were gathered and stockpiled in the village square where the proposed meeting was scheduled to take place. Money was contributed toward purchase of trade store goods like rice, sugar, tea, coffee, milk and fresh protein. Youth groups, children, Sunday school groups, and women groups organised and prepared themselves with special items (songs and dance) to perform at the welcome ceremonies for the visiting contingents and for other session throughout the program. Special sub-groups within these groups were organised and delegated with various activities to perform over the period of the meeting. This included food preparation, fetching water and collecting water.

...Villager from Bopirumpun

**Reciprocity and obligations**

Morauta (1983) notes that Papua New Guinea societies are face-to-face societies, and that interpersonal relationships are conducted largely with the framework of kinship relationships. A characteristic feature of interpersonal relationship is embedded in the traditional culture that requires that feelings of affection, pity and friendship be expressed and amplified by material transfers or gifts. In Mari communities, these acts consist of various exchanges that take place between kinship groups and related individuals. Customary exchanges can be made in a form of daily or regular gifts of cooked food, labour for garden or cash cropping activities, various services and cash contributions to signify major events like initiations, death, marriages, adoption and dispute settlements. The relationship they wish to emphasise is expressed by the amount of goods and services and the products exchanged.

Apart from maintaining regular social relationships and friendships, the exchange of labour and food becomes obligatory in circumstance where another member of kin is in dire need of assistance. For example, many of the Mari households explained that events such as losing a house to a fire, or of food shortages resulting from natural disasters, would automatically draw immediate attention from friends and relatives in the community to work together to construct a new house or provide food for the family. Underlying the social networking and its maintenance
is a risk-sharing strategy in the community, based on the principle that if you are down now I help you, and if I am down, you help me.

5.3 Household land and resource-use choices

This section examines the second subsidiary question of how livelihood strategies of the landowners have shape and influence their land and resource-use choices. The behaviour patterns manifested in land-use activities reflect and characterise the range of livelihood strategies that Mari households aspire to achieve on a daily basis. Household land and resources-use choices bring together two economic systems, those of the subsistence and the cash economies. Land-use decisions are made in the context of production systems that focus on feeding and clothing the household; meeting the costs of education, health, transport and communications; and to meet the producers' other needs and social obligations. The primary goals of a landowner are survival, self-sufficiency, minimising risk and maximisation of household incomes to meet basic needs. In addition, social values such as identity, ownership to material wealth and maintaining social networks and relationships are important factors in the process of land-use decision-making.

The study observations also showed that relationships between human needs and the setting of priorities in land-use decisions are consistent with those Maslow (1954) postulated in his Needs Hierarchy Theory. Under this theory, the deficiency in basic needs - such as for food, water and clothing - must be at least partially satisfied before the higher level needs in hierarchy become a stronger motivating factor (Maslow 1954). Table 5.10 reflects this aspect about landowners in their land-use behaviour. The first attribute is the manner in which production strategies align with theoretical needs hierarchy as postulated by Maslow, with the basic need for food and money at the lower end of the needs-hierarchy and moving higher as indicated by the direction of the arrow in the table to higher order needs. The second aspect of the data in Table 5.10 demonstrates the manner in which landowners plan, prioritise and organise land-use decisions. In the main, landowners focus their decisions in three time horizons: the immediate future (principally in relation to food production), annual or similar cycles (principally in relation to recurring cash requirements), and the much longer time horizon (which has significant legacy and intergenerational elements). The data set provides an important articulation point from which a commercial timber tree growing option can be viewed and considered.

Land, labour and financial resources are the principal livelihood assets that landowners own and use. The choices and decisions they make on how to use these resources determines the prosperity and stability in the household, and provides leverage for improvement of livelihoods. Landowners are mindful of threats to their livelihoods from extreme weather conditions such as prolonged droughts or floods and take measures to minimise such risks. This was strongly evident with the different subsistence food production practices that Mari people had adopted.
for the agro-ecological zone in which they live. Apart from meeting livelihood needs and social outcomes, and reflecting risk management strategies, the land-use decisions of smallholders are also dependent on a range of other factors - including crop attributes, the availability of extension and information, and infrastructure and marketing facilities.

<table>
<thead>
<tr>
<th>Scheduling of daily activities</th>
<th>Production strategies</th>
<th>Maslow’s (1954) Needs Hierarchy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Business opportunities</td>
<td>Self actualisation</td>
</tr>
<tr>
<td></td>
<td>Maintaining social capital</td>
<td>Need for love, relationship</td>
</tr>
<tr>
<td>3 years or more</td>
<td>Security</td>
<td>Need for security</td>
</tr>
<tr>
<td>2 – 3 years</td>
<td>Cash cropping</td>
<td>Need for money</td>
</tr>
<tr>
<td>1 – 2 years</td>
<td>Subsistence Gardening</td>
<td>Physiological needs or Basic needs</td>
</tr>
</tbody>
</table>

It is also evident that landowners do make informed decisions about adoption and production choices from a number of given land-use opportunities. While land-use choice is generally based on factors interfacing two economic systems, critical decisions between choices are consistent with what Pannell et al. (2006) described as the ‘relative advantage’ of a particular option. This is clearly evident from the behaviour patterns throughout the case study. For example, the growing and selling of peanuts offered Mari landowners the flexibility to participate in this activity while simultaneously continuing to use land and labour for subsistence gardening. Peanuts as a cash crop had number of advantages, including a quick return time between growing and selling, relatively little input of land and labour and capital outlay required for production, compared to other alternatives, such as option for sugar cane cultivation and cattle, both of which were tried previously. These attributes of peanuts provided the ‘relative advantage’, leading to decisions to undertake peanut growing and selling.

It was also evident that landowners’ decisions are often based on the information available or as a result of the lack of information and knowledge. This also influences decisions about the use of the land, labour and financial assets of the landowners. Landowners’ decisions about the adoption and participation in smallholder cattle projects, for example, was made with different expectations by the landowners – a new way of building status and wealth. However, when the new activity competed for labour with the pre-eminent food production, people became disillusioned and abandoned the project. People were not adequately informed about opportunities in relation to cattle projects when they were being encouraged to adopt them as part of their production systems.

This study also notes the significance of extension services, infrastructure and marketing services in the decision process of landowners. The study notes that the success of sugarcane cultivation on customary land under the outgrower scheme is attributable to the extension
services provided by RAIL. The increasing accessibility and areas of customary land under sugar cultivation prior to the emergence of serious conflict over land testify to the interest of Mari landowners in using sugarcane production opportunities to generate household income.

Similar behaviour in land-use activities was noted with the introduction and adoption of oil palm production in adjacent communities. While success is being enjoyed by those landowners who are participating, it also opens up an avenue for conflict by others within the community, in particular landownership conflicts. This is the case with Mari landowners who are now defending their rights to ownership against other rival parties for the land on which sugarcane is being grown. The successful adoption and participation of landowners in sugarcane cultivation can also be attributed to the infrastructure and marketing services being provided by RAIL. These points illustrate the complementary roles that corporate interests and smallholders can play in commercial crop production, as well as some of the pitfalls in PNG.

5.4 Conclusion

It is clear from this case study that proposals for changes to land use and production systems, including commercial timber tree growing, should begin with consideration of what outcomes the landowners expect, particularly in terms of the significance of cash income and subsistence food production in the household economy. Both are important factors in land-use decisions. It is apparent that the choice of a particular land use option should not compete for land, labour and financial assets of the landowner in such ways that it affects the outcomes of subsistence food production in major ways; and it will only be adopted in preference to other cash-generation options if it is judged likely to deliver more or comparable cash income, at equal or lower risk, to current options. Behaviour patterns and case study observations in the case region exemplify this attitude of landowners. The implications of these issues for commercial tree growing are discussed further in Chapter 10.
Chapter 6: Upper Markham Valley Region

6.1 Introduction

This chapter presents qualitative descriptions of landowners’ behaviour patterns in land-use activities observed at Ragigumpuan and Marawasa in the upper Markham Valley case study region. As with Chapter 5, it explores the primary research question of the basis on which Papua New Guinea landowners make land-use decisions as part of their livelihood system. The first part focuses on answering the first subsidiary research question which aims to ascertain a better understanding of the livelihood system of the Upper Markham Valley people. Here, I describe relevant component of household livelihood assets, household engagement in subsistence and cash income generating activities, household patterns of consumption and expenditure, social and cultural organisations and household allocation of labour. The second part (Section 6.7) I investigate how these strategies influence landowner households’ land-and resource-use choices.

As with Chapter 5, the discussions are organised around the landowner decision-environment (Figure 3.3), where I use the insights from three theoretical constructs described in Chapter 2; Maslow’s Hierarchal Needs theory, the Sustainable Livelihoods Framework and the Farmer Adoption Decision Framework to assess landowners’ needs and aspirations, and their attitudes and perceptions and how these affect their land-use choices. This focuses on unveiling the underlying perceptions, attitudes and motives of landowners, and how they link together and are also influenced by the wider economic, management, social and cultural norms and biophysical conditions of the decision-environment. It provides a detailed assessment of how smallholder choices, behaviour and attitudes bear on decisions about subsistence food production, cash income strategies, food consumption, risk management strategies, household exchanges and opportunities in rural entrepreneurial activities.

6.2 Livelihood strategies

This section presents a qualitative interpretation of the land-use behaviour patterns of Ragigumpuan and Marawasa smallholders to ascertain their choices and attitudes in relation to livelihood strategies, including subsistence food and cash crop production. This assists achieving a greater understanding of the relationship between the processes involved in land-use decisions and the household economy and the wider community in which these people operate. This section is focussed on food production systems, tree crop integration, and adoption strategies in response to the changing situation in which the Amari people find themselves.

6.2.1 Subsistence food production system

The food garden systems in this case study region are similar in their broad characteristics to the ones described for the Mari case study region. The regions are some 20 kilometres apart
and share similar biophysical and climatic factors. However, the production and consumption behaviour and the opportunities available to landowners are quite different between the two regions, with significant implications for land-use behaviour patterns. The staple food consumed by Ragigumpuan and Marawasa households includes sweet banana, sweet potato, and yam. Other food crops also grown and consumed are cassava, Chinese taro and variety of fruit and vegetable.

Two major types of gardening systems were observed. The first type of food garden is located on the valley floor of the Markham Valley, consisting of a flat grass-covered plain and terraces. In this garden system, banana, sweet potato, taro, cassava and a variety of vegetables and fruits are grown for consumption by the people. The other type of garden is made on the steep foothills, covered by grass and forests, and mountains where yam, taro and other mixed vegetable are cultivated. The observations described in this study are consistent with those reported in upper Ramu Valley described in Chapter 5. The following description provides specific details observed in these systems.

**Valley floor gardens**

Two main types of food production strategies are practiced in the valley floor garden system. The first type of valley food garden is the valley gardening system, grown with mixed food crops, often with sweet potato dominating but followed by a variety of vegetables, taro and cassava. Gardening cycles and the rhythm of daily subsistence production activities generally follow the weather pattern in the upper Markham Valley region, which is characterised by June to September being the drier months of the year with a wetter period between November and March. Land preparation and clearing of the new garden site, especially those planted with a variety of vegetables, banana, taro, sweet potato, cassava, cucumber, and watermelon, is made during the dry season of the year. The garden preparation task involves clearing of the garden boundary, burning of grass and tilling of soil on the proposed garden site. Soil preparation involves tilling, digging of holes to plant banana suckers. These tasks are performed by mostly by men, while women attend to the tilling and mound-building where sweet potato is grown. Planting resumes just before the onset of the wet season and planting tasks are performed mostly by women, although men are also involved in this activity. Three to four weeding take place between time of planting and the first harvest. Women do most of the weeding, but men also assist in the task. Women perform most of the harvesting and carrying tasks.

The second type of food garden observed in the case region is located adjacent to rivers and streams and other well-watered places. This type of food garden is planted predominantly with triploid bananas and can be intensively maintained for up 10 years or longer (Bourke 2002) after the first planting. Based on information from the participants interviewed, some of these gardens continue to be used for up 20 years. Participants’ estimates were based on their own age, and time since childhood. This study observed that banana gardens are often converted
from other mixed food crop valley gardens described earlier. In this way, the household labour is saved from the initial land and boundary clearing activities that would otherwise be required in making this garden. Planting of banana suckers takes place during the harvesting period of the former garden. The task of growing bananas involves weeding and clearing where necessary, holing and bringing of banana suckers to the planned site. Men often perform these tasks, the carrying usually by young women. Young banana suckers are planted directly into the hole. Bourke et al. (2002) observed various vegetables, lowland pitpit, sugarcane, beans and cucumbers are also planted in the garden after the young banana have become established. Garden maintenance tasks such as weeding, pruning of dead or dying leaves, removal of dead stems after harvest, clearing and spacing of suckers, bagging and wrapping of fruit to prevent damage from bats are important parts of the production and management strategies in this gardening system. Men mostly perform these tasks, though women also assist. Tasks associated with harvesting of food, cleaning and preparation, and transportation of food are usually performed by women.

**Hill gardens**

Mountain gardens are predominantly planted with yams, taro and a range of other vegetables. No banana is grown in this garden. Participants reported similar reasons to those provided by Mari smallholders for having mountain and valley gardens, that is, to adapt themselves to the annual weather cycle. Garden site preparation, planting weeding and harvesting patterns are similar to the valley gardens, and are closely linked with annual weather patterns. The tasks of clearing garden perimeter boundaries, cutting and burning cover vegetation (either grass or forested land), tilling of the ground or making holes with digging sticks in a new garden is mostly performed by men. Women undertake the collection and preparation of stock material for planting, transfer them to the garden site, and do the planting of other crops in the new gardens. It is mostly men who planted the yam seedlings or sprouts. Weeding of mountain garden is a female dominated task. Harvesting of food, cleaning and preparation and transportation from gardens is performed by women for crops other than yam, while men perform similar tasks associated with yams.

**6.2.2 Tree crop integration**

Ragigumpuan and Marawasa landowners' also cultivate a variety of trees species within their production landscape. They do this for a number of reasons, principally for food and to increase the diversity of livelihood outcomes in the household. Tree species, shrubs and other types of plants recorded by this study included coconut, mango, breadfruit, orange, lemon, and many locally important timber tree species. Trees supply food supplements, in the form of fruits and nuts, or are used as a means of earning cash. Timber trees provided people with building materials, fuelwood, and shade as well as shade and soil stabilisation along creeks and water holes. Table 6.1 lists the tree species, their uses and where they are grown by the case study.
Managing and maintaining productivity in this kind of integrated system requires a good understanding of crop physiology and interactions between different components of the system. This includes crop spacing, soil drainage, soil depth, soil fertility, shading and interactions at different crown cover levels and structures, and of crop protection and pest management systems including fire hazard. Fire risk is managed by growing trees that have generally higher levels of robustness and tolerance to fire hazards, or by keeping clean fire breaks. In the case of such natural events, or those that might arise from other causes, tree crops can be converted into cash incomes to meet the need for food and other necessities.
6.2.3 Changing trends in subsistence system

While they are well adapted to suit specific biophysical and climatic regions, the subsistence production systems described in earlier sections are not static. They can also succumb or respond to changes in the production environment. The theoretical underpinnings for this human behavioural-phenomenon are widely discussed in the socio-economic, cultural and biophysical environment literature. A number of authors (e.g., Rogers 1995; Pannell et al. 2006; Guerin and Guerin 1994) describe the changing behaviour of people in a changing production environment, particularly in agriculture-related fields; this is a process of adoption, adaptation and diffusion in efforts to improving their quality of life. This process involves concepts such as relative advantage, complexity, trialability and observability (Rogers 1995; Pannell et al. 2006). These concepts have been described at length in Chapter 2.

This section examines how Ragigumpuan and Marawasa people are responding to the changing production environment and as a result are influenced by it in their land-use decision processes. For the Ragigumpuan and Marawasa communities, the production environment has changed in a number of ways in the interviewees’ memories. These ways include a deteriorating state of their natural resources, increased interaction with other cultures and people, as a result of increased incidence from natural causes such as disasters and new opportunities. These have influenced the ways in which smallholders make land-use choices. Evidence based on the comparison between the findings from this study and those previously reported attempt to illustrate these aspects. For example, Bourke et al. (2002) observed the increasing importance of sweet potato and cassava in the types of food produced and eaten over the last 50 years in the region. Sweet potato is a staple food in the neighbouring highland regions. The continuous interaction through intermarriages and other exchanges that exist between the upper Markham and the neighbouring Kainantu people of the Eastern Highlands Province is a possible route for the increased sweet potato cultivation in the former region to become more established and more acceptable as a main staple.

This view is widely postulated in the geography and crop adoption literature (for examples see Brookfield and Hart 1971, among others). Furthermore, from a smallholder’s decision perspective the productivity attributes of the crop give sweet potato a relative advantage over older crops such as taro (Wijmeersch 2001). Cultural factors also have an important bearing on the land-use choice decisions of smallholders. Bourke et al. (2002), citing Read (1948), noted that yam is culturally more important than banana, but in terms of the amounts consumed, banana and sweet potato were more important than yam. Yams are of course highly seasonal where as banana and sweet potato are produced and consumed on a regular basis by the landowners. Other changing behaviour patterns in the smallholder food production strategies include increasing cultivation of peanuts, use of tractors in the ploughing of land before planting and the movement of groups of people from settlements near the sides of the valley to be closer to the main road going through along the valley floor (Bourke et al. 2002). The increased
production of peanut cultivation in the region is motivated and influenced by opportunities for cash income associated with roadside market activities (described in Section 6.3.1).

This study observed from an account provided by a survey participant at Ragigumpuan notes that the village settlement has moved three times in living memory of the current generation. A number of reasons were given for moving the village settlement. Ragigumpuan village is situated on the valley side of the landscape where the Markham Valley meets the Owen Stanley Ranges foothills. The slow drainage from the catchment affects food gardens as well as accessibility to and from the village during the annual wet season. Furthermore, it is normal in this area for villages to move location every 10–20 years; this is partly related to the danger of falling coconuts from palms as they grow taller, but also the renewal of houses as roofing becomes old and leaking. Village movements can be motivated, firstly, in the search for higher ground closer to the mountain foothills (and away from flooding creeks) and, secondly, to reduce the distance to forest resources on which community members heavily depend for shelter and fuelwood needs. This is discussed further in the Section 6.2.4. Other considerations in the land-use decisions of smallholders related to crop characteristics such as suitability for integration with other crops that have already been adopted into the production system. Bourke et al. (2002) observe that one peanut cycle takes about three months, and that this timing fitted in well with yam growing; as a result, peanuts have become the most important cash crop in the system.

6.2.4 Subsistence tree growing – a case of community land- and-resource-use decision-making

The changing behaviour patterns observed in land-use decisions are often underpinned by the shift in equilibrium normally associated with the resources supply and demand situation, or caused as a result of an emerging opportunity. This situation has an important bearing on adoption and production decisions of smallholders. The observation described in the previous section demonstrates how people assess their circumstance and make necessary adjustments in their livelihood decisions in respond to changing situations. Here the choice of a particular land-use option is made internally in the mind of the decision-maker. In situation where the common interests of a particular group are affected, the decision-making process involves community consultation and deliberations. This decision process is a dynamic one that involves group meetings, deliberations and negotiation. The need for group involvement in the process of resource management decisions is well recognised since land rights are held by kinship groups, not by individuals. This decision process is an example of a participatory approach typical of community-based forest management (see, e.g., FAO 2001), where ‘community forestry’ is understood as ‘a situation that intimately involves local people in forestry activity’ (FAO 2001).
A case of community land-use decision-making process

At Ragigumpuan and Marawasa communities, young village men responded collectively when they had to travel longer distances than previously to collect timber for constructing new houses. After a lengthy process of community consultation and deliberation, a decision was made to set aside community land specifically to grow trees to provide house construction timber. Part of the conversation describing the context in which this group decision was deliberated and arrived at is presented in Box 6.1.

Box 6.1 Summary of interviewees’ descriptions of a community land-use decision-process, Ragigumpuan and Marawasa communities

1) In the valley there is no forest from which we can cut the right kind of timber with which to construct our houses.

2) We walk long distance over the mountains to reach our forests to cut poles, timber and collect vines to construct new houses. This often takes 2 hours or longer to walk to the forest, another 6 hours spent collecting materials for house construction and another 2 hours or so to return to the village.

3) After cutting we have to work hard to carry the timber back to the village.

4) It is difficult a task especially for us, the young men, to endure the hardship of cutting and carrying these building material for house constructions.

5) Because of this situation we decided that we should grow trees in our gardens. This will save our labour from travelling long distance and also the hardship in carting the materials over the rugged terrain.

6) We posted an agenda for a village meeting with the village councillor, who then convened a meeting in the village where we discussed our concerns with the rest of the village members and eventually resolved to grow trees.

7) The community agreed and land next to the village was allocated, and we then started growing trees.

The first statement in Box 6.1 describes the situation as seen and experienced by the young men in the community. The situation has a serious negative implication for the ‘young men’ of the community. They felt most vulnerable as a result of the diminished state of forest resources. The use of the noun ‘we’ (Statement 2) separates and emphasises that they are the most affected part of the community as result of this diminished state of forest. They express their experience, hardships and the labour they have to endure and link this with matters concerning the shelter needs of the community (statements 3 and 4). The message was deliberately phrased in this way in order to convey and connect their hardships associated with the community’s shelter needs to the wider community. In statement 5, a decision is proposed. That proposal is then brought to the attention of community, following the usual protocol and village hierarchy system (Statement 6). Statement 7 describes the endorsement of the proposal by the community.
Following this sequence of events, a very active subsistence tree-growing program began to take place at Ragigumpuan and Marawasa villages. The villagers took the initial steps, and support from RAIL followed; subsequently, the ACIAR FST 2004/050 Project provided further support. Under the supervision of both RAIL and Papua New Guinea University of Technology (PNGUoT), a social survey was conducted. Basic nursery training and tree seedling production nurseries were developed and conducted at Ragigumpuan village. A particular area of mountainside behind Ragigumpuan village, mainly covered with *Imperata* grass, was earmarked and allocated for the village tree program. *Eucalyptus pellita* and *Tectona grandis* tree seedlings were raised at the temporary village nurseries and planted on the earmarked land. During the course of fieldwork in this study, a total of 970 seedlings of both species were collected from the RAIL nursery and supplied to the villages.

At Marawasa, a family took the initiative and planted just under 2 hectares of their land with a number of tree species including *Eucalyptus pellita*, *Tectona grandis* and Kwila (*Intsia bijuga*). The ACIAR FST 2004/050 Project provided funds and assisted its PNG partners to establish a small community nursery with a production capacity of 5000 seedling at Marawasa. One challenge amongst others the smallholder faced with this tree growing endeavour was the lack of basic technical skills for the production of good nursery seedlings. The ACIAR ACIAR FST 2004/050 project identified this limitation at the project implementation stage and has now developed a basic forestry nursery guide. This should assist smallholder tree growing initiatives in the upper Markham Valley and other regions where people have similar enthusiasm.

**Why didn’t the tree-growers individually make decisions to grow trees?**

This question of why the decision to grow trees was not made individually was raised at the group meeting that was held with the villages. The explanation provided in response to the question is paraphrased as follows. In the upper Markham Valley region, like in many other parts of PNG, land tenure is based on a privatised customary ownership and use system that operates according to locally established norms. Based on the account of Ragigumpuan and Marawasa community informants, a wide range of rights including land inheritance, use, access and control is vested in customary landowning groups and their individuals. As observed by Fingleton *et al.* (2005), these ‘land groups’ are kinship-based; while final decisions regarding land and other natural resources can be made at different levels of any of these groups, the most important of these are made at the clan level. Different rights may apply to different natural resources on the same parcel of land (AusAID 2008; Fingleton *et al.* (2005). Implications of this for the decision-making processes, especially on the choices about economic trees, have to be discussed openly in order for the individual landowning group members to be fully informed, and so decide whether to participate or not. At Ragigumpuan and Marawasa communities, economic trees (such as coconut, mango, timber trees, and variety of fruit and nut trees) are individually owned but are planted on clan land; individual members plant and look after their
trees. In this production system, a bona fide clan member can garden, harvest, use and manage natural resources on any part of the clan estate.

**Group responsibility, weed and fire risk management strategies**

It was also explained that, in the group land-use decision process, the group is obligated to assume responsibility for crop protection and management. In other words, individual members are tied by the group decision to individually take responsibility in ways that ensure that the planted forest will be well looked after and managed. For example, in a community like theirs, where burning ‘kunai’ grass is a common and annual occurrence, fire protection will be critical for the successful establishment of tree growing activities. The group land-use decision process is a transparent way of individuals taking responsibility in their attitudes towards the management and control of burning grass. This is very important since the need for growing trees concerns the cooperative wellbeing of the group.

The study also noted that growing number of tree-growers plant their trees on the same parcel of land together with food crops. Tree seedlings were planted together with banana and other food crops at the same time, or at some later stages in the service life of the food garden. This was explained, firstly, as a way of managing the weeds from overtaking the planted trees and, secondly and more importantly, as a way of minimising risk of fire destroying planted trees. By planting both food and tree crops together, labour efficiency in weed management is expedited and fire is prevented from destroying planted crops. This example also demonstrates how people adopt new crops to fit within the existing production strategies without placing much stress on those strategies.

### 6.3 Household cash income strategies

As observed in the introductory part of Section 5.2, rural households in PNG derive their income from two primary sources. The first source of income comes from agricultural activities and includes cash cropping, sales of food and other processed products at local informal markets. The second source of income comes from non-agricultural activities and includes off-farm employment and a variety of rural entrepreneurial activities. Other sources may include remittances from relatives working in urban centres. However, this source was found to be negligible for the case study communities.

This section examines various income opportunities pursued by smallholders in the two communities in the Upper Markham Valley, their influence on land-use choices, and how these affect household labour organisation and distribution, and in turn contribute to the expenditure and consumption behaviour of the people. This section is particularly concerned with various sources of income, how they are earned and how they are expended to affect the quality of people’s lives in the case study region.
6.3.1 Income from agricultural activities

**Roadside marketing**

The main sources of household cash income in the case study region include the sale of betel nut, peanuts, fresh foods, coconuts and a variety of fruits such as mango, pineapple and cucumber at roadside markets along the main highway. Bourke et al. (2002) made similar observations. While an assumption in economic thinking postulates informal market activities as marginal, using few skills, limited technology and capital (Anderson 2008), to the contrary, informal markets form an important part of the household economy in many rural societies of PNG. For example, Anderson (2008), quoting from Sowei et al. (2003), notes that the average informal income (kina per fortnight) were K315, K248, K260, and K275 for Central, East New Britain, Morobe and Western Highland provinces respectively. Compared to the current minimum rural labour wage of K160 per fortnight, the informal market can be seen as a more attractive financial option for rural households. Successful participation of smallholders in this activity is characterised by number of factors including access to good land for production, reliable means of communication to provide market data on daily basis, good transport and access facilities and outlets for where the produce can be sold (FPDA 2008; Anderson 2008).

Accordingly, access to roadside markets has a very important bearing on smallholder land-use choices, their labour organisation and distribution, and associated land-use behaviour. Section 6.6 describes how much household time and labour of smallholders is directed to informal marketing activities. Women in Ragigumpuan and Marawasa spend, on average, up to 10 hours a week taking part in roadside market activities. This excludes time and labour spent on tasks involved in the preparation of produce such as cleaning, bundling and packaging. Furthermore, Table 6.6 in Section 6.5 does not include the time and labour of men working on tasks directly involved with informal marketing activities. Men may, for example, assist with the transportation of produce to the house from gardens and again to the market. This study observed that women roadside sellers can earn between K120 to K160 per day. Ragigumpuan and Marawasa women on average spend 2 days in a week at roadside markets. Average fortnightly income from roadside market activities is K560 and represents 42 percent of the total fortnightly income earned by the household. This is based on K140 (mid-point) multiplied by 4 days fortnightly spent at the market. Produce traded at these roadside markets include betelnut, betel pepper, tobacco, coconut, mango, watermelon, peanuts, banana, taro, a variety of fruits and vegetables, processed products and varieties of imported products. Processed products also sold at the roadside market included ice blocks, cooked or roasted peanuts, biscuits and variety of other small goods. Anderson (2008) observed that roadside vendors at Wararais market earned between K1000 and K2000 per week. This is a difference of about 33 percent when sales of peanuts were also included in the calculation of average income. The difference observed could be attributed to a number of factors. Firstly, the time of the year in which surveys are
conducted can be critical. Anderson's study was carried out during the month of December, when the number of travellers during the Christmas and holiday period is at a peak along the highway passing through the Watarais market. This meant more sales with the increased number of customers travelling during this period. On the other hand, the survey for the study being reported here was conducted in the month of October and the numbers of people travelling during this time are relatively low. A second reason for the difference is due to price fluctuation with betelnut supply and demand. Betel is a major commodity sold at these markets and when supply becomes low it quickly affects the price and this, in turn, has a significant bearing on incomes earned by the roadside sellers. Anderson (2008) notes that his survey was conducted during the period when supply of betel nut was low and so the price was high. This could be a factor contributing to the observed difference.

The income from roadside market depends greatly on the products being sold, the location of the market and the frequency of participation. For example, the Watarais market - where Ragigumpuan and Marawasa women normally sell their produce - is located at the junction where the Highway forks, with one road leading to the Highland provinces and the other road going towards Madang. The high rate of earning by vendors is due mainly to the volume of people travelling along the highway, especially people from the five Highland provinces. Also, the Watarais market is the last market in the valley for Highland-bound travellers to buy coast- or lowlands-produced goods such as coconuts, watermelon, mangos, and betelnut, none of which are grown in the highlands. This means that a Highlands-bound traveller who has not bought any of these goods on the coast at other markets must buy these items at that market regardless of the price, if they are to fulfil their social obligations. This gives Watarais an advantaged location for its roadside market.

The concern for this study is, firstly, to assess the frequency of participation and how this bears on land-use decision processes of smallholders and, secondly, how this in turn influences the expenditure and consumption of smallholders. These discussions are presented below in sections 6.4 and 6.6 respectively.

**Cash cropping**

Apart from peanut growing and selling, smallholder cocoa is other cash cropping activity observed in the region. However, evidence from the literature suggests that attempts by the colonial administration to introduce cash crops were only partially successful (Bourke et al. 2002). This were attributed by a number of factors, including lack of market infrastructure, market uncertainties, poor crop pricing leading to lower input/output ratio of introduced cash crops such as cocoa and copra as opposed to road side sales of peanut, betelnut, mangoes and other commodities.
Oil Palm

Commercial plantings of oil palm in the upper Ramu and upper Markham valley region began in 2003 (Thomas 2010). Smallholder participation in growing oil palm began somewhat later, around 2007 and 2008. This is in part due to the establishment of a processing facility for palm oil by RAIL, a subsidiary of the New Britain Palm Oil (NBPO), in the neighbouring Ramu Valley. RAIL provides access to the market for smallholder growers and also management support and assistance in accessing financial support from the National Development Bank.

A palm oil processing mill was constructed for RAIL at Gusap and commissioned in 2008 (Post Courier 2008). The factory processes 56,196 tonnes of fresh fruit bunch annually with 124 tonnes of this produce coming from smallholder growers. These figures are based on statistics for 2008 and 2009, when smallholder plantations were only some two years old. This will have increased markedly subsequently, since the smallholder crop has gone into full production. Based on estimates by Bourke et al. (2009), a smallholder grower earns about K362 per tonne from the sale of fresh fruit bunch; the yield estimate based on current production figures for estate plantation production in the Ramu and Markham valleys is about 14 tonnes/ha/year. Based on these figures, smallholder income from growing oil palm is about K5014 per hectare annually.

Growing and selling peanuts

Crop characteristics, production behaviour, costs involved in the production and marketing of peanuts in this case study region are very similar to the description provided for the Mari case study region in Chapter 5.

The growing and selling of peanuts forms a very important part of the Ragigumpuan and Marawasa people’s livelihoods system. It is perhaps the major cash cropping activity, with wide participation by smallholders in the region. Almost all households interviewed for this study indicated that growing peanuts was an income generating activity. Tasks involved with growing of peanuts include land preparation, planting, weeding, harvesting and post-harvest handling. Land preparations include clearing a boundary for the proposed peanut garden site, burning off of grass, ploughing (mostly using a tractor), and preparing a planting bed. Planting includes seed preparation and sowing. Weeding is carried out three or four times during the crop cycle. Harvesting includes uprooting, freeing soil from the uprooted stock, and separating nuts from the plant stock. Post-harvest work includes drying, packaging and storage before transporting the produce to markets. Apart from the ploughing of land, nearly all the tasks mentioned are carried out by manual labour, labour that is provided by relatives, or other villagers who may reciprocate a favour from a previous engagement. Usually Food is usually provided in this labour exchange. Table 5.4 provides an outline of the main types of costs involved in peanut growing and marketing. As mentioned in Chapter 5, smallholders in the case region on average produce three crops of peanuts per year on an approximate cycle of 100 days. Bags of peanuts
are sold for between K25 and K100 during the season and off-season respectively (Wemin et al. 2006).

6.3.2 Income from non-agricultural activities

Employment opportunities within the case study region are inconsistent and therefore treated as negligible. Apart from truck drivers who are normally based in and operate out of Lae, most the participants interviewed were not in active employment during the survey, nor had they been employed during the previous three months. This made it difficult to compare and correlate data; hence some generalisations were derived from the variety of data sources.

The fieldwork for this part of this study was conducted in 2007, when employment opportunities in this region did not exist. However, it is worth noting what employment possibilities existed at the time of writing this thesis. The commercial growing of oil palm in the Upper Ramu and Upper Markham valleys began in 2003, but smallholder participation did not get under way until late 2007 and 2008 (Thomas 2010). As noted above, a palm oil processing mill was constructed at Gusap, neighbouring this case study region. This development at present provides employment to some 844 people at the mill (Post Courier 2008). Further employment opportunities exist in the estate plantations with field-related activities when the estate goes into full production. It is possible for the people in the neighbouring villages, particularly Marawasa, to benefit from these emerging employment opportunities.

6.3.3 Summary of household income

Table 6.2 presents sources of income and average amounts of money earned fortnightly by Ragigumpuan and Marawasa households. It is difficult to provide a robust assessment of the income/expenditure behaviour of rural households as the data for these analyses are often irregular and inconsistent. This, combined together with the low level of literacy and numeracy skills, makes communication a great challenge in collecting data for such research work as this. Data presented in Table 6.2 is produced from extrapolating and collating data from various sources including household interviews, informant experiences, secondary sources as well as data from various communications and information gathered throughout the course of the fieldwork. As such, the results are reliant on data provided by a wide range of sources and analyses, and the use of these data should have a caveat with that background. While the data provided is not a precise statement of the financial transactions that take place in rural households, for the purpose of this study it does forms a valid impression of household income and expenditure behaviour of the Ragigumpuan and Marawasa people.
Table 6.2 Household incomes from various sources (Kina)*

<table>
<thead>
<tr>
<th>Sources of income</th>
<th>Kina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash crops (oil palm K193; peanut K113)</td>
<td>306</td>
</tr>
<tr>
<td>Garden produce, betel nuts, fruits and other produce</td>
<td>560</td>
</tr>
<tr>
<td>Total</td>
<td>866</td>
</tr>
</tbody>
</table>

* Assumptions:
- Peanuts: Income from peanuts is based on the following assumption: three crops per year multiplied by an average sale price of K65/bag, multiplied by 15 bags per crop on 1 ha of land, multiplied by three crops in year, divided into 26 fortnights per year.
- Oil Palm: Fortnightly income from growing oil palm is estimated at K5014 (annual income per hectare in production) divided by 26 fortnights per year.
- Sales from informal markets: K140 per day, multiplied by 4 days per fortnight spent on this activity.

6.4 Household expenditure and consumption behaviour

There were similar trends in the patterns of household food consumption behaviour as observed in other regions. Data presented in Table 6.3 resulted from a survey question asked about the types of food and their sources as consumed by Ragigumpuan and Marawasa households within the week when this survey was conducted. The results for each of the surveyed households were collated and analysed. Table 6.3 provides data on the proportion of types of food as a percentage of total consumption, together with the corresponding sources from which a particular type of food is derived. The data demonstrate how household food consumption behaviour influences household land-use decision-making processes. The data show the pattern of household food consumption behaviour, noting the types of food, the amounts as a percentage of total consumption, and illustrate the linkage between production and consumption. The staple food consumed by Ragigumpuan and Marawasa households are bananas as the main food, sweet potato, greens, coconut, yam, and a variety of fruits. This food is grown entirely by each household. The list of food consumed by the surveyed household is also consistent with the types of food grown in the garden (Section 6.2.1), showing linkages between food grown and food consumed. In addition to subsistence food gardens, households in Ragigumpuan and Marawasa also obtain their food from other sources. These include foods that are purchased at stores or at local informal markets and those that are transacted through household exchanges. The types of food purchased are essentially those that cannot be produced by the household. The cash income earned from land use activities described in Section 6.3.2 is used in these purchases. The types of food include wheat products (such as flour), canned protein and frozen meat, and live chickens purchased at local markets. Food derived from household exchanges is described in Section 6.5 and, as observed there, most often these are transactions that are carried out to forge, foster and maintain relationships between individuals, families and larger groups.
Table 6.3 Types of food consumed and sources from which the food is derived

<table>
<thead>
<tr>
<th>Types of food consumed by households</th>
<th>Proportion of meals in which each food types is consumed (%)</th>
<th>Source (self-produced, purchased or given by relatives)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greens</td>
<td>65</td>
<td>Self-produced</td>
</tr>
<tr>
<td>Banana</td>
<td>55</td>
<td>Self-produced or given by friend</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>35</td>
<td>Self-produced or given by friend</td>
</tr>
<tr>
<td>Coconut</td>
<td>25</td>
<td>Self-produced</td>
</tr>
<tr>
<td>Yam</td>
<td>18</td>
<td>Self-produced</td>
</tr>
<tr>
<td>Taro and Chinese taro</td>
<td>18</td>
<td>Self-produced</td>
</tr>
<tr>
<td>Casava</td>
<td>15</td>
<td>Self-produced</td>
</tr>
<tr>
<td>Bush meat &amp; chicken</td>
<td>15</td>
<td>Hunted, purchased at the local market or given by friend</td>
</tr>
<tr>
<td>Legumes</td>
<td>10</td>
<td>Self-produced/ purchased/ or given by friend</td>
</tr>
<tr>
<td>Tinned fish</td>
<td>3</td>
<td>Purchased</td>
</tr>
<tr>
<td>Rice</td>
<td>3</td>
<td>Purchased</td>
</tr>
<tr>
<td>Tinned meat</td>
<td>5</td>
<td>Purchased</td>
</tr>
<tr>
<td>Biscuit/bread/flour/scone</td>
<td>2</td>
<td>Purchased</td>
</tr>
<tr>
<td>Pork, beef, other meat</td>
<td>2</td>
<td>Purchased/ or self-produced or given by friend</td>
</tr>
<tr>
<td>Bush meat</td>
<td>2</td>
<td>Hunted, purchased at the local market or given by friend</td>
</tr>
</tbody>
</table>

Aside from food, other household consumption items purchased are trade store (shops) goods including food, kerosene, soap, detergents, kitchenware, tools, smoke, beverages and other essential services such as health, education, transport, mobile telephone that contribute to household livelihoods. These are products that cannot be produced by households and the cash income derived from activities described in Section 6.3 is used in the purchases of these goods and services. Table 6.4 and Table 6.5 present household expenditure behaviour for regular and large items, respectively. These items are defined as in Chapter 5: ‘regular items’ refers to goods and services for which the expenses are incurred on a fortnightly basis, and larger items refer to those purchases that occur irregularly. These items include clothes, tools, kitchenware, building material and school fees.
6.4.1 Household spending behaviour

Table 6.4 Household fortnightly expenditure

<table>
<thead>
<tr>
<th>Mean weekly spending</th>
<th>Kina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade store: Food, drinks, oil, salt &amp; other household needs</td>
<td>120</td>
</tr>
<tr>
<td>Food from informal markets</td>
<td>40</td>
</tr>
<tr>
<td>Phone cards</td>
<td>30</td>
</tr>
<tr>
<td>Kerosene, batteries</td>
<td>30</td>
</tr>
<tr>
<td>Soap, detergents</td>
<td>30</td>
</tr>
<tr>
<td>Transport</td>
<td>40</td>
</tr>
<tr>
<td>Health care</td>
<td>20</td>
</tr>
<tr>
<td>Church donations</td>
<td>10</td>
</tr>
<tr>
<td>Betel nuts</td>
<td>10</td>
</tr>
<tr>
<td>Cigarettes, tobacco</td>
<td>10</td>
</tr>
<tr>
<td>*Purchase of goods for sale at markets</td>
<td>250</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>K590</strong></td>
</tr>
</tbody>
</table>

*Note: this amount of money is set aside for the purchase of other commodity items that are not produced by the household. This includes betelnut, biscuits, sausages, cordial and variety of other manufactured goods.

From these data, the fortnightly household income is K866 (Table 6.2) and expenditure is K590 (Table 6.4). The difference is the amount saved towards purchases of larger items. Fortnightly savings are about K275, or K7,159 annually when multiplied by 26 fortnights in a year. Savings made from fortnightly income and spending then contribute towards purchases of larger items like school fees and other livelihood needs of the households.

6.4.2 Household spending on large items

Table 6.5 Ragigumpuan and Marawasa household spending on large items*

<table>
<thead>
<tr>
<th>Spending on large items</th>
<th>Kina</th>
</tr>
</thead>
<tbody>
<tr>
<td>School fees</td>
<td>1,600</td>
</tr>
<tr>
<td>Tractor hire (K300/day* 4 planting seasons in a year)</td>
<td>1200</td>
</tr>
<tr>
<td>Generator set, videos, CDs</td>
<td>3,500</td>
</tr>
<tr>
<td>Clothes</td>
<td>200</td>
</tr>
<tr>
<td>Kitchen utensils</td>
<td>150</td>
</tr>
<tr>
<td>House construction materials</td>
<td>130</td>
</tr>
<tr>
<td>Tools (Bush knives, spades, axes)</td>
<td>180</td>
</tr>
<tr>
<td>Exchanges (including 'Basket senis')</td>
<td>100</td>
</tr>
<tr>
<td>Customary exchanges</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7180</strong></td>
</tr>
</tbody>
</table>

* Spending on larger items are usually accumulated over a year

Table 6.4 and Table 6.5 provide an indication of household income and expenditure pattern, respectively, of smallholders in the case study region. Forty-two percent of fortnightly income earned by households is redirected towards the purchase of other tradable goods sold at roadside market. A number of reasons exist for this. Firstly, the Wararais market is ideally located and offers smallholders an excellent opportunity to sell goods, especially to buyers travelling the highway between Lae, the Highlands provinces and Madang. Because it is an ideal market location, people in the region benefit from the opportunity to also buy and sell
goods that are not produced within their local region. For example, betel nut was once extensively cultivated in the Markham Valley but can no longer be grown as a result of a disease that destroyed the nut-bearing palm. Betel nut is imported from other regions and sold at this market. Vendors also bring in other products to conduct trade at this ideal location. This is a relative advantage for smallholders, and influences their land-use choice decisions.

6.5 Household exchanges and socio-cultural activities

As observed elsewhere (for example, Morauta 1983), food plays important roles in the social and cultural processes of Papua New Guinean people. Read (1948) observed that production and cultivation of banana as food has played an important role in signifying initiation of young man, marriage, mortuary and other important cultural ceremonies, and also in maintaining extended family network system in the Upper Markham Valley region. These socio-cultural exchanges continue to exist in the region and, somewhat has a bearing in the way decisions about use of labour, land and financial resources of the households.

6.6 Household labour organisation and distribution patterns

Sections 6.2 and 6.3, above, described household production strategies. Little attention was given there to how significant each of these activities were in relation to the overall economy of the household and other determinants in the land-use decision environment. The following discussion examines how various activities performed as part of the livelihood strategies of the people in this area, how much labour and which part of labour is allocated in performing various livelihood activities in the household.

6.6.1 Tasks and labour allocation in livelihood strategies

‘Time-use’ analysis was applied in assessing household labour organisation and distribution to various livelihood activities of the households. Specific details are discussed in Section 3.3.3. Table 6.6 is generated from responses to a survey question about what each household member did in the previous week and what approximate amount of time was spent performing each of those activities. The responses were collated and analysed. The main tasks performed as part of the livelihood system were then identified and grouped accordingly. This enabled a distinction to be made, firstly, in the labour division between male/female categories, and, secondly, which activity task was performed by whom.

Time use was used to assess the importance of the activity tasks described in the production and consumption strategies in sections 6.2, 6.3, 6.4 and 6.5; here I examine how these tasks and strategies influence bear on the smallholder choices in their land-use decision processes. It is assumed here that the significance of a particular task is directly proportional to the amount of time allocated in performing that activity. The underpinning assumption of this
notion is found in the motivational theories previously discussed. The contemporary theories of motivation, for example, assume that people initiate and persist in carrying out a particular behaviour to the extent that they believe that behaviour will lead to a desired outcome (Maslow 1957; Deci and Ryan 2000). In this case, the ‘persistence of behaviour’ refers to the amount of time actually committed in performing a particular activity, and indirectly represents the corresponding value of that activity in the consideration of smallholder land-use decisions.

As observed in Chapter 5, for the purposes of this study, the duration of time spent on a particular activity was used as a measure to assess land-use behaviour patterns of Ragiumpuan and Marawasa households. This is expressed as a percentage of the ‘total active hours’. The ‘total active hours’ refers to the duration of time from 6 am to 9 pm (15 hours per day).

### 6.6.2 Tasks and labour allocation in livelihood strategies

Table 6.6 was generated from responses to the survey question about what each household member did in the previous week and what was an approximate amount of time spent performing that activity. The responses were collated and analysed. The main tasks performed were then identified and grouped. The analyses of these data also made it possible to distinguish labour division between male/female categories and the assignment of time to the performed individual tasks.

<table>
<thead>
<tr>
<th>Activities</th>
<th>Time (Total active hours/week)</th>
<th>Activities</th>
<th>Time (Total active hours/week)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours %</td>
<td></td>
<td>Hours %</td>
</tr>
<tr>
<td>Subsistence food &amp; fetching firewood</td>
<td>10 9.5</td>
<td>Subsistence food production</td>
<td>19 20</td>
</tr>
<tr>
<td>Cash crop</td>
<td>10 9.5</td>
<td>Cash cropping</td>
<td>38 40</td>
</tr>
<tr>
<td>Laundry/washing and fetching water</td>
<td>6 5.7</td>
<td>Wage employment</td>
<td>nil nil</td>
</tr>
<tr>
<td>Marketing</td>
<td>10 9.5</td>
<td>Other subsistence activities</td>
<td>9.5 10</td>
</tr>
<tr>
<td>Cleaning (house &amp; home yard)</td>
<td>10 9.5</td>
<td>Cleaning around house</td>
<td>4.8 5</td>
</tr>
<tr>
<td>Preparing meals</td>
<td>30 28.6</td>
<td>Meetings &amp; other external activities</td>
<td>2.9 3</td>
</tr>
<tr>
<td>Child Care</td>
<td>7 6.7</td>
<td>Minding children</td>
<td>4.8 5</td>
</tr>
<tr>
<td>Caring for senior family members</td>
<td>4 3.8</td>
<td>Repairs house maintenance, tools, etc.</td>
<td>4.8 5</td>
</tr>
<tr>
<td>Rest &amp; Socialising</td>
<td>15 14.3</td>
<td>Rest &amp; socializing</td>
<td>14.3 15</td>
</tr>
<tr>
<td>Miscellaneous (bilums, sewing)</td>
<td>3 2.9</td>
<td>Miscellaneous</td>
<td>2.9 2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>105 100</strong></td>
<td></td>
<td><strong>100 105</strong></td>
</tr>
</tbody>
</table>
The data in Table 6.6 demonstrate how household labour is divided and allocated between different categories of household outcomes. From this data, 30 percent of the total available time of Ragigumpuan and Marawasa women’s time is spent on activities other than food production or cash cropping, this time being used for cooking, food preparation, collecting of firewood and fetching water. Resting and socializing takes 15 percent, followed by marketing, cash cropping and cleaning at 10 percent each. The remainder of the time is taken up by the care of elderly relatives, minding children and other miscellaneous tasks. Ragigumpuan and Marawasa men, on the other hand, spend 60 percent of their total active hours on subsistence food production and cash cropping activities. Specific details of the types of activities performed are described in sections 6.2 and 6.3. Peanut growing and selling and the more recent participation in oil palm growing, are important activities for men and take 40 percent of the total available time. This followed by subsistence food production at 20 percent with rest and socializing following at 14 percent. Helping women with marketing activities represents about 10 percent.

6.7 Land- and resource-use choices in the Upper Markham Valley

6.7.1 Introduction

The discussion presented in Section 6.1 to 6.7 focussed on the livelihood strategies of the Wankung and Marawasa landowners, and described how landowners make land-use choices in response to subsistence and cash economic opportunities, risk aversion strategies, labour allocation and distribution, production and consumption behaviour and other social obligations. This section responds to subsidiary research question 2 and discusses how these strategies influence landowner land-and resource-use choices. Here, I use the insights from the theoretical constructs presented in Chapter 2 (Section 2.2) to assess landowners’ needs and aspiration, and their attitude and perceptions and how they affect their land-use choices. The discussions are accordingly organised around Landowner Decision Environment model presented as Figure 3.3.

6.7.2 Motives and land- and resource-use decisions

The study also observed that the land-use decisions of Ragigumpuan and Marawasa landowners were consistent with Maslow’s Hierarchal Needs Theory. While opportunities in terms of crop adoption, adaptation and production decisions differed somewhat, from each other, similar livelihood strategies were noted as observed in Section 5.3 (see Table 5.10) where land-use decisions were aligned with production activities of landowners. The basic needs, including the need for water, for food and for clothing are satisfied or partially satisfied before the higher order needs such as love, security and self actualisation may become factors for motivation. The decision time-horizon is also similar to the observations made for the upper Ramu region. Ragigumpuan and Marawasa landowners also focussed their land-use decisions
on three time horizons, namely on the immediate future (in relation to food production), on the annual or similar cycles (for recurring cash requirements), and on the much longer-term (for legacy and intergeneration elements). The behaviour patterns just described present important consideration points with which decisions about commercial timber tree growing opportunities could be articulated.

6.7.3 Livelihood assets of the landowners

Land, labour and financial assets are very important livelihood resources owned and used by Ragigumpuan and Marawasa landowners. The choices asset-owners make about how these assets are to be accessed and used determines and provides prosperity and stability in the household and the wider society. Observations in this study show that adoption and production decisions in land-use choices, particularly the choice of cropping and methods of production, resulted from and accompanied a wide range of interacting extant factors in their decision-environment. These include threats from natural calamities, the existing biophysical conditions, and agricultural and economic opportunities. So, for example, the mountain and valley gardens, as noted in Section 6.2, are an adoption by people in response to extreme weather conditions such as flooding that have adverse effects on their livelihood systems. Landowners also recognise if a condition is placing them in a vulnerable situation.

The diminishing state of the traditionally owned forest resources in the community prompted people to respond by planting trees for subsistence uses. Different types of food gardens are part of the risk management strategy adopted by the people of Ragigumpuan and Marawasa in preparedness for any possible natural calamities. Increasing use of tractors in ploughing, for example, and changing behaviour patterns in terms of the foods being consumed, in particular sweet potato, are other noticeable changes among the Ragigumpuan and Marawasa communities. This has also influenced landowners’ production practices. Economic opportunity is another important determinant in landowners’ decision-environment. The increasing use of tractors to plough land has been motivated by peanut growing and selling. Peanuts are an important cash income crop for the Ragigumpuan and Marawasa communities, and the use of tractors in the recent past has enabled landowners to significantly increase their peanut production. Increased production means greater incomes for households.

6.7.4 Adoption and production decisions

Economic opportunities with peanut growing and selling are attributed to the ideal location of a roadside market that provides easy access to the Ragigumpuan and Marawasa communities to bring their produce for sale. Large numbers of people travelling on the highway between Lae, the Highlands and Madang are major customers for peanuts. Road access and market location can be seen as key determinants in providing this opportunity. As observed above, peanut growing and selling has a number attributes that make the crop an ideal choice when different
crop options are being considered. This is consistent with what Pannell et al. (2006) described as 'relative advantage'. This also shows that landowners do make informed judgements about their land-use decisions. Money is not the only motivation in land-use decision considerations. In 2007, smallholder oil palm was introduced into the region but not everyone took an interest in participating in this opportunity. There were negative perceptions about oil palm in that there were fears about soil nutrient drain and other possibly bad environmental effects. This also suggests that a lack of good communication and extension can affect the adoption process somewhat for new interventions such as oil palm. Good communications here includes packaging the right kinds of information so that they can be easily internalised and then form the basis of judgement in the landowners' land-use decisions process.

Adoption and production choice with timber tree growing was another decision landowners took in light diminishing forest resources. Here as the case study showed, decisions to grow timber trees as house construction and fuel wood material were considered and rooted within the broader set of livelihood and social strategies discussed above. Decision about tree growing began with landowners' and community needs. In this region, people had already begun subsistence tree growing in response to the shrinking size of their forests and the increasing distance to travel to acquire those timber products from their natural forest reserves. Subsistence needs for timber products to build residential houses in the village was the principal driver for this action. Opportunities for commercial tree growing could be channelled and promoted through the current interest about subsistence tree growing. Smallholders could be made aware of the opportunities associated with options for commercial tree growing. For example, smallholders could be encouraged also to plant high value timber tree species such as teak, kwila and rosewood in addition to trees for subsistence uses. This should be facilitated and demonstrated by good communication and extension strategies, backed-up with a package of key technical guides that can guide smallholders on and on which they can base their decisions. Both commercial and subsistence tree growing have been well adopted and form an important part of the economic system for smallholders in some other regions of the country. The incorporation of commercial balsa trees with food production and other cash cropping activities in East New Britain Province is one good example (Midgley et al., 2009). Examples observed during the course of this study in the Trans Gogol and Naru valleys in Madang Province also demonstrate the willingness of smallholders to participate in growing trees for industrial wood production.

6.7.5 Conclusion

As with Chapters 5, 7 and 8, land- and resource-use choices and adoption decision of the landowners were characterised by the strong interface between subsistence food production and cash income maximisation strategies. These were driven by the need for secured food sources, the growing need for the consumer goods by the household, and the need to access essential
services such as children’s education, health, communication and transportation. In addition to these basic needs, social network and maintaining stability within cultural and kinship ties was noted to be an important motivational factor in the landowners’ land- and resource-use choices. As with other regions, the study also noted that land, labour and financial resources were important capital assets landowners possessed, owned, and used individually in different ways to better their situations. An exception to this may be in situation where community as a whole is affected and therefore collective decision was required for making adoption choices to address that particular need.

The example of this was noted in the Ragigumpuan community, where a decision about subsistence tree growing was reached after a community process of discussion and consultation. In this example, the group decision process not only paid attention to cultural norms about crop ownership and its tenure, but as a process it committed individuals within the community to take ownership and responsibility to protect the planted tree crop from fire. In this case, the risk of fire on the tree crops’ was a major concern and resolution of this risk was a significant part of success of the process. The study also noted that, while adoption and production decisions are greatly influenced by the opportunities and challenges, decisions on the scale or rate of adoption differed between individuals and households depending on personal preferences, circumstances and situations. It was further noted that these choices also depended how these opportunities or challenges fitted with other livelihood outcomes of the decision-makers. The opportunity to grow timber tree within the food gardens, and so use labour efficiently and minimise the risk of fire to the planted trees crop, was also considered from this perspective.
Chapter 7: Western Province

7.1 Introduction

This chapter describes livelihood strategies of four case study communities in Western Province. The village communities directly involved in this study were Yeteni in the North Fly District and Komovai and Kasa villages in the Lake Murray District. These village communities belong to the Yonggom, Boazi and Zemakan tribes respectively. The approximate location of the case study communities is shown in Figure 4.1.

As in Chapters 5 and 6, the first part of the discussion focuses on answering subsidiary research question 1 where I describe the livelihood strategies of households in the case study communities. I assess the relevant components of livelihood assets, household engagement in subsistence and cash income generating activities, household patterns of consumption and expenditure, and household allocation of labour. The second part (Section 7.7) explores how these livelihood strategies influence landowners’ household choices in their land- and resource-use decisions. Here, as in the other results chapters (5, 6 and 8), I use the insights of the theoretical constructs described in Chapter 2 to assess landowners’ needs and aspirations, their attitudes and perceptions, and their motives and how these affect their choices in the land-use decision-making process. The discussion is organised and presented based on the Landowner Decision Environment model described in Figure 3.3.

7.2 Livelihood strategies

7.2.1 Subsistence food production strategies

People across the three case study communities in this region share similar cultural attitudes to food production and consumption activities. Accordingly, a single summary is presented encompassing production, consumption, exchanges, and risk aversion behaviour for the three communities. Individual cases are mentioned specifically only where an emphasis may be needed to elicit issues affecting land-use choices in different ways.

The staple food consumed by the typical Western Province case study household comprises sago, banana, fish, vegetables and wild fruits, coconut and yam (Table 7.3). Other foods include sweet potato, cassava and a variety of other vegetables and wild fruits, and hunted animal products. As discussed in Chapters 5 and 6, decisions about strategies for securing food profoundly influence parallel decisions regarding use of time, land and labour in other activities. Time and labour allocations to various activities of the household are presented in Table 7.7 and discussed in Section 7.5.

Subsistence food production strategies across the communities of Yeteni, Komovai and Kasa are dominated by foraging, hunting, fishing and gardening activities. The household food production strategies in these communities are described below.
7.2.2 Foraging

Roscoe (2002) defines hunter-gatherer groups as those who derive at least 75 percent of their subsistence calories by collecting wild resources (plant, animal and marine). In Western Province, the sago palms that grow in the swampy valleys are the most important source of food for the people. These, together with aquatic resources and limited game, make up 90 – 96 percent of daily calories of the Moian, Yulawas, Komovai and Kasa people (Roscoe 2002).

The production of sago flour requires several days of intensive labour every fortnight. Men fell the palms and split open the hard outer bark of the trunk; women then process the soft interior pith of the palms with wooden pounders. The starch-bearing, pounded pith is carried to tubs made from black palm leaf base (TP: *limbum*), where it is washed with clean water and squeezed with hands to separate the starch from the fibres. The separated sago starch accumulates at the bottom of the tub reservoir where it is collected and left in the sun to dry before being transported home and stored for use.

In addition to sago starch production, other foraging activities include food collection from a wide range of nuts, fruits and vegetables in the forest. The most common are breadfruit, okari nuts and pandanus (TP: *marita*). Food from the forest is often consumed immediately, although meat from larger game animals is smoked in the bush and then carried back to the village where it is distributed. Sago as a food has other important attributes: it is available all year around and, because of its relatively long storage life (of only a few months), it ensures a stable supply of food for the household.

Hunting and fishing

Men hunt wild pigs and cassowaries using blackpalm bows strung with bamboo or cane or by making snare traps and deadfall traps (Kirsch 2006). Smaller game animals include marsupials, birds, fruit bats, and lizards. Women and girls usually carry out fishing activities (Kirsch 2006) using traps, nets, derris roots, and lines with metal hooks.

From semi-nomadic food production strategies to intensive gardening

The change from semi-nomadic food production strategies and behaviours to a more sedentary agriculture is perhaps the cultural challenge with the most impact for the Yonggom, Boazi and Zemakani people. Kirsch (2006) notes that the colonial administration's efforts to resettle people in permanent residential settlements meant significantly extending the distances between their settlements and their traditional foraging reserves. This forced households, whose livelihoods and lifestyle depended on foraging, hunting and fishing activities, to produce more of their food requirements from gardens. The permanent settlements also meant population increases in localised areas that, in turn, required more intensive food production strategies which itself led to more settled food gardening. In the case study communities, the pressure to
depend on subsistence food from gardens was further aggravated when the PNG Government granted permission to Ok Tedi Mining Limited (OTML) to dispose of mine waste into the Fly River system, which came about when the construction of the planned tailings dam was delayed as a result of landslides (Swales et al. 1998). The waste disposal loads in the Fly River caused high rates of sedimentation, resulting in water logging and dieback to natural and planted stands of sago and loss of supporting aquatic resources and other animal life on which people depended for their livelihoods. The result was that people had to increase the proportion of household food needs derived from gardening activities. In the subsequent sections, I examine how people behaved in response to these changes.

7.2.3 Food gardens

In addition to procuring food from wild sources, Moian and Yulawas people also produced their food from gardening activities. Based on a survey question about the types of food consumed and the sources from which each food item was acquired by the household, food from gardens now represents about 30 - 40 percent of meals consumed by the household. Banana is a major staple food for the Yonggom people, with more than a dozen varieties cultivated (Kirsch 2006). Most varieties are cooked before being consumed. At Moian and Yulawas, people grow their food in mixed gardens that are also planted with yams, taro, sugarcane and pitpit (an undeveloped grass flowerhead). A variety of other more recently introduced food crops like high-yield sweet potatoes, cassava, peanuts and vegetables are also planted in the gardens. The introduction of these new crops has been part of OTML's food security measures for the mine-affected regions. While a transition from semi-nomadic food production strategies to strategies based on more sedentary agriculture is underway among the Moian and Yuluwas people, these cultural changes are generational and take place over extended time periods. As one OTML employee explained, 'these transitions are slow but the difficulties associated with the loss of traditional food sources has awakened people to do more gardening to secure the food supply for their households' (Mr. Tom Nami, pers. com).

Similar cropping patterns were observed in the gardens made at Komovai and at Kasa. In addition, people also plant valuable tree species in their garden; the common ones include breadfruit (Artocarpus), okari (Terminalia), mango, laulau and pandanus. These trees are not only planted in food gardens, but also around village settlements. For example, coconut, mango, and betelnut (Areca sp.) palms are planted extensively beside village settlements, forming neat hedgerows in the village landscape and along trails through the rainforest. Betelnut palms - not traditionally part of Yonggom culture in the past - are extensively planted in backyards and in the surrounding landscape for sales at local markets. Sago palms (Metroxylon sagu) from which sago starch is collected, which remain the main diet of most communities throughout the province, are also planted. Sago palms take up to 15 years before they can be harvested to
extract the starch. At least three of the 10 men interviewed had planted at least one sago sucker for each their children, while three others had planted one each.

### 7.2.4 OTDF and food security measures

The Ok Tedi Development Foundation (OTDF) spends over US$1 million annually under its food security and nutrition program (OTDF 2006). These programs included the introduction of new food crops, the development and expansion of fishery resources, and research and technical support in food crop production (OTDF 2008). OTDF introduced its community agriculture program in 1996 to assist communities affected by the OTML mine to become more food secure and economically independent. A wide range of crops including cassava, taro, coconut, rice and yams have been introduced to the villages of Moian, Yulawas, Komovai and Kasa: these are categorised as being in the mine-affected zone and have been the target communities under the OTDF program. For example, one of the interviewee participants at Komovai Village converted 3 hectares of his forested land into an intensive mixed cultivation of perennial and annual crops. Food crop plantings there included taro, yam, banana and cassava, together with a range of vegetables and perennial tree crops, including various tropical timber species. Sago suckers were planted in the valley where part of this garden land was frequently inundated. Similar initiatives were reported to be taking place in other areas impacted by the mine, including Kasa village.

### 7.3 Household cash income and expenditure

Sources of household income for the case study communities in this region include mine-related payments, income generated from selling rubber and fishery products, and income derived from rural entrepreneurial activities and from informal markets.

#### 7.3.1 Mine-related damage payments from OTDF

Records provided by OTDF show that people in mine-impacted villages receive regular payments throughout each year in the form of either compensation packages or as development assistance grants. These compensation payments include mine-impact compensation (paid quarterly), compensation for environmental damage (paid annually), and special compensation claims for specific damage done to sago palm stocks and to other livelihood systems of the people. Moian, Yulawas, Komovai and Kasa village communities are located in regions where mine-related impacts were felt to be the greatest, and people in these villages therefore were direct beneficiaries for these income streams. As an example, in 2010 OTML paid 4 million Kina in cash to 12,340 persons living across 18 village communities in the Middle Fly Region, where these communities are located. Each person received K324.00, so that total income to the household is the per capita amount multiplied by the number of persons living in each household unit.
In addition to these compensation payments, mine-impacted communities also have the opportunity to access financial grants, from a pool of approximately 23 million Kina per annum, held by the Middle Fly Trust Funds on behalf of the different groups of people. These funds are available to the villagers to initiate and implement the development of ideas that could deliver social and economic benefits to improve the wellbeing of their households. Table 7.1 presents the funds allocated and disbursed to the case study communities in 2004. These data illustrate the limited response of these communities in relation to opportunities based on financial resources available to them, as only a small proportion - less than 10 percent, with exception of Yeteni/Yuluwas - of the allocated budget has actually been committed and actually implemented. The low rate of uptake of these opportunities, and the lack of implementation of many of them, are attributed to a number of issues by OTDF staff members who work with these communities (pers. comm., Mr F. Essacu, Forestry Officer OTDF; other OTDF community development officers). These reasons include a lack of interested or commitment on the part of villagers, or a lack of the basic skills necessary to identify and develop ideas, and to manage and implement projects. According to Mr Essacu (pers. comm.), this is in part due to lack of community leadership, in terms of forward thinking and lack imagination on the part of leading individual in the village in not recognising, fostering, facilitating and harnessing the opportunities available to them. Underlying social and cultural attitudes have a strong bearing in the behaviour of the people in this study region. These attitudes, at both at individual and group levels, include the lack of basic skills and abilities to engage successfully with the modern economy, or to take the lead to organise, co-ordinate and carry out relevant projects successfully. This is possibly linked to the nomadic cultural behaviour of the people, out of which they were emerging.

Table 7.1 Budgeted OTDF allocation and disbursed funds to various projects in the Western Province case study villages

<table>
<thead>
<tr>
<th>Communities</th>
<th>Money allocated (in Kina)</th>
<th>Money spent (in Kina)</th>
<th>Percentage of funds spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yeteni</td>
<td>440,000</td>
<td>17,015</td>
<td>4</td>
</tr>
<tr>
<td>Yuluwas</td>
<td>437,000</td>
<td>102,075</td>
<td>23</td>
</tr>
<tr>
<td>Komovai</td>
<td>364,000</td>
<td>23,232</td>
<td>6</td>
</tr>
<tr>
<td>Kasa</td>
<td>460,000</td>
<td>41,153</td>
<td>9</td>
</tr>
</tbody>
</table>

7.3.2 Cash cropping

**Rubber**

The growing and selling of rubber is other source of income for the landowners in the case study region. Commercial rubber was first introduced to PNG in 1903, and is grown from sea level up to about 700 metres in altitude, in an environment where the annual rainfall ranges from 1500 mm to 5000 mm (Allen et al. 2009). Rubber production is not seasonal. Although an important cash crop in some regions of the country, it is relatively minor compared to other
export crops. Between 2004 and 2006, rubber generated export earnings of 19 million Kina per year, representing only 1% of the value of agricultural exports for that period (Allen et al. 2009).

There are both plantation and smallholder production models for rubber in PNG. Plantation models were established in PNG’s Southern Region near Galley Ridge, Sogeri and Cape Rodney in Central Province, and in the Kerema area of Gulf province (Allen et al. 2009). Plantation rubber production was based on profit motive and the deployment of a wage employment labour force: The village-based smallholder model was promoted by the Department of Agriculture, Livestock and Fisheries (DASF) in Gulf and Western provinces between the 1960s and 1970s. Other smallholder schemes were in Central Province, and at Gabien near Angoram in East Sepik Province (Allen et al. 2009). Smallholder production increased steadily from 1980 and by 1990 it had overtaken plantation production (Allen et al. 2009). Between 1992 and 1996, a sharp increase in production coincided with the increasing export price for rubber (Allen et al. 2009).

**Moian/ Yulawas, Komovai and Kasa rubber growers**

Rubber as a cash crop in Western Province has clear and specific support from all levels of government (Western Provincial Development Plan 2010 - 2012). A key issue is the coordination of this support and the channelling of support programs for rubber development. The current smallholder rubber production in Western Province is co-ordinated and supported by North Fly Rubber Limited (NFRL), with subsidy support from OTML and from the PNG Sustainable Development Program (PNGSDP). Apart from providing technical support and extension services, NFRL also encourages smallholder grower to become grower-shareholders of North Fly Rubber Limited (Warren Dutton, pers.com.).

More than 2,700 ha of smallholder rubber has been planted in the Kiunga area and over 100 ha in the Lake Murray area, by some 3,700 smallholder rubber growers (pers. comm., Mr B. Chiju, Manager of NFRL). There are plans to increase rubber planting to total of 10,000 hectares in the Province (Allen et al. 2009). Although NFRL provides free planting materials and free technical advice, not all villagers are keen to plant rubber. Allen et al. (2009) note that this is a crop that will not provide an income for around six years, and even then it provides only a modest return of about K2,000 per family per 2 to 3 hectare block of mature rubber, at current rubber prices. While this does not compare favourably with formal employment, it is a crop that is well suited to Western Province and it provides an opportunity to generate cash income over the long term for a large proportion of the population on a regular basis. Furthermore, rubber does not need constant inputs after the establishment phase, and rubber trees can be tapped when cash is needed.
Tapping, coagulation and management of rubber

The bark of the *Hevea* tree is partially cut through (tapped) and a milky liquid exudes from the wound and dries to yield a rubbery film. Rubber trees are tapped approximately every two days, yielding a cupful of latex, containing approximately 100 grams of solid rubber, under favourable environmental conditions. Latex is collected in cups overnight and was transferred into larger containers known as cup-lumps the next morning. The standard method of tapping is to cut the rubber tree’s bark (phloem) with a knife for half the circumference of the trunk, slanting the cut down from left to right at an angle of 30° starting at the highest point convenient to the tapper. Each subsequent cut is made immediately below the previous cut. Trees are often rested for a period after heavy tapping. In Western Province, latex production begins when a tree is 7 years old and, with care, the tree’s useful life may extend to more than 20 years. At a plant spacing of 5 metres by 3.4 metres, the landowner had 500 trees per hectare to weed on a regular basis, in particular within the first four years after planting. In addition to tapping, the usual management of field crops requires frequent tending from initial planting and establishment to the production stage. This crop husbandry information is relevant because it offers an insight into the demands of rubber production on household labour, which in turn influences decisions about other land-use options that which also require household labour, time and land.

Income from rubber

All rubber produced by smallholders is sold to North Fly Rubber Limited and NFRL has a projection of an eventual 12,000 tonnes per year of dry rubber. Currently capacity is about 2,500 tons per year, projected to increase to 5,000 tons per year based on smallholder production. In 2008, the cup lump price was K1.60 per kilogram, of which K0.60 was received at the point of sale and K1.00 was held back by NFRL to be paid out at Christmas in order for growers to have cash ready to pay their children’s school fees for the next school year.

The estimated rubber yield from mature stock for smallholders is 0.39 tons/ha/year stock (pers. comm., Mr B. Chiu, Manager of NFRL). Many of the recent rubber plantings in the case study region have been with new clonal varieties that have higher yield productivity. The oldest plantings of the new clones are already in production. For the purpose of estimating household income, yields from the new clones are used. Mr Liu (pers. com) quoting from literature sources that the new clonal varieties grown in India and Sri Lanka are able to produce a yield of between 2,500 and 4,500 kg/ha from a stand density of 375-450 stems per hectare. However, he notes further that for purposes of estimating household income derived from growing and selling rubber, a more modest production of 1,000kg/ha/year has been assumed.

These assumptions above are based on two primary considerations. The first is that the culture of cash cropping as part of the land-use system in the case study communities had not yet reached the adoption and diffusion stage when the incremental growth of an innovation is
highest (Pannell et al. 2006; Rogers 1995; Moulik 1973). My assumption is that, in Western Province, the diffusion and acceptance of rubber as cash crop is still in the initial stage, but will gradually gain momentum. Significant awareness raising and continued extension services are necessary in order to reach the stage where the potential for rubber as a major cash crop is exploited to its maximum potential. The second consideration is related to the issue of conflict between landowners and land-users, discussed below. The potential for the future expansion of smallholder rubber holdings also hinges on the landowner – land-user status of the land available for growing rubber, as discussed below. A central issue is that of the willingness of the landowners to grow rubber. The average size of smallholder rubber holdings in the case study region is 0.8 ha. On this basis, the average household income from rubber is K2,500 per year at the current rates of remuneration and current production yields.

7.3.3 Fisheries

Sales of fish and of other animal products (e.g., deer horn) are another source of income for households living within and around the vicinity of Obo government base camp. A fish marketing facility supported by OTDF buys fish from local fisherman and resells it in Port Moresby as fish fillets. The engagement of people from Komovai and Kasa villages in these activities was irregular, and it was difficult to elucidate how much household income is generated from this activity.

7.3.4 Other sources of income

Sales of trade store goods, outboard motor fuel, oils and lubricants are other sources of income for some families. However, supply and inventories are very irregular, and it is very difficult to elucidate how much these activities contribute to the household income. Sales of betelnut and other food items at informal markets were another source of income, especially by women. It was difficult to establish accurately the income generated from these sales, for reasons discussed in Chapters 5 and 6. However, an estimate was made based on responses to interview questions. Estimates of income to the household from these sources are presented in Table 7.2.

Implications of land use conflicts for production systems and options

Conflicts between landowners and land-users are an emerging concern affecting agricultural production systems and options for their development across the case study communities. The local population in the case study communities includes both customary landowners and land-users, who have been relocated under government direction or migrated from other parts of Western Province (Warren Dutton, pers. comm.). Land-users are now thought to outnumber landowners in the case study communities. The landowners have permitted the land-users to grow food crops, and in some cases grow some perennial crops, but
there is a general presumption in favour of land use for subsistence food production, and against land use for income generation. Because tenure for cash cropping activities means a longer period of occupation on the land that owners are therefore reluctant to allow land for such uses. Land-users are also a source of labour for landowners. As population pressures increase, and as economic land-users may be further restricted by landowners in what they can do or grow the latter’s land, or may have to enter into production-sharing arrangements with the landowners. The landowner - land-user issue is common to both the North and Middle Fly areas, including the Lake Murray area, and will constrain the opportunities of many people in these communities to plant blocks of rubber.

The Middle Fly area is flat and prone to seasonal flooding. Obtaining fresh water in this area can be difficult. The North Fly is suited to agriculture in elevated areas although many of the Middle Fly residents traditionally relied on hunting and gathering (including the cultivation of sago) rather than agriculture. There has been a loss of sago and forest trees in some areas of the North and Middle Fly areas due to increased sedimentation and increased flooding through the river system as a result of the mine tailings disposal.

7.3.5 Summary of household cash income in Western Province case study communities

Table 7.2 presents sources of income and average amounts of money earned fortnightly by the Mojan, Yuluwas, Komovai and Kasa households. As mentioned above, it is difficult to provide a robust assessment of income and expenditure behaviour of rural households in PNG. The households examined in this case study area are a specific case in point, where production and consumption activity patterns are highly irregular and inconsistent over any given period. The strategies for food gathering and consumption are apparently still associated with and characterised by nomadic cultural behaviour. Informants’ low levels of literacy also complicate the communication of basic data and information. Thus, as for the other case study regions, the data presented in Table 7.2 are generated from collating and extrapolating data from various sources, including household interviews, informant experiences, secondary sources, and information gathered and communication throughout the course of the study. Thus, as discussed also in chapters 5 and 6, while the data provided do not provide a precise statement of financial transactions occurring in these rural households, they do provide a valid generalised impression of household income and expenditure behaviour of households in the Middle Fly case study area.
Table 7.2 Average fortnightly incomes Yeteni, Komovai and Kasa

<table>
<thead>
<tr>
<th>Sources of income</th>
<th>Kina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine related compensation</td>
<td>378</td>
</tr>
<tr>
<td>Cash crops - rubber</td>
<td>96</td>
</tr>
<tr>
<td>Garden produce, betel nuts and other sales at informal markets</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>504</td>
</tr>
</tbody>
</table>

Assumptions underlying this table:

1. Mine-related payments
   An average household income of K324 per person is multiplied by an average of 7 persons per household and divided by the number of fortnights per quarter. Other mine-related income is not included in this calculation.

2. Cash cropping
   Assumptions related to cash cropping activities are discussed in Section 7.4.2. The main one is that with the use of an improved clonal variety, the average annual latex yield per hectare is increased to about 1.5 ton per hectare for smallholder production.

7.4 Household consumption and expenditure

This section examines the consumption behaviour of people in the Moian, Yuluwas, Komovai and Kasa households. Attention is paid to the types of goods and services consumed by households, how they are acquired, how much money is actually spent in acquiring them, and attempts to express their influence on land-use decisions.

7.4.1 Types and sources of food consumed by the household

The household survey data in Table 7.3 provides, firstly, the types of food being consumed by households and, secondly, the sources from which particular types of food are derived. The data illustrate the links between food produced and food consumed by the household. Table 7.3 shows that staple foods in the case study communities comprise sago, bananas, fish, vegetables and fruits, coconuts, sweet potato, cassava and yams. Other than sago that is harvested from wild stock; most of the foods listed in Table 7.3 are grown by the household. The list of foods consumed by the household is also consistent with the types of food collected through foraging activities and the food grown in the garden, descriptions of which are presented in Section 7.2. In addition to subsistence food gardens; households in the case study communities obtain their food from other sources as well. These include foods that are purchased at stores or at local informal markets and those that are transacted through household exchanges. The types of food purchased are essentially those that cannot be produced by the household. They include foods like rice, floor, mutton and biscuits. However, because they must be purchased, they are still at trivial proportions here. The cash incomes earned from land-use activities described in Section 7.2 are used to cover these purchases.
<table>
<thead>
<tr>
<th>Types of food consumed by the household</th>
<th>Proportion of meals in which each food is consumed (%)</th>
<th>Source derived (self produced, purchased or given by relatives)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sago</td>
<td>75</td>
<td>Self produced (collected from wild)</td>
</tr>
<tr>
<td>Banana</td>
<td>55</td>
<td>Gardens</td>
</tr>
<tr>
<td>Fish</td>
<td>45</td>
<td>Own production</td>
</tr>
<tr>
<td>Vegetable &amp; wild fruits</td>
<td>45</td>
<td>Growing wild or in garden</td>
</tr>
<tr>
<td>Coconut</td>
<td>40</td>
<td>Garden</td>
</tr>
<tr>
<td>Yam</td>
<td>25</td>
<td>Garden</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>20</td>
<td>Collected from garden</td>
</tr>
<tr>
<td>Cassava</td>
<td>20</td>
<td>Collected from garden</td>
</tr>
<tr>
<td>Pork and bush meat</td>
<td>15</td>
<td>Hunted</td>
</tr>
<tr>
<td>Chicken (home grown)</td>
<td>7</td>
<td>Own production</td>
</tr>
<tr>
<td>Rice</td>
<td>5</td>
<td>Purchased from store</td>
</tr>
<tr>
<td>Biscuits/ bread/ flour</td>
<td>5</td>
<td>Purchased from store</td>
</tr>
<tr>
<td>Canned protein</td>
<td>2</td>
<td>Purchased from store</td>
</tr>
<tr>
<td>Lamb and mutton</td>
<td>1</td>
<td>Purchased from store</td>
</tr>
</tbody>
</table>

Aside from food, other household consumption items purchased include trade store goods such as kerosene, soap, detergents, kitchenware, tools, cigarettes, and beverages, and other essential services including health, education, transport and mobile telephones that are important to household livelihoods. These are products that cannot be produced by households but can be purchased with the cash income derived from activities described in Section 7.4.2. Table 7.4 and Table 7.5 present household expenditure behaviour, for small and larger items respectively. As previously discussed, small item purchases refer to goods and services for which expenses are incurred on a fortnightly basis. The larger item purchases are those items that incur irregular spending. These items include clothes, tools, kitchenware, building materials and school fees.

### 7.4.2 Spending behaviour of household

The spending behaviour characterises types of goods and services that are consumed by households, the frequency at which they are consumed and how much is spent in acquiring them. This behaviour has an important bearing on cash income strategies and links directly to land-use decisions of the landowners. For the purposes of this study, the spending behaviour of the Yeteni, Obo and Kasa landowners is grouped into two broad categories, as in previous chapters: regular spending and spending on large items.

**Regular or fortnightly spending behaviour**

Regular spending consists of expenses that Yeteni, Obo and Kasa households incur on a regular basis to sustain themselves. For the purposes of this study, a fortnightly cycle is taken as the unit of analysis for this behaviour. The household fortnightly spending includes money...
spent on acquiring a wide range of goods and services. The list presented in Table 7.4 provides some indication of what these items are and how much money is spent purchasing them and together they signify the importance of these commodities in the household economy. Table 7.2 was produced from a survey question that asked households to give an estimate of the amount of money earned and for what purpose it was spent. The table demonstrates, firstly, household spending behaviour, the kinds of goods and services consumed and the indicative significance of these items in the household economy. About 36 percent of the fortnightly income of the household is spent on food items. Twenty five percent of this is spent on trade store-purchased food items. This shows the increasing trend in the consumption of store-purchased goods. Other essential items include kerosene, batteries, soap and detergents, at 18 percent of the household fortnightly income. Important services such as transport, health services and communications take up 25 percent of the fortnightly income.

<table>
<thead>
<tr>
<th>Table 7.4 Household fortnightly expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean weekly spending</td>
</tr>
<tr>
<td>Trade store: Food, drinks, oil, salt &amp; other household needs</td>
</tr>
<tr>
<td>Food from informal markets</td>
</tr>
<tr>
<td>Mobile phone cards</td>
</tr>
<tr>
<td>Kerosene, batteries</td>
</tr>
<tr>
<td>Soap, detergents</td>
</tr>
<tr>
<td>Transport</td>
</tr>
<tr>
<td>Health care</td>
</tr>
<tr>
<td>Church donations</td>
</tr>
<tr>
<td>Betelnut</td>
</tr>
<tr>
<td>Alcohol</td>
</tr>
<tr>
<td>Cigarettes, tobacco, matches</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

The fortnightly household income is K504 (Table 7.2); fortnightly expenditure is K280. The difference between the two is the savings made towards purchases of larger items.

**Spending on larger items**

In addition to the fortnightly spending behaviour presented above, landowners also plan and budget their income and expenditure on much longer cycles. These are items not frequently used but essential to the livelihood of the household and therefore people are inclined to make regular savings over time in order to acquire them. For this purpose the study employed an annual cycle as a basis for this analysis. The types of goods and service also range widely, but the listing presented in Table 7.4 characterises the kinds of goods acquired, how much money is spent acquiring them but, more importantly, they reflect the significance of these items in the household economy. In this instance the word 'significance' refers to the monetary value; the higher the monetary value, the more significant that item is in the household economy.
Table 7.5 Household yearly expenditure of larger items

<table>
<thead>
<tr>
<th>Spending on large items</th>
<th>Kina</th>
</tr>
</thead>
<tbody>
<tr>
<td>School fees</td>
<td>K1200</td>
</tr>
<tr>
<td>Clothes</td>
<td>K150</td>
</tr>
<tr>
<td>Kitchen utensils</td>
<td>K150</td>
</tr>
<tr>
<td>Fish nets</td>
<td>K150</td>
</tr>
<tr>
<td>Tools (Bush knives, grass knives, spades, axes)</td>
<td>K150</td>
</tr>
<tr>
<td>Exchanges</td>
<td>K100</td>
</tr>
<tr>
<td>Customary exchanges (bride price)</td>
<td>K4000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>K5,900</strong></td>
</tr>
</tbody>
</table>

Large item purchases are very irregular and inconsistent, but they are spread over a yearly basis, depending on the needs, wants and services that are required. The fortnightly savings made from fortnightly spending of K280 compared to the fortnightly income of K504 (Table 7.2) is K224. This corresponds to an annual saving of K5828; when added to K200 from sales of other non-regular income, this suggests a total income of K6,027.

Table 7.5 clearly shows that both bride price and social obligations are very important determinants as ‘large expense’ items. These represent 68 percent of the annual income. This is followed by the education related expenses (at 20 percent) and others including clothes, kitchenware, tools each at about 3 percent of the annual income.

### 7.5 Household labour organisation and distribution

The demographic profile in Table 7.6 provides potential labour availability per household in the case study area. These data appear to suggest more men than women in a household. Young adult males who cannot afford bride price continue to reside with their parents or with other married members of the family; this explains the slightly skewed proportion of males in Western Province households. The question of bride price and how it affects smallholder land-use decisions is discussed further in Section 7.5.

#### Table 7.6 Demographic profiles of the case study villages

<table>
<thead>
<tr>
<th>District</th>
<th>Village</th>
<th>Household</th>
<th>Total no. Person</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Fly</td>
<td>Moian</td>
<td>64</td>
<td>386</td>
<td>198</td>
<td>188</td>
</tr>
<tr>
<td></td>
<td>Yulawas</td>
<td>25</td>
<td>134</td>
<td>71</td>
<td>63</td>
</tr>
<tr>
<td>Lake Murray</td>
<td>Komovai</td>
<td>35</td>
<td>203</td>
<td>109</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>Kasa</td>
<td>*64</td>
<td>*577</td>
<td>*292</td>
<td>*285</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources:
(1) PNG 2000 National Census

#### 7.5.1 Household activities and distribution of labour

Subsistence food production is the main economic activity for the households in this case study region. Sago and fish are staple food for the households and up to nineteen percents
(Table 7.7) of both man’s and woman’s time is devoted to sago-making while 31 percent of man’s time and 14 percent of woman’s time is devoted to hunting and fishing.

<table>
<thead>
<tr>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activities</strong></td>
<td><strong>Time (Total active hours/week)</strong></td>
</tr>
<tr>
<td></td>
<td>Hours</td>
</tr>
<tr>
<td>Subsistence -Making sago</td>
<td>20</td>
</tr>
<tr>
<td>-Fishing</td>
<td>15</td>
</tr>
<tr>
<td>-Gardening</td>
<td>5</td>
</tr>
<tr>
<td>Caring for children</td>
<td>10</td>
</tr>
<tr>
<td>Cooking</td>
<td>30</td>
</tr>
<tr>
<td>Fetching water/firewood</td>
<td>5</td>
</tr>
<tr>
<td>Cleaning and other household duties</td>
<td>3</td>
</tr>
<tr>
<td>Resting and visiting friends</td>
<td>17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>105</td>
</tr>
</tbody>
</table>

Until very recently, people lived a nomadic way of life predominantly collecting food from wild (Kirsch 2006). As seen from Table 7.7, most household observed in this study still practice these mode production, but at much lesser extent than previously. This explains for the low labour allocation to the gardening activities for making sago, hunting and fishing. The similar amount of time is devoted to gardening activities in other case study regions. Cash cropping activities take less than 15 percent of the household labour and time.

### 7.6 Household exchanges and other socio-cultural activities

Exchanges taking place between households, within groups and across different groups are another household event that also influences peoples’ land-use choices and production behaviour. As observed in Section 4.2.2, different types of exchanges and gifts that take place across different sections of societies in PNG are an enactment of the collective life and establishment of social relationships. The exchanges and gifts may take different forms and shapes, but the theme underpinning these actions is aimed at maintaining relationships, and often is associated with the portrayal of a person’s measure in terms of what he or she is able to elicit from others (Morauta 1983; Kirsch 2006). On the other hand, the spirit of the gift
humanises the participants in successful exchange relations by demonstrating their mutual recognition and acceptance (Kirsch 2006).

In Yonggom culture, the enactment of these exchanges is performed by pig feasts, marriage exchanges and mortuary exchanges (Kirsch 2006). At the regional pig feast, Yonggom and their neighbours (including Ningerum people) exchanged pigs for cowries. Pig feasts attract guests who offer shell valuables, or more recently, money in return for a share of pork. The pigs are raised primarily by the sponsor of the feast or other members of his lineage (Kirsch 2006). In these transactions, the host invites individuals from whom he has previously received pork in return for his shells or money during previous feasts. These transactions operate in reciprocal relations, whether they are brother-in-laws, share a matrilineal affiliation, or have long-standing trade partnerships (Kirsch 2006). A successful ‘pig feast’ converts pigs into shells or money, both of which can be used in other exchange relationships that most often includes bride price payments (Kirsch 2006). The money or cowrie shells are used for the payment of bride price in arranged marriages. In 2008 the bride price was around the K4000.00 mark. Bride price is usually paid before marriage and often a young man without money or cowry shell remains a bachelor until he has accumulated enough money or shells to pay for the bride. The higher proportion male population per household in Table 7.6 is partly due to this.

Another form of exchange among the Yonggom people is the mortuary transaction (Kirsch 2006). After death, claims for compensation are levied against the property of the deceased on the basis of previous transactions, including specific contributions to bride price payments and relationships established between exchange partners (Kirsch 2006). The significance of this to the land-use decision-making process is the manner and influence that these exchanges have on the way decisions are made for the use of labour, land and other resources. For example the pig used in exchanges at a ‘pig feast’ has to be fed and raised by the sponsor. This means that the sponsor must provide food and care for the pig. The time, labour and food for the pig must be provided and these have implications on the land-use choices that are made by smallholders. In my interviews, two of the unmarried participants indicated that they would delay their marriages because they couldn’t yet afford the bride price. Box 7.1 describes how marriage and bride price influence land-use decisions of the young Yonggom man.

Part of the conversation in the box amplifies the need for money as a critical factor in marriage, and the important implications this has for the land-use decision process for young men in the Yonggom, Boazi and Zimakani tribes.
Box 7.1 Influence of bride price on land-use decisions of a young Yonggom man

Bride price is very important in the Yonggom culture; if a man can't afford bride wealth, he may remain a bachelor for the rest of his life.

...You must build a house, save some money for the brideprice before proposing marriage to a young woman. Only then the bride's parents will consent to your engagement to their daughter.

...It was very difficult to raise money for the brideprice in the past, and as a result many men remained bachelors. However, with the opportunities now for growing and selling of rubber, young men can afford the bride price. I hope to save enough money from the sales of rubber in order to pay for the brideprice I have to give.

young Yonggom man

7.7 Land- and resource-use choices

7.7.1 Introduction

The discussion presented in Section 7.1 to 7.6 focussed on the livelihood strategies of the people. The presentation demonstrates how landowners’ strategies their livelihood activities in response to the contemporary circumstances such as subsistence and cash economic needs of the households, risk aversion strategies, labour allocation and distribution. In the next Section, I examine the second subsidiary research question; it explores the question of how the livelihood activities influence landowners’ land-and resource-use choices. To do this, I use theoretical construct described in Chapter 2 to assess landowner motives, attitudes and perception, and how they influence landowner choices in their land-use decision process. I use the Farmer Decision Environment presented in Figure 3.3 to organise the discussion in this section.

7.7.2 Motives and land-and resource-use decisions

Land-use decisions characterise a production system that is focused on feeding, and meeting the costs of education, health, transport and communication services of, landowners. Land-use decisions also focussed on meeting producers’ other needs and social obligations. The primary goals of a landowner are survival, self-sufficiency, minimising risk and maximisation of household income to meet basic needs. In addition, social values such as identity, ownership and maintaining social networks and building relationships are also equally important determinants in land-use decisions.

Similar observations were noted for this case study region where land-use decisions of the landowners were consistent with the needs hierarchy postulated by Maslow. He stated that the deficiency in needs such as food, water and clothing in the lower hierarchy must be partially satisfied before the needs higher in the hierarchy may become factors for motivation (Maslow
The data set out in Table 7.7 testify to this behaviour, where up to 65 percent of male labour and up 38 percent of female labour are allocated to food-gathering tasks. Subsistence food production efforts include foraging, gardening and hunting or fishing. On average some 68 percent of men's labour is spent in subsistence food production activities. Seventy-five percent of this is spent on extracting sago and on hunting and fishing activities. Only 25 percent is spent on food gardens. Women, on the other hand, spent 33 percent of their labour on making sago and on fishing. According to these data women spent only 5 percent of their labour on gardening activities.

The study also revealed that smallholders were more dependent on sago than on garden or trade store foods. Almost 90 percent of the ingredients of a meal consumed by the household were produced from foraging and gardening activities. However, the amounts and types of trade store-purchased foods are also increasing. This suggests the increasing importance of money in the household economy. In addition to this increasing trend in the consumption of goods purchased in trade stores, the increasing need for children's school fees, and needs for medical and other social services, and for transportation and communication services, also suggests the increasing importance of money in the household economy. Cash cropping activities only take 10 percent of male labour. In Western Province, subsistence food sources are derived primarily from foraging activities and so people need to spend a greater proportion of their available time in food gathering activities, including making sago and fishing. Consequently, subsistence gardening only takes up small proportion of their time.

7.7.3 Livelihood assets of the landowners

Livelihood assets of the people in this case study region include land, labour and, to a limited extent, financial resources. As observed in other case study regions, decisions about these resources can be used to determine the stability and prosperity of households. A number of potential issues exist with the land asset that have an important bearing on the question of options for commercial development, including those for commercial tree growing. The first is concerned with the issue of landowner/land-user, an issue that has a significant socio-cultural dimension. The growing population pressure on the land, coupled with the consequences of the colonial policy to move remote communities closer for purposes of administration access, has resulted in communities being divided into landowners and land-users. This has implications on the adoption and production decisions of landowners, including options for commercial tree growing. Separation of the two groups is based on cultural and land ownership factors. The second issue has biophysical dimension and has a bearing on the production potential of the land itself. Hanson et al. (2001) have noted that the land in this study region has low to moderate potential for agricultural purposes. The main constraints include high rainfall levels, poor soils and frequent and regular inundation. This has two important implications: the first is the limitation in terms of the choice of crops that can be adopted and grown in the area. The
second implication concerns a limitation in the levels of production and raises the issue of the scale of production possible from smallholders in the region.

Household labour assets in the region are relatively limited. The total population in Western Province is 106,000 persons (Hanson et al. 2001: 27), or 20 persons per square kilometre; this, too, may pose some difficulty with development and production of smallholding cash cropping activities. The field data from this study show the typical household size for the case study region to be about 5-6 persons per household and so household labour is limited to this capacity. This study's findings show that up to 70 percent of household labour is focussed on subsistence food production, consistent with the experience of North Fly Rubber Ltd. The high level of time committed to subsistence food production suggests that there is likely to be a high degree of competition with cash income generation opportunities.

Economic and social pressures arising from money-related needs are reflected in the increasing levels of landowner participation in the market economy, especially in cash cropping and other income-generating strategies. This applies, in particular to the need for bride price, an item that represents 68 percent of the total annual income of the household. This is followed by children's educational expenses at about 20 percent of the annual income; others include clothes, purchase of tools, kitchenware at 3 percent each. In Western Province, particularly in the case study region, the most common source of income is funds from mine-related compensation, and these represent 75 percent of the total income. The remainder is derived from agricultural activities, mainly from sales of rubber latex (19% of income) and sales of garden food (6%). Sales from animal products contribute significantly to the household economy but are irregular and unpredictable.

7.7.4 Cash cropping

As explained earlier in Chapter 4, land potential is low to moderate in the region and seriously constrained by high rainfall, poor soil, and frequent inundation (Hanson et al. 2001). This limits the opportunities for many cash crops. Furthermore, uncertain market opportunities, poor and costly infrastructure system in the regions, and the low availability of household labour inhibits investments decisions for many cash crops. From this backdrop, rubber is perhaps the most robust cash crop suited for this region. Firstly, rubber trees does not need constant inputs and can be tapped when cash is needed. Secondly, the harvested latex has much longer post-harvest life and can withstand the long delays in the transportation delivery to the factory and exposure to bad weather conditions in the field. According to North Fly Rubber Limited (NFRL) more than 2,700 ha of smallholder rubber have been planted in the Kiunga area and over 100 ha in the Lake Murray area by some 3,700 smallholder rubber growers. Growers are supported with seedling, technical advice, harvesting and transportation, by the North Fly Rubber Limited, with subsidy support from OTML. The crop provides modest return of around K2,000 per family for a 2 to 3 hectare block of mature rubber at current rubber prices.
7.8 Conclusion

As with other case study observations noted throughout in Chapters 5, 6, and 8, the land­
and-resource use decisions of the Yonggom, Buasi and Zemakani landowners are characterised
by both subsistence food production and cash income strategies. These were motivated by the
need for secure food sources and to afford essential services, including the need for school fees,
health, transport and communication. In subsistence food production, there is shift in adoption
and production decisions, particularly from food-gatherer to sedentary agriculture strategies,
where proportion of food consumed by the household from garden sources has increased. This
has meant more intensive cultivation, which has led to other social issues as divisions between
landowner/land-user groups. In addition, especially among the young men, the need for money
was strongly motivated by the bride price demands and other social and cultural exchanges that
take place in the community. The main source of income of the landowners include mine­
related compensation, followed by cash cropping, predominantly growing and selling of latex
from rubber trees.

7.9 What does this mean for commercial timber tree
growing?

The options for commercial tree growing in Western Province should be considered in the
light of the issues and opportunities discussed in the previous section. Firstly, accessibility to
the land for industrial-scale timber tree crop production is limited by the biophysical and socio­
cultural related constraints. These issues pose the question of competing uses, namely
subsistence food production and cash cropping.

Aside from land, household labour or human capital is another limiting production factor
that has implications on decisions about options for commercial tree growing in Western
Province. As observed in Section 7.2, up to 68 percent of male and 30 percent of female labour
is allocated to subsistence food production activities. This means labour diverted to other
activities will have significant implications on food production. Both of these factors have
competing effects on the subsistence food production strategies. On the other hand, economic
pressures driven by the need for money and cash income offer opportunities for commercial tree
growing. Given the biophysical and economic background just described, commercial options
can be considered in terms of increasing the unit value of return on an area of land. This can be
undertaken from an integrated farming systems approach, a system that is already being widely
practiced within the region and as well in other regions of the country. Through this approach,
food crops, rubber tree crops and high-value timber tree crops (such as teak) can be grown
sequentially on the same area of land.

Food gardens can be maintained on the land on which rubber plantations are established
for around five years, after which the rubber tree crowns close and shade out the food crops.
High-value timber trees could be planted between the rows of rubber trees. The rubber tree
starts producing latex at around age 7 and will continue on until the trees are around 30 years of age. At this time, some of the high-value timber tree species will also be ready for harvest.

In fact, a combination of subsistence food production and cash cropping, especially of rubber trees, is already in practice in Western Province where forest land is cleared and planted with food crops, followed a few months later by the planting and maintenance of rubber trees. This farming system, especially with the incorporation of food crops, will force people to stop moving from place to place to forage for food. The socio-cultural practice of people moving from place to place has been a major drawback of some of the current development initiatives in the region.
Chapter 8: Madang Region

8.1 Introduction

This chapter describes livelihood strategies of landowners in the Trans-Gogol, Naru and Wasab case study region in Madang Province. As with Chapters 5, 6 and 7, it explores the primary research question about the basis on which Papua New Guinea landowners make land-use decisions relevant to tree growing, as part of their livelihood system. The first part of the chapter focuses on achieving a better understanding of the livelihood systems of landowners. It draws from the insights of theoretical constructs described in Section 2.2 and provides an assessment of relevant components of household livelihood assets, household engagement in subsistence and cash income activities, household pattern of consumption and expenditure, and household allocation of labour. The second part then investigates how these strategies influence landowner households' decision processes regarding the use of their land and other resources. It seeks to identify motives, attitudes and perceptions of smallholders in these decision processes. This assessment involves a qualitative interpretation of behaviour patterns in the household production system, of consumption and exchange activities, risk management strategies and of the pattern of labour organisation and distribution to various activities.

8.2 Livelihood strategies – Lower Madang Region

In Section 8.2 to 8.6, I examine various livelihood strategies pursued by households in the case study region, to understand how these activities influence their choices about use of their assets, such as land, labour and financial resources.

8.2.1 Subsistence food production

In this section, I examine types of staple foods consumed by the households, their production strategies, and how these bear on the peoples' choices in the land-and-resource-use decisions. Subsistence food production includes gardening, fishing and hunting. Of particular concern to this study is the process or manner in which decisions about the use of household land and labour towards subsistence food production are considered in relation to other livelihood outcomes.

The staple food consumed by the households in the Trans Gogol, Naru and Wasab comprise taro (Colocasia), banana, Chinese taro, and yam (D. esculenta) (Allen et al. 2002). Other important foods include sweet potato, pumpkin and cassava. Vegetables and fruits also consumed include aibika, Amaranthus spp, a variety of beans, choko tips, corn, cucumber, water melons, lowland pitpit, pumpkin tips, mango, marita (pandanus), papaya, pineapple, sugarcane, ton and mon (both tree fruits); breadfruit, coconut and galip nut. In addition to food, other trees and plants widely used for a range of reasons include betel nut palm, betel pepper vine, kava and tobacco as narcotics; lepa for fibre, and a variety of secondary tree species as
8.2 Food gardens - Trans Gogol and Naru areas

As with all subsistence systems, food and other production are directly linked to the needs of the household. In Trans Gogol, Naru and North Coast regions, food production strategies include crops that provide food in a year and those that provide food for two or more years. These termed as annual or perennial crops.

The annual food gardens are prepared on fallows of secondary regrowth from a clear-felled forestry logging operation that had taken place some 20 years earlier. A brief description of logging activities is presented in Section 8.3.3; Section 8.2.2 describes how this experience has influenced land-use behaviour in food and opportunities for cash income production strategies. Food gardens are based on fallow periods ranging between 5 to 15 years (Allen et al. 2002). The tasks involved in preparing a garden include clearing and burning of fallow vegetation, fence-making if required, mound building in the case of yam cultivation, planting, weeding, harvesting, and transporting of produce home or to market. The question of how much household labour is allocated to subsistence food production and who provides is presented in Section 8.6.

The types of gardens comprise mixed gardens or gardens made specifically for monocropping with yam or taro. Garden making activity commences in the August/September period when fallow vegetation is cut and burnt, fenced if needed. Planting is usually done just before the wet season begins, around November. The first weeding is carried out during February to March and the second weeding around April - May. A garden is ready for harvest by June, July and August. Garden land is cropped only once and then a new garden in a new location is prepared and the cycle starts again. Many households make more than one garden, the principal ones being market gardens and family gardens. The former is planted with food crops for sale at local informal markets, and the latter provides food for household consumption.

8.2.3 Other crop integration strategies – rotating food and timber tree crops

In 1971, the national forestry administration negotiated the Timber Rights Purchase (TRP) arrangement from the traditional landowners to clear fell primary forest in the Gogol/Naru TRP. A permit was granted to JANT and clear-felling logging operations began in 1972. Logs were processed into wood chips and exported to pulpwood markets. The clear-felled forest logging and commercial forestry plantation activities that took place in the Gogol and Naru valleys altered land-use behaviour of people in a number of ways. Among other developments that resumed after logging operations, smallholders in the logging concession areas were encouraged
to participate in commercial tree farming activities on their customary land. In taking up this opportunity, smallholders adopted and developed a production strategy that maintains their subsistence food levels and at the same time provides industrial wood requirements for some cash income in return. The production system is described in Section 8.3.3.

The production strategy is characterised by integration of food crops and industrial tree crops on the same parcel of land. A brief description of this system is as follows. At the stage when 50 percent of a food crop is harvested, the land is then planted with *Acacia* spp. trees again and left to go back into fallow again. The first weeding is carried around the base of the trees 6 months after the initial planting. *Acacia* trees are harvested three to five years from the time planted and sold to Jant Pty. Ltd. for wood chip production. The land cleared by a tree-harvesting operation becomes immediately available for cultivating food crops again. Food crops are planted on this cleared land and the process continues in this cycle. The relative advantage to the household of this system of cyclical cropping is the savings made in labour required for clearing and burning of the bush for a new garden. Similarly, savings on labour costs are made in site clearing and tending operations associated with the growing of acacia trees for cash income. In addition, the debris and leaf litter from timber harvesting operation decompose and make nutrients available for the newly planted food crops.

*Acacia* trees, as legume plants, are likely to enrich nitrogen levels in the soil and this has obvious benefits to the subsequent food cropping. People indicated that they receive good harvests from food gardens that are grown on the land previously planted with acacia trees. However, for reasons discussed subsequently, landowners’ willingness to plant acacia as a cash crop is diminishing, prejudicing the continuation of this system. While the positive features of this land-use model may encourage its wider adoption in other logged-over areas in Papua New Guinea, the constraints to ongoing adoption of acacia growing, discussed subsequently, also point to risks associated with the system.

### 8.2.4 Gardens in the North Coast area

The staple foods consumed by households in the North Coast area are similar to those reported for the Naru and Trans Gogol areas. They include taro, banana, yam, sweet potato and a variety of fruits and vegetable. The most important food crops include sweet potato and taro (Allen et al. 2002). Other important food crops are banana and Chinese taro. Cassava, sago, and *yam* (*D. alata* and *D. esculenta*) are other cultivated food crops (Allen et al. 2002). Apart from the food grown in the garden, people also draw much of their food from fruit and nut trees that are extensively cultivated in the subsistence systems, as discussed in Section 8.2.4. Gardening cycles and methods of making gardens are similar in many respects to the practices described for the Gogol and Naru regions. Fallow vegetation is tall woody regrowth. After a number of cultivation-fallow cycles within a restricted area (for between 30 and 40 years), another area of older, taller woody regrowth is selected for clearing and gardening. The more intensive
cultivation-fallow cycle is begun here and the previously used area is left to fallow (Allen et al. 2002). Garden-making tasks include cutting and burning of fallow vegetation, making fences to keep out pigs, planting and weeding.

Garden clearing activities are carried out during the months of April and May by both men and women, both doing the work of clearing the undergrowth vegetation. The task of felling and cutting big trees is restricted to men. Burning of cleared vegetation and making fencing begins immediately after that. Women do the burning of debris while men make fences. Soil preparation (mound building, especially for yam and sweet potato) is also carried out during this period. Planting of food crop takes place around the months of July to August. Allen et al. (2002) observed that gardens are planted between July and December, and this is related to localised climatic seasons. With the exception of yam planting, performed mostly by men for reasons discussed in Chapter 5, the planting of a garden is a joint activity performed by both men and women. Weeding is carried out two to three times, the first one after 6 to 8 weeks after planting and again in the third and the fourth months and is usually performed by women. The garden is ready for harvest after six months from the time of planting.

8.2.5 Production of perennial crops

Apart from food crops, landowners also cultivate a variety of perennial tree crops and shrub species for various reasons including for food, for medicine, as windbreaks, for fibre, for shelter, to use as tools and implements, for poison (e.g., to stun fish), for narcotics, as ornamentals and to maintain soil fertility. They form an important part of the livelihoods system of landowners. Edible fruit and nut trees dominate the integrated tree crop system. The common ones include; *Institia bijuga* trees, *Pometia pinnata*, and *Artocarpus* breadfruit trees integrated with coconuts and other fruit trees like galip nut and dracontamelon trees. These tree crops constituted the most upper horizon of the system in the vertical structure. These are used by the landowners for timber, landmark and soil support (kwila, teak, galip nut, and taun). Coconut (*Cocos nucifera*) and betel nut (*Areca* sp) trees form the next lower horizon. Coconut is extensively grown as a source of food and as a means of cash income. The coconut kernel is eaten and the juice drunk as food at all stages of development, and milk from the grated dried kernel is used as a cream in the preparation of meals. Leaves and other part of the coconut are also used for various other things including as fuelwood, for manufactured products such as brooms, baskets and mats. In permanently wet locations or along the gullies, and small streams sago palm (*Metroxylon sagu*), another important food tree, is cultivated and this forms the upper most or next canopy layer. Apart from the starch that is consumed, its leaves are used as roof thatching material in the house construction. Betel nut palms and the betel pepper vines are grown for the grower’s own use as a narcotic and as well as to sell at local informal markets to earn cash income. Other tree species also forming this horizon includes fruit trees like mangoes and galip nut trees.
The next level in the structure comprises of cocoa trees, other fruit and nut trees such as rambutan & orange/mandarin, okari nuts trees, and other tree such as Leucaena as fuel wood or as for the shade or for the support for other crops. These lower trees are also used as stands in which mustard is grown. Mustard is a good form of cash revenue together with betel nut, which is also included in this horizon. At the same horizon, one can find edible shrubs like ficus and *Gnetum gnemon* which mostly incorporated as vegetables in the meals when there is not enough budget for other favourite greens/vegetable that are obtained at the market. Below these horizons food crops described Section 8.2.2 and 8.2.4. These horizons are arranged in a way that adequate sunlight still penetrates down to the lowest horizons and that there is available space for nutrient uptake by the plant whether it be a plant in the top horizon or bottom. The spatial arrangement of the vertical structure could be the reason behind the success of the system or it could be the soil fertility or the temperature and rainfall distribution, or as a result of the combination of all of this factors interacting in a complex way. In addition the same land can also accommodate animals for food such as chicken & pigs, dog and cats.

Table 8.1 summarises the types of end-uses for which a tree is grown; the proportion of sampled population cultivating the crop signifies the relative importance that crop in the livelihood system.

**Summary**

In summary, the crop production system described in Sections 8.2.2 - 8.2.5 provides a brief account of the landowners’ adoption strategies in maintaining their food and other livelihood necessities. This also reflects the choices they make between different options in the land- and other resource-use decisions, as well as in managing risks. It also demonstrates, particularly in Section 8.2.3, the landowners’ willingness to adopt new opportunities if it fits well without affecting the balance in the existing system. As demonstrated here, the sustainability of such a production system is underpinned by the depth of intergenerational knowledge and experience about the plant-biophysical interaction system, gained over generations by trial and error. In-depth understanding of these plant-biophysical relationships provides useful insights into how such knowledge systems influence the choices in land-use decisions.
<table>
<thead>
<tr>
<th>Tree/ Plant species</th>
<th>% of households growing</th>
<th>Uses</th>
<th>Brief description of crop husbandry and management system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coconut Cocos nucifera</td>
<td>100</td>
<td>Kernel and juice as food, leaves used for making variety of products (mats, baskets, brooms), coconut husk used as fuelwood, and wood used as timber. Extensively grown as cash crop (to sell or make copra).</td>
<td>Coconut palms are planted along village hedgerows; separately in secluded gardens or mixed with other crops, adjacent to hamlets, along tracts or old garden sites, in smallholding plantations for commercial production. Tending and grass cutting is carried out in the first three years of planting, after which the plants are left to grow. Coconut palm has its first fruits five to six after planting.</td>
</tr>
<tr>
<td>Betel nut Areca catechu</td>
<td>95</td>
<td>For own use as stimulants, symbolic gestures as part of cultural exchanges, sales at local markets.</td>
<td>Often grown in betelnut gardens, usually besides residential dwellings or in old garden sites. Sometimes planted together with coconuts and other cash crops.</td>
</tr>
<tr>
<td>Betel pepper Piper betle</td>
<td>85</td>
<td>As stimulant, sales at local markets.</td>
<td>Betel pepper vines are grown on Gliricidia, Leucaena and other small shade-bearing trees. Trees are intercropped with cocoa and coconut trees, sometimes along village hedgerows, old garden sites. Important requirement is to grow the trees where they receive sufficient sunlight for production.</td>
</tr>
<tr>
<td>Mango Mangifera indica</td>
<td>75</td>
<td>Mango fruits is consumed as food and is also sold at the local informal market for cash income opportunities.</td>
<td>Similar to coconut trees. They are grown along village hedgerows or in old garden sites. The tree also provides very good shade and therefore finds itself planted in or alongside residential hamlets. The tree requires sufficient sunlight for fruit production.</td>
</tr>
<tr>
<td>Tree/ Plant species</td>
<td>% of households growing</td>
<td>Uses</td>
<td>Brief description of crop husbandry and management system</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------</td>
<td>------</td>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>Tulip <em>Gnetum gnemon</em></td>
<td>100</td>
<td>Young leaves, florescences and seeds of tulip tree are important sources of vegetable food when cooked and eaten. Tree bark is used as fibre for making bilums and other artefacts as traps for catching wild game.</td>
<td>Tulip tree is planted almost everywhere in the landscape; old garden sites, next to village hamlets, or intercropped with coconut and cocoa and other tree species. Young tulip trees are top-pruned when they reach about two metres in height. This is done to encourage formation of stronger lateral branches that are also pruned at 'arms length' distance from the main bole. Optimum sunlight and shade are important for a continued production at all times. Old leave and branches are regularly pruned to encourage growth of young leaves.</td>
</tr>
<tr>
<td>Sago <em>Metroxylon sagu</em></td>
<td>50</td>
<td>Sago starch is a very important source of food. Leaves are used as roof thatching material in house construction.</td>
<td>Sago palms are planted along creeks or other well-watered areas within the production landscape. These palms take 12 to 15 years to mature. Management regimes include provision of sufficient sunlight and spacing for high starch yield production. Growing of sago trees is considered as food security measure.</td>
</tr>
<tr>
<td>Breadfruit <em>Artocarpus altiss</em></td>
<td>50</td>
<td>Fruit and the seed are used as foods. It is cooked or roasted over fire before eating.</td>
<td>Breadfruit trees are grown in old garden sites or together with coconuts and other tree species. Breadfruit trees are grown as part of food security measures in the subsistence production system.</td>
</tr>
<tr>
<td>Galip nut <em>Canarium indicum</em></td>
<td>50</td>
<td>Seed of galip nut is extracted by cracking open its tough shell before it can be eaten raw. Galip oil can be extracted from the nut and is used with banana or taro to prepare rich puddings. The shell is used as fuelwood, wood is used as timber.</td>
<td>Galip trees are planted before an old garden is left to fallow. Tending and other maintenance is necessary throughout the initial establishment period. A galip tree produces its first nuts six years after planting. Harvesting and pruning takes place at the same time. This enable heavy flushing in the next crop.</td>
</tr>
<tr>
<td>Mon <em>Dracontomelon dao</em></td>
<td>50</td>
<td>Fruit of mon tree is eaten raw. Sometimes the seed is removed and the flesh is packed with mashed galip nut and boiled before eating.</td>
<td>Mon tree is planted in old garden prior to fallowing, or transplanting a wildling. Sometimes Mon tree is planted beside residential hamlets as a shade tree. Harvesting and pruning takes place at the same time to allow good harvest in the next cropping season. Tree is pruned and maintained at a manageable height where fruit can be easily collected.</td>
</tr>
<tr>
<td>Tree/ Plant species</td>
<td>% of households growing</td>
<td>Uses</td>
<td>Brief description of crop husbandry and management system</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------</td>
<td>------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>Marita pandanas</td>
<td>40</td>
<td>Marita fruit is boiled in water and squeezed to extract the oil. Extracted oil is nutritious and used with other food.</td>
<td>Marita tree is planted along water drainage pathways or other well-watered regions. Young Marita seedling is planted from cuttings. Trees need good tending and sufficient sunlight for fruit production.</td>
</tr>
<tr>
<td>Talis/Okari nut</td>
<td>40</td>
<td>Okari nut is extracted by cracking open the shell before eating it raw. Taste is similar to galip nut or dried coconut meat.</td>
<td>Okari nut tree is planted or tended from transplanted wildlings and maintained until they are fully established. Planted tree is left in old garden sites to fallow together with other commercial tree species in old garden sites.</td>
</tr>
<tr>
<td>Aila inocarpus fagifer</td>
<td>30</td>
<td>Aila seed is cooked in pots or roasted over charcoal and eaten. It tastes similar to bean seeds.</td>
<td>Wild Aila trees are tended and looked after as part of the food security management system in the subsistence production landscape.</td>
</tr>
<tr>
<td>Ton (taun)</td>
<td>30</td>
<td>Fruit is used as a food and eaten raw. It has a similar taste to rambutan.</td>
<td>Ton tree is planted from seed along paths on village edges or tended from wildlings and maintained throughout the crop life. Fruiting of ton is seasonal with the main flush around the December/ January period. Fruit is harvested from trees that are easily reached. Trees where the fruit grows out of reach are abandoned and become part of the forest system.</td>
</tr>
<tr>
<td>Avocado</td>
<td>30</td>
<td>Fruit is used as food</td>
<td>Avocado is planted along village hedgerows or adjacent to hamlets.</td>
</tr>
<tr>
<td>Pouteria barringtonia procera</td>
<td>20</td>
<td>Fruit is used as food</td>
<td>Tree is planted or tended along village hedgerows or adjacent to residential hamlets.</td>
</tr>
<tr>
<td>Guava</td>
<td>10</td>
<td>Fruit is used as food</td>
<td>Similar to Barringtonia, these are planted in village hedgerows or adjacent to residential hamlets.</td>
</tr>
<tr>
<td>Orange</td>
<td>10</td>
<td>Fruit is used as food</td>
<td>Require similar husbandry practices as Barringtonia.</td>
</tr>
<tr>
<td>Tree/ Plant species</td>
<td>% of households growing</td>
<td>Uses</td>
<td>Brief description of crop husbandry and management system</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------</td>
<td>------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>Rambutan <em>Nephelium mutabile</em></td>
<td>10</td>
<td>Fruit is used as food</td>
<td>Require similar husbandry practices as Barringtonia</td>
</tr>
<tr>
<td>Spondias <em>Spondias cytheria</em></td>
<td>10</td>
<td>Fruit is used as food</td>
<td>Require similar husbandry practices as Barringtonia</td>
</tr>
<tr>
<td>Laulau <em>Syzygium spp</em></td>
<td>10</td>
<td>Fruit is used as fruit</td>
<td>Require similar husbandry practices as Barringtonia</td>
</tr>
<tr>
<td>Lepa <em>Agave fourcroydes</em></td>
<td>30</td>
<td>Fibre from the leaf blade is extracted and woven in ply-fashion into string for making carry-bags (bilum)</td>
<td>Lepa is a very important fibre resource that women use in the manufacture of craft products like carry-bags known as <em>bilum</em>. It is planted as hedges along residential backyards or in old garden sites. Plants require good sunlight for strong fibre formation and development.</td>
</tr>
</tbody>
</table>

*Note: The table entries are based on the provided information and may not be exhaustive or representative of all possible uses and practices.*
8.3 Household cash income strategies

This section examines various sources from which households derive their income and how these sources influence land-use choices. The main sources of income are agricultural activities that derive from rural entrepreneurial activities, and those that derive from selling labour. The latter two are categorised as income derived from non-agricultural activities. Landowner behaviour in these activities is described below.

8.3.1 Cocoa

Cocoa was introduced in PNG in the 1920s by German colonial settlers. After coffee and fresh food, cocoa is the third most important source of household income from agriculture in PNG. Between the years 2004 to 2006, cocoa generated an average income of 218 million Kina per year, representing 14 percent of the total agriculture export value (Allen et al. 2009). Cocoa produces pods all year around, with the flush period between May and July, which is when the related income stream becomes available to smallholders. Smallholder cocoa production was promoted and expanded by the Department of Agriculture (Allen et al. 2009; McKillop 1981). Smallholder cocoa production accounts for 90 percent of the total production in PNG (Allen et al. 2009). Madang Province accounts for about 8 percent of the country’s production, sharing third place with East Sepik Province after North Solomons and East New Britain provinces.

Income generated from growing and selling cocoa varies greatly between households and depends on the number of cocoa trees each has, the age of the cocoa trees, their production and the prevailing market price. These factors link directly to the adoption and production decisions in the land-use choices of the people. The level and intensity of smallholder participation in cocoa adoption and production was greatly influenced by the expected return on their land and labour investment. These issues and how they affect smallholder land-use behaviour, particularly in relation to their attitudes and decisions to crop adoption and production, are discussed in further detail in Chapter 9.

In the Trans Gogol, Naru and Wasab areas, cocoa is an important cash crop for smallholders. About 95 percent of the households interviewed in the household survey indicated that they had planted cocoa trees, although the planted areas involved varied from 0.5 ha to more than 5 hectares. Ten percent of the households in Trans Gogol and Naru are recorded as planting over 3,000 trees (about 4.8 ha) each; sixty percent indicated they had planted between 1,000 and 2,900 trees. The remainder had planted between 500 and 1,000 trees. In the North Coast area, ten percent of the households had planted 2,500 trees or more; more than 70 percent of households indicated planting between 1,000 and 2,500 trees; and the remaining 20 percent had planted below 1,000 trees. These statistics suggest a high level of participation by smallholders in the growing and selling of cocoa as a cash crop. They also suggest how people assess how much labour to commit to cocoa production while also making parallel decisions regarding the allocation of labour to subsistence food production and other activities.
Information describing decisions about labour allocation to various activities in the case study region is presented in Table 8.8.

Those farmers having more than 2,000 trees on their blocks are allowed to build their own cocoa curing and drying facility. However, because of the high capital cost relative to income levels and savings, only five households in the Gogol/Naru area and three in the North Coast area have built small cocoa drying facilities. These driers have the capacity to produce 1 ton of dried cocoa beans a month. Assuming an average cocoa block size for each household of 1 ha, a production rate of 250 kg/ha (McGregor and Bourke 2009), and a current price of K4,000.00/ton at local cocoa buyers in Madang, the income to the household from this source is about K1,000.00 a fortnight for those who sell cocoa as dried beans. However, many households do not have their own cocoa drying and fermentation facilities and wet bean cocoa is sold to the driers at prices ranging from 50 toea to 90 toea per kilogram. Assuming an average green weight (about fifty percent more than dried weight) cocoa bean production of 0.8kg/tree, 625 trees/ha of a typical cocoa block, and a price of 75 toea, this corresponds to a household fortnightly income from sale of wet bean of K375.

8.3.2 Coconut

Commercial cultivation of coconut palms in PNG commenced in the 1880s with European settlement. Smallholder copra production was encouraged in the 1950’s by agricultural extension services. Coconuts produce nuts all year round and so provides an income option to households from coconut and copra production (McKillop 1983). Copra is important source of income for some 17 percent of PNG’s rural population (Allen et al. 2009). Between 2004 and 2006, copra and copra oil generated average annual export earnings of 93 million Kina, representing 6% of the total value of agricultural exports (Allen et al. 2009). Coconut production from smallholders contributes 82 percent of the total production in PNG (Allen et al. 2009). This makes smallholder participation in the industry very significant. However, sensitivity to variation in export prices influences this production level greatly.

The production from the smallholder sector in Madang Province accounts for 16 percent of the country’s total production. The income stream to the household deriving from coconut production is important for smallholders. At average production yields of 500 kg/ha, and with the current export price of K912.00 per tonne (Bank of PNG 2010), the estimated income from air-dried copra is K456.00/ha/year. Fresh ripe nuts are also sold at local markets for use in the preparation of meals and as also for oil extraction for other uses. The market for this end-use of coconut is more attractive to landowners than the option of selling them as copra. In the North Coast area and other parts of Madang Province, including Trans Gogol and Naru areas, fresh nuts are sold at between thirty and fifty toea per nut. In 2007, farmers earned about K1,260.00 per annum by selling coconuts at informal roadside markets. Assuming 300 nuts make one full
sack of copra, and 14 such bags make a tonne, the equivalent number of nuts, hot air-dried and sold to an oil mill would earn a smallholder farmer about K600.00/tonne.

Smallholders living along the North Coast Highway stopped making copra in favour of selling green and fresh nuts at local informal markets or to traders from the Highlands who buy the nuts and resell them in major population centres in the highlands. Copra is produced once every two months or so. Based on this assumption, income earned from green and fresh nuts at roadside markets is K315, and that from copra K150, per fortnight.

### 8.3.3 Tree farms

The smallholder tree farming activities in the Gogol and Naru valleys had their origin in the Gogol Reforestation Company (GRC). This was a subsidiary company of Japan and New Guinea Timbers (JANT) Limited, established in the mid-1970s to grow fast-growing tree species (initially *Eucalyptus deglupta*, but subsequently *Acacia mangium*) that could supply its processing facilities for export wood chip markets. JANT Limited was granted a permit to clearfell and log primary rain forest in the Gogol and Naru valleys, southwest of Madang, in 1974. Lamb (1990) notes that one of the motives for customary landowners’ willingness to grow and sell this kind of timber was the belief that logging would lead to roads being built into their area. These roads would then allow people in the two valleys to participate more fully in agriculture development. Lamb (1990) notes that while there was a general interest in some form of cash cropping, the degree of enthusiasm differed greatly amongst the people.

Commercial tree growing for industrial wood chip processing was one the income generating activities available for households, among various other cash crops introduced into the area. Smallholder planting was introduced in 1999. Table 8.2 presents the number of tree farmers and areas of land planted with tree between 1999 and 2007. Although there are annual fluctuations, there are a number of indications of the behaviour patterns of growers and their attitudes to commercial tree growing. The first indication is the gradual increase in the number of participating tree farmers between 1999 and 2007, with a surge between 2000 and 2003. This could be an initial response to the opportunity for commercial tree growing option when it was first introduced in 1999. However, after the first three years, the average area planted per farmer declined from an average of 1.3 ha/farmer to 0.7 ha/farmer, and remained low (less than the 0.85 ha/farmer in the first year of the program) until 2006. The expansion in the unit area planted in 2007 was a response to the increase in the annual land lease fees paid by the company from K1.20 to K6.

Human attitudes in adoption behaviour over time have often been characterised by three main stages (Pannell *et al.*, 2006; Rogers 1999; Moulik 1983). The first stage is the initial period in which an innovation is introduced; here, growth is characterised by a slow uptake over time. This is then followed by a surge period in which growth is rapid and then, finally, the period when enthusiasm reaches that point when incremental rates of growth begin to decline.
There is some evidence that the behaviour of smallholders in the Gogol/Naru areas follow this pattern of adoption.

Table 8.2 Number of tree farmers and area planted between 1999 and 2007 in Gogol/Naru areas

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Farmers</th>
<th>Area planted (ha)</th>
<th>Unit area planted/farmer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>234</td>
<td>198.8</td>
<td>0.85</td>
</tr>
<tr>
<td>2000</td>
<td>231</td>
<td>307</td>
<td>1.33</td>
</tr>
<tr>
<td>2001</td>
<td>235</td>
<td>408.8</td>
<td>1.74</td>
</tr>
<tr>
<td>2002</td>
<td>280</td>
<td>204.9</td>
<td>0.74</td>
</tr>
<tr>
<td>2003</td>
<td>342</td>
<td>218.9</td>
<td>0.64</td>
</tr>
<tr>
<td>2004</td>
<td>227</td>
<td>112.5</td>
<td>0.5</td>
</tr>
<tr>
<td>2005</td>
<td>241</td>
<td>187</td>
<td>0.76</td>
</tr>
<tr>
<td>2006</td>
<td>250</td>
<td>191.7</td>
<td>0.76</td>
</tr>
<tr>
<td>2007</td>
<td>176</td>
<td>184.8</td>
<td>1.05</td>
</tr>
</tbody>
</table>

Growing trees for industrial wood chip production

Smallholder tree growing in the Gogol and Naru valleys and parts of the north coast area of Madang Province comprises site preparation, planting, growing, tending and harvesting of *Acacia mangium* over a 3-year rotation. Acacia tree seedlings are raised and supplied to tree farmers living within a 50-kilometre radius to the factory located near Madang town. Farmers plant the trees, maintain them for three years, harvest them and sell the trees to JANT. Apart from initial assistance by JANT with seedling supply and also with the first and second rounds of weeding, most of the tasks in growing trees are performed by the tree farmers. Trees are harvested at the end of the third year of planting.

Harvesting operations include felling, debarking and transportation of logs from its stump to the roadside for pick-up by heavy vehicles. Most of the harvesting operations are now carried out manually, in contrast to the semi-mechanised systems originally used by JANT.

Income derived from tree farming

At the time of fieldwork, tree farmers were being paid the following fees by JANT: a cost of land lease fee, a farm levy fee, a fee for establishment and maintaining a tree farm, a harvesting fee, and fee towards the cost of transportation of harvested trees to the mill.

- **Annual Land lease fees**: K 1.20/ha (increased to K6/ha in 2007)
- **Tree farm levies**: K10/ha for *Acacia* and K5/ha for other species
- **Cost of growing trees**: K770 / ha
- **Harvesting**: K38/ day (for manual harvesting)
- **Transportation**: Refer to Table 8.3
- **Total**: K819.20/ha + K38.00/day (harvesting) + Transport
Table 8.3 Schedule of payment for transporting logs to the factory

<table>
<thead>
<tr>
<th></th>
<th>MHS (Kina)</th>
<th>Cost of transport (Kina)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;25km</td>
</tr>
<tr>
<td>Normal days</td>
<td>38.50</td>
<td>32.00</td>
</tr>
<tr>
<td>Saturday</td>
<td>39.50</td>
<td>33.00</td>
</tr>
<tr>
<td>Rainy days</td>
<td>39.50</td>
<td>34.00</td>
</tr>
</tbody>
</table>

The net payment a tree-grower actually receives from selling acacia stems is much less than the figures presented in Table 8.3, as a significant proportion of this is deducted and paid to various contractors who are involved in various parts of company-linked activities. The tree-growers interviewed in this study reported that they did not receive clear enough communications about the basis on which deductions are made. As a result, growers reported feeling cheated in the absence of an itemised statement from JANT of the income and deductions from their tree farming activities.

My interviews found that the poor communication strategies currently employed by JANT were a major threat to the participation of smallholders in commercial tree growing opportunities in the Madang study region. Possible responses to this problem are discussed in Chapter 10.

Smallholder fortnightly income from tree growing over the three-year pulpwood rotation is estimated at K20.00/ha at roadside (i.e., not accounting for transport costs or fees). This is based on the total of fees shown above and assuming 20 man-days/ha for manual harvesting operations, apportioned over 78 fortnights on a non-discounted basis.

8.3.4 Informal markets

As discussed in earlier chapters, local informal markets play an important role in the household economy of many rural families in Papua New Guinea. The relevance of informal markets to the smallholder land-use decision-process is in the manner in which household labour, time and land are organised towards sustaining these activities. For example, as shown in Table 8.8, about 9 percent of women’s time per week is allocated to marketing activities.

A survey of roadside sellers in Madang Province found that they earn a weighted average income of more than three times the national minimum wage (Anderson 2008). Items sold by vendors vary widely, from fresh food, animal products, fish, betel nut and betel pepper (Allen et al. 2009; Anderson 2008). This section examines the main types of products produced and sold by households, and the prices received. Section 8.6 then examines how much household labour and time is devoted to these activities in the case study region.

Production, trading, transport and retailing of betel nut and betel pepper are important economic activities for smallholders. Allen et al. (2009) estimated that between 1990 and 1995, sales of betel nut and betel pepper generated an estimated income of K20 million for rural
villagers in PNG. This represents 10% of the total income earnings from agricultural activities by villagers and is ranked fourth in terms of importance after Arabica coffee, fresh food, and cocoa (Allen et al. 2009). Betel nut is the fruit of the Areca catechu palm, which is grown in groves or isolated stands near many lowlands villages (Powell 1976). With increased demand, the betel nut crop is often grown together with food crops, along the edges of gardens. After the harvesting of food, betel nut crops are regularly tended during the garden’s fallow period, until it begins to produce fruit. From time to time, the owner returns to clean the area and harvest the crop. Betel nut is combined together with betel pepper and mild lime and chewed as a narcotic. Its use is widespread in coastal regions and urban centres, and in the recent past - with the improvement of highways and the transportation system - its use has spread to the highlands. The combination of these factors has increased consumption demand for betel nut and its ingredients significantly. Lowland villagers have responded to the demand for betel nut, betel pepper and lime by expanding their plantings (Allen et al. 2009). Large numbers of people are involved in the process of growing, trading, transporting and retailing betel nut (Allen et al. 2009).

**Sales at local markets**

In the case study region of Madang Province, as well as in the other case study regions, the climatic and environmental conditions are favourable for growing both betel nut and betel pepper. When the betel nut dieback disease affected the Markham Valley supply areas from early 2000, market attention switched to supply from Madang and Sepik provinces. This meant demand for betel nut from this region also increased. Further, the road infrastructure within Madang Province and to some other major centres is good. One of these roads is the southern highway that links Madang with Morobe and all the Highland provinces. Since betel nut production from the Markham Valley declined, most of the Highland betel nut traders, transporters and retailers moved to Madang.

A second road is the northern highway that links Madang town to Bogia and other northern parts of Madang Province. This road access has enabled the increase both of the volume and unit value of betel nut. Anderson (2008) estimates average weighted earnings from betel nut of K138 weekly. Observations from this study show roadside market sellers taking home between K120 and K150 weekly. This includes the sale of betel nut, betel pepper, a variety of locally grown food products and a variety of manufactured goods (including some imported items. Roadside coconut sellers earn about K40 per week.

The geographical location of Madang in relation to a major consumption region is an important factor in the trade and distribution of the commodities sold at Madang markets. The case study areas are well located within the main road network system of the production, trading, transportation and retailing of betel nut and betel pepper business. These offer opportunities for increasing household income from the production, sale and marketing of betel
nut and betel pepper. All of the households interviewed (Gogol, Naru and North Coast areas) indicated they sold betel nut during the week in which fieldwork was carried out. Twenty percent of the households indicated selling twice in a week. Ten percent indicated that they sold it three times a week, particularly when buyers came to the farm gate.

Households in the Gogol and Naru areas sell a very wide range of foods at the local Madang Market, or other roadside markets such as Four-mile or Mambu markets, while households along the North Coast area bring their produce to Kubukam or other roadside markets for sale. The buyers are both Madang town residents and traders or travellers between Madang and other provinces linked by southern road networks. Along the North Coast, buyers usually travel between Bogia, Karkar Island and Bagabag Island, with Highlanders buyers travelling the North Coast road to buy coconuts and betel nut. Most of the foods are grown by the vendors themselves. Women generally go to markets twice a week. The income earned from informal marketing activities is presented in Table 8.4, and represents 33 percent of the total fortnightly income for the household.

8.3.5 Rural entrepreneurial activities

It was apparent from this interviews that one of the hidden motives of innovative farmers in this region and possibly others as well, is raising money to start small business enterprises to help other members of the community. These activities include providing transport services (PMVs), trade stores, sales of kerosene, poultry, pigs, cattle, and village cocoa drying facilities. Trade stores are small and the range of items sold are limited to rice, canned meat, vegetable oil, sugar, tea, coffee, biscuits, cigarettes, matches, soft drinks, alcohol and snack foods. Collating income figures and making generalisations from them does not always resemble the true situation, as this is complicated by the variation between the levels of activities, participant numbers, incomes generated from them, and the kinds of activities involved. Though these activities make significant contributions to the household economy and their influence on smallholders’ land-use choices is significant, the wide range of variation in the data makes such generalisation meaningless. For this reason, the income generated from these activities is omitted from the calculations. However, it is significant for some households.

8.3.6 Wage employment

Wage employment is another source of income for some households. Data collected from the field interviews show that over seventy percent of the sampled households indicated that one member of the family, usually the husband, had been employed during the previous year or so. Employment opportunities included those in JANT’s forestry plantations and field activities, in small business operations as shop assistants, as PMV drivers, in assisting with cocoa drying and fermentation, and general labouring work or skilled artisan work in Madang town. Only forty percent of the seventy percent who indicated employment over the past year reported that they
were currently employed at the time of interview. Apart from those employed in Madang town, who received urban wages, the remainder were paid at rural wage rates. The minimum rural wage rate is between K1.10 and K1.30 per hour. Some indication of fortnightly income to households can be extrapolated from these figures and others presented in Table 8.8. Based on the data provided in Table 8.4, wage employment represents just over 5 percent of average fortnightly household incomes.

Thus, fortnightly income derived from selling labour is relatively small compared to the income derived from other sources. The scope for exploring employment opportunities is beyond the focus for this research. However, the low level of participation in off-farm employment activity is explained partly by the limited employment opportunities available to most households and partly by the low unit rates paid for labouring work. This issue is discussed further in Chapter 9, but generally options for directing household labour to cash cropping activities were financially more advantageous to the landowner than those for wage employment.

8.3.7 Summary of income from various sources

On the basis of the information discussed above, the average household income in the Madang case study households is summarised in Table 8.4.

<table>
<thead>
<tr>
<th>Sources of income</th>
<th>Kina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash crops including commercial tree growing</td>
<td>414</td>
</tr>
<tr>
<td>Garden produce, betel nut and other sales at informal markets</td>
<td>339</td>
</tr>
<tr>
<td>Others (e.g., poultry/ piggery)</td>
<td>176</td>
</tr>
<tr>
<td>Employment</td>
<td>46</td>
</tr>
<tr>
<td>Total</td>
<td>975</td>
</tr>
</tbody>
</table>

Notes: assumptions underlying Table 8.4
1. Household income from cash cropping activities includes earnings from cocoa, coconut and tree farming. Fortnightly income from cocoa is K375/ha, from tree farming is K20/ha, and from copra is K19/ha. These figures are not discounted.
2. Fortnightly income from informal markets from the sale of betel nut and other commodities is K339. This consists of K260 worth of sales of various items, sales of coconuts at roadside markets is K315 over four fortnights.
3. Poultry and sales of 52 chickens multiplied by K27/chicken divided by eight weeks. This figure does not include feed and other associated cost.

8.4 Household expenditure and consumption behaviour

This section describes the pattern of household consumption behaviour in the Lower Madang case study region, for reasons discussed in the corresponding sections of chapters 5-7. The analyses in this case study region mirror those outlined in Section 2.7 and Chapter 3 (sections 3.2.3 and 3.4.3), and by Bourke et al. (2009). In this case study region, as in others,
there is changing behaviour in the types of food consumed by the household. The household
survey data shown in Table 8.5 describes the types of food consumed by the household and the
sources from which these particular types of food are derived. The data show linkages between
food produced and food consumed by the household. Table 8.5 shows that staple foods
comprise taro, banana, sago, fish, vegetables and fruits, coconut, sweet potato, cassava and yam.
Apart from sago, which is harvested largely from wild stock, most of the foods listed in Table
8.5 are grown by the household (Section 8.2). Table 8.6 sets out a household’s mean weekly
spending pattern.

Table 8.5 Types of food consumed and their sources by the communities in the
case study regions

<table>
<thead>
<tr>
<th>Types of food consumed by the household</th>
<th>Proportion of meals in which each food type is consumed (%)</th>
<th>Source derived (own production, purchased or given by relatives)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables</td>
<td>75</td>
<td>Garden/ given by friends</td>
</tr>
<tr>
<td>Taro, Chinese taro, banana</td>
<td>65</td>
<td>Gardens</td>
</tr>
<tr>
<td>Yam/ sweet potato</td>
<td>45</td>
<td>Garden</td>
</tr>
<tr>
<td>Coconut</td>
<td>45</td>
<td>Garden</td>
</tr>
<tr>
<td>Rice</td>
<td>40</td>
<td>Garden</td>
</tr>
<tr>
<td>Flour, sugar, tea, biscuits</td>
<td>25-30</td>
<td>Garden</td>
</tr>
<tr>
<td>Chicken and fresh protein</td>
<td>20</td>
<td>Own production or purchased</td>
</tr>
<tr>
<td>Canned protein</td>
<td>20</td>
<td>Purchase</td>
</tr>
<tr>
<td>Lamb, mutton</td>
<td>15</td>
<td>Purchased</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Own production</td>
</tr>
</tbody>
</table>

Table 8.6 Household fortnightly spending

<table>
<thead>
<tr>
<th>Mean weekly spending</th>
<th>Kina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade store: Food, drinks, oil, salt &amp; other household needs</td>
<td>240</td>
</tr>
<tr>
<td>Food from informal market</td>
<td>60</td>
</tr>
<tr>
<td>Phone card</td>
<td>40</td>
</tr>
<tr>
<td>Kerosene, batteries, fuel and lubricants for generator sets</td>
<td>60</td>
</tr>
<tr>
<td>Soap, detergents</td>
<td>30</td>
</tr>
<tr>
<td>Transport</td>
<td>50</td>
</tr>
<tr>
<td>Health care</td>
<td>50</td>
</tr>
<tr>
<td>Church donation</td>
<td>10</td>
</tr>
<tr>
<td>Betel nuts</td>
<td>5</td>
</tr>
<tr>
<td>Alcohol</td>
<td>30</td>
</tr>
<tr>
<td>Cigarettes, tobacco, matches</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>545</td>
</tr>
</tbody>
</table>

The difference between estimated fortnightly income (K845) and fortnightly expenditure
(K545) is K300, corresponding to K7,800 annually. This is saved and spent on larger
expenditure items. The average expenditure on these items in surveyed households is shown in
Table 8.7.
Table 8.7 Yearly expenditure on larger items by surveyed households in Madang Province

<table>
<thead>
<tr>
<th>Spending on large items</th>
<th>Kina</th>
</tr>
</thead>
<tbody>
<tr>
<td>School fees</td>
<td>1,600</td>
</tr>
<tr>
<td>Clothes</td>
<td>300</td>
</tr>
<tr>
<td>Kitchen utensils</td>
<td>500</td>
</tr>
<tr>
<td>Gen sets, building material, iron roof</td>
<td>4,500</td>
</tr>
<tr>
<td>Tools (bush knives, grass knives, spades, axes)</td>
<td>300</td>
</tr>
<tr>
<td>Customary exchanges</td>
<td>600</td>
</tr>
<tr>
<td>Savings Account</td>
<td>150</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7,950</td>
</tr>
</tbody>
</table>

As discussed previously, the household expenditure pattern for larger item purchases is characterised as very irregular and inconsistent. For the purpose of this presentation, spending is averaged over the period of a year.

8.5 Household exchanges and cultural activities

The behavioural descriptions and underlying motives for conducting household exchanges that take place between households in this case study regions are similar to those discussed previously for the Upper Ramu Valley case study region (Chapter 5). Differences between the two regions may lie in the items of value and the trading partners involved.

8.6 Household labour organisation and distribution

The discussions above described household production strategies. This section considers the significance of each of these activities in relation to the overall economy of the household, and to the other determinants in the land-use decision environment. As discussed in previous chapters, the next section examines how various activities are performed as part of household livelihood strategies, how much labour was and allocated in performing these activities.

8.6.1 Defining labour and time in the rural PNG context

As observed in the other case study regions, rural labour in most parts of rural PNG is generally characterised by low degrees of specialisation. This means that every household must produce as much of what it needs for survival as it is able. Household labour is accordingly organised to meet such a production system. Thus, as in previous chapters, the ‘time-duration’ of each activity was used to assess the relative importance of that activity in the household economy, and examine how these relativities influence smallholder choices in their land-use decision processes. The theoretical basis of this assumption was discussed in the corresponding section of Chapter 3, and the assumptions made about duration of rural Papua New Guinean’s day are also as discussed there. The weekly allocation of time to livelihood activities in the Lower Madang region is summarised in Table 8.8.
### Table 8.8 Weekly time allocation to various livelihood activities of the surveyed households in the Lower Madang Case study regions

<table>
<thead>
<tr>
<th>Activities</th>
<th>Women</th>
<th>Men</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time (Total active hours/week)</td>
<td>Time (Total active hours/week)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hours</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Subsistence food production &amp; fetching firewood</td>
<td>12</td>
<td>11.4</td>
<td>10.5</td>
</tr>
<tr>
<td>Cash cropping</td>
<td>10</td>
<td>9.5</td>
<td>28.6</td>
</tr>
<tr>
<td>Laundry/washing and fetching water</td>
<td>6</td>
<td>5.7</td>
<td>33</td>
</tr>
<tr>
<td>Marketing</td>
<td>10</td>
<td>9.5</td>
<td>1.9</td>
</tr>
<tr>
<td>Cleaning (house &amp; yard)</td>
<td>6</td>
<td>5.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Preparing meals</td>
<td>30</td>
<td>28.6</td>
<td>1.9</td>
</tr>
<tr>
<td>Children Care</td>
<td>10</td>
<td>9.5</td>
<td>1.9</td>
</tr>
<tr>
<td>Other duties (taking care of seniors, sick and feeding of pigs)</td>
<td>4</td>
<td>3.8</td>
<td>4</td>
</tr>
<tr>
<td>Rest &amp; Socialising</td>
<td>15</td>
<td>14.3</td>
<td>14.3</td>
</tr>
<tr>
<td>Miscellaneous (making billums, sewing)</td>
<td>2</td>
<td>1.9</td>
<td>1.9</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

### 8.6.2 Task and labour allocation in livelihood strategies

As with corresponding data in previous chapters, Table 8.8 was generated from a response to a survey question about what each household member did in the previous week and what was an approximate amount of time spent performing that activity. The responses were collated and analysed. The main tasks performed as part of the livelihood system were then identified and grouped. This firstly enabled a distinction to be made in the labour of division between men and women. Secondly, proportion of the time allocated reflected the importance that activity is in the household economy and livelihood system of the household. Thirdly, the range of activities to which labour is allocated defines the livelihood system within the household economy.

The data presented in Table 8.8 demonstrates the organisation and distribution of labour between different categories of the household economy in the Lower Madang case study region. Data suggest about 35 percent of man's labour is allocated to cash cropping activities. This is followed by wage employment at 30 percent, and resting and socialising at 15 percent. Subsistence food production activities take 12 percent of men's labour. The remaining 13 percent of men's labour is spent on a range of activities, including security to property, attending meetings, repair and maintenance, and miscellaneous activities. On the other hand,
about 29 percent of the available female labour is used in various tasks associated with meal preparation. This is followed by resting and socialising activities at 14 percent. Subsistence food production, cash cropping, marketing activities and childcare each take up around 10 percent of women’s labour. Childcare is a task usually shared between mothers, grandmothers and senior daughters. Other tasks performed by women include providing care for elderly relatives, cleaning the house environs, and performing miscellaneous activities. These require less than 10 percent of women’s labour.

From these observations, as with other case studies the cash income is an important economic activity for the household. It illustrates the need for money and its importance in the economy of the household. As such households respond as and when opportunities for these activities arise, shifting labour between subsistence food production and other activities. In addition, livelihood system is defined by wide range of activities.

8.6.3 Flexibility - overlaps between different roles and tasks

The data set presented in Table 8.8 illuminate how significant each activity task is in the household economy of smallholders. However, as discussed in earlier chapters, the data conceal two important attributes regarding the organisational behaviour of household labour. The first attribute is that the roles of female labour and the roles of male labour are concealed in the overlaps between many of these activity tasks. It is very difficult to disaggregate activities into constituent components of tasks that can be exclusively categorised specifically as male or female activities. Household labour is made up of the family unit, and as such male and female members perform many of the household activity tasks jointly. For example, yam planting is an activity specifically designated as a male responsibility, according to the cultural norms in the case study region, but women may assist men to carry poles that support the yam vine creepers. Similarly, in food preparation, an activity generally said to be performed by women, men may contribute in making and maintaining fires that cook the food and some foods are prepared solely by men. A similar observation can be made about cash cropping activities - here men are mainly tasked with those activities, but women may also provide support and assist men in the harvesting and transporting involved in cash cropping operations.

The second attribute is the lack of clearly defined boundaries within which various tasks are actually performed. The physical boundaries in the work place are not distinctly defined. As a result daily activities overlap and this spreads across different tasks that happen in a particular place or region at a particular time. For example, a woman on her way to the garden to collect food may also gather firewood, collect bush vegetables, and on her way back home may fetch water. Each of these activities contributes to the household economy. A man on his way to the garden may harvest betelnut or collect betel pepper, or stop at a friend’s house who has just return from town to find out the current commodity price for cocoa is. These overlaps are very
common and vary considerably between household units. Both men and women perform daily activities with a considerable degree of flexibility.

### 8.6.4 Rural labour characteristics and their implications for the household economy

As observed in other case study regions, wage-employment labour in rural areas is characterised by a low degree of specialisation, commonly referred to as unskilled labour. Issues associated with this terminology were discussed in Chapter 5. Although wage-labour is an important source of income, it also impinges negatively on other production systems of the household economy and has a bearing on smallholder choices in their land-use decision considerations, especially in the manner in which production activities are organised, managed and performed. However, competition from wage labour opportunities was not as great in the case study communities as in some of those from other regions, reflecting both the limited employment opportunities in the Madang Province communities and the relatively low income from labour compared to other activities for households in the case study communities.

### 8.7 Household land-and resource-use choices

#### 8.7.1 Introduction

Similar conclusions to those reported elsewhere are evident for this case study region. The behaviour patterns associated with land-use activities reflect and characterise a broad range of livelihood activities of landowners in the Lower Madang region.

#### 8.7.2 Livelihood assets

Land, labour and financial assets are the key elements in the livelihood systems of the people of the Trans Gogol, Naru and North Coast areas of Madang Province, as they are for all rural communities in PNG. Stability and prosperity in the household depends on the choices that owners make on how these assets are used. In terms of land, its accessibility and use follow the traditional systems of control and distribution since land is allocated to kin group households for subsistence food and other needs by clan leaders. Kin groups (mostly clans) retain rights to specific parcels of land only as long as they contain economically valuable plants. While use rights to land are shared by a number of individual and households, ownership of cultivated plants is permanent and private. The individuals who cultivate trees or other perennials could secure long-term tenure rights. Current livelihood strategies include the use of land for cash cropping activities following the traditional controls and understandings about the land.

Household labour is also a key asset. In the case study households, about 76 percent of male labour was allocated to subsistence and cash income activities, while women allocated 30 percent of their labour to food production. In the case of women’s labour, meal preparation is an important activity that also takes about 30 percent of the total active time. The high percentages
of labour allocation to these food production and preparation tasks demonstrate the significance of these activities in the household economy. In addition to land and labour, the study findings strongly suggest that social and economic pressures also exert influence on land-use choices. Increasing demand for processed consumer goods, needs for children education, transportation and communication services, health care and aspirations to venture into business opportunities are the main drivers for income generation and the saving activities of households. The savings for and purchases of larger consumer goods by the household reflect the financial capacity of smallholders and the types of goods and services sought by the household.

8.7.3 Landowner Motives and Choices

In summary, then, there are three important points to note from these observations. First, subsistence food continues to be the principal driver in land-use decisions of smallholders. Secondly, the increasing dependence of rural people on cash incomes, especially in relation to rising material aspirations and other non-market exchange transactions, is also driving land-use decisions. Thirdly, risk management strategies are directed at maintaining positive social relationships and a measure of protection against natural forces. These are important considerations in land-use choice decisions, and are also consistent with Maslow’s (1954) theory as set out in his needs hierarchy (see Figure 2.1). As discussed in previous case study chapters, smallholder decisions focus on three time horizons: the immediate future, principally in relation to food production; annual or similar cycles, principally in relation to recurring cash requirements; and the much longer-term, with significant bearing on the higher order needs such as security, self esteem and being liked and accepted by all the community.

8.7.4 Adoption and production decisions

As observed throughout the case study, landowners pursue wide range of livelihood strategies. Adoption and production decisions of the landowners are focussed on subsistence food production, maximisation of cash income, managing risks especially the issue of food security, and maintaining social and cultural network and stability within family ties.

In addition, the study also noted that landowners make informed judgements that lead to their land-use choice decisions. This is particularly evident with regard to the use of their land and their labour, especially if this fits well and do not affect already existing livelihood outcomes. While land-use choices generally appear to focus on the two interfacing economic systems, critical decisions between choices are consistent with what Rogers (1995) and Pannell et al. (2006) described as the ‘relative advantage’ of a given option. The choice of a particular option is based on what relative advantage that option provides against one or more rival options. This kind of behaviour has been observed throughout the study region. For example, the crop integration systems discussed in Section 8.2.2 exploits ways in which household labour savings can be made and used elsewhere. Similarly, landowners are sensitive to the relative
returns from cash cropping activities: when the price of copra was below their expected ‘return to labour’, and returns from green coconuts comparatively attractive, landowners along the North Coast quickly switched from copra production to the selling of green coconuts at roadside markets. Similarly, the landowners in the Gogol and Naru areas decided not to continue to lease their land for industrial pulp wood production when they felt that the rental fees they received as payment of using their land were not adequate. As a result, the area of land committed to commercial tree growing was reduced.

Extension and communication also proved very critical for the adoption and production decision of the landowners. The successful introduction and establishment of cocoa and coconut production on smallholdings throughout this case study region is attributed to the successful extension and communication services provided by government and the commodity boards. The experience of commercial tree growers, who felt that price and cost information was not communicated sufficiently transparently and so began to withdraw from tree growing, also illustrates this point.

8.8 Conclusion

It is clear from this case study that landowners engage in wide range of activities to satisfy their livelihood outcomes. Need for money is increasingly becoming an important consideration in the decision about the land-and other resource use choices. Landowners are readily willing to commit their land and labour to the activities that enhance their cash income opportunities. But, extension and communication are very important factors for the successful adoption and production decisions. It is apparent that the choice of a particular land use option should not compete for land, labour and financial assets of the landowner in such ways that it affects the outcomes of subsistence food production in major ways; and it will only be adopted in preference to other cash-generation options if it is judged likely to deliver more or comparable cash income, at equal or lower risk, to current options. The above points are important factors in land-use decision-making in relation to the choices that smallholders make; these are also the factors that are considered when making planning decisions for commercial tree growing options, as discussed further in Chapter 10.
Chapter 9: Land- and resource-use choices of PNG landowners

9.1 Introduction

This thesis focused on answering its primary research question, the basis on which Papua New Guinean landowners make decisions about their land- and resource-use options, from case study data in four regions of PNG. The theoretical insights drawn from Hierarchical Needs Theory (Maslow 1954), the Sustainable Livelihoods Framework (Chambers and Conway 1991), and Farmer Adoption Decision Framework (Rogers, 1995 and Pannell et al. 2006), enabled development of a conceptual model, the 'PNG Landowner Decision Environment' (Figure 3.3), as the basis for understanding these land- and resource-use decision processes. The model recognises, as do the theoretical frameworks from which it draws, that these decision-making processes are very complex, with many individual factors at play before a particular decision is reached. As depicted in Figure 3.3 and described in Section 3.3.2, the 'PNG Landowner Decision Environment' model recognises each of landowner motives, livelihood and risk management strategies, knowledge and skills, livelihood assets and outcomes, and institutional systems and processes as the key categories of factors relevant to landowner decisions. The factors are interrelated, and interact in the decision process. Therefore, the primary utility of the model is to accommodate a large and complex body of decision factors, synthesise them into constituent components to facilitate visualisation of relationships between them, and help identify the functional roles of the individual factors within the whole decision system.

In this chapter, I use this model to organise and synthesise findings of this study, in terms of the primary research question - On what basis do Papua New Guinea landowners make land- and resource-use choices? - and its sub-questions, What are landowner households’ livelihood strategies?; and How do these strategies influence landowner households’ land- and resource-use choices?. The implications of these findings for decisions landowners might make about adoption of commercial tree growing are considered in the next chapter. These issues are addressed in three parts, reflected in the structure of the chapter. In Sections 9.2 to 9.6, I draw on the results of this research across the case study locations, to identify common themes from the research as a whole.

9.2 Motives, needs and resource-use choices

As observed throughout this study, the land- and resource-use choices of the landowners are motivated by different sets of the household needs and wants. Here, results of the study showed that relationship between human needs and wants and the setting of priorities in land-and resource-use decisions are consistent with those Maslow (1954) postulated in his Theory of Needs hierarchy. This is illustrated by Table 5.10, which shows that landowners’ production strategies align with the needs hierarchy of Maslow’s theory, with basic needs for food and...
money at the base of the hierarchy. It was evident from this and the other case studies that landowners’ needs and consequent land- and resource-use choices focused on three time horizons: the immediate future, which is framed principally in terms of food production; annual or similar cycles, which are framed principally in relation to recurring cash requirements; and the much longer-term, which is associated with both intermittent cash requirements and legacy considerations.

The land-and resource-use choices between individual landowners varied greatly within and across the different case study sites. While the immediate foci of these choices were influenced by the daily need and wants of the households, decisions about cropping, scale and location of production, and how much labour and other resources to commit to these activities were influenced greatly by the personal expectation of the decision-makers. These expectations varied according to age, gender, social standing, household composition, tribal group, and access to and control of resources. In addition, attitudes and decisions about adopting new crops, the extent to which they are adopted, depended on how easy new crops were to manage and how compatible their management was with other household activities. This suggests that characteristics of crops and their husbandry practices are important considerations in the adoption and production decisions of landowners. Other factors that influenced the adoption decision were landowners’ beliefs and opinions about the new crops; perceived relevance of the new crop is to other components of their livelihood system; their level of motivation; and expected returns to their labour.

Furthermore, the study found that households choose what land and labour they need to allocate to subsistence food production, and then look at maximising income generation around these constraints. In many cases, the landowner faces a choice between continuing with a known crop variety, farming technology, or land use system, and adopting one or more of these with the expectation of better outcomes. However, as observed in this study, adoption choices are made without full information. The study also shows that many of the landowners are not risk-takers but, rather, are risk-averse decision-makers.

Many aspects of landowner behaviour observed in this study are consistent with the Farmer Adoption Decision Framework postulated by Rogers (1995) and Pannell et al. (2006), where decisions to adopt and remain engaged in the production of the crop or not are influenced by the landowner’s assessment of the relative advantage of the new introduction to the existing system. This has long been reported for PNG; for example, Epstein (1962) makes this point in describing responses of the Tolai people towards adoption and production decisions of cash crops. He noted that the successful introduction, adoption and production of cocoa in the Gazelle Peninsula of East New Britain reflected the ease with which cocoa production could be integrated with growing food crops on the same piece of land. As a result, landowners could expend scarce household labour to meet cash income needs as well as food needs. More
recently, Bourke and Harwood (2009) described the behavioural responses of smallholder growers in relation to prices fluctuation and the return on the labour.

In summary, then, the motives, behaviour and attitude of the PNG landowners sampled in this study were consistent with the expectations of the underlying theories, and with the results previous studies of landowner behaviour in PNG, reviewed in Chapter 2. The land-and resource-use choices, and decisions about various options in the livelihood system, were linked to the various needs and wants felt by households. Social, cultural and economic factors strongly influenced the attitude of the landowners and their decisions about adoption and production options. Individually, the choices and attitude to various land-and resource-use decisions varied widely between households across the case study sites; at the same time, there was high degree of consistency in the rationale for assessing and planning livelihood outcomes. As predicted by Maslow’s needs hierarchy, household food and clothing needs were most immediate, and planning for these were on an annual basis; in contrast, cash income, shelter and other recurring needs were planned and executed on a bi-annual basis or similar basis; others, including social and intergenerational obligations, were planned and executed on much longer term basis, with a minimum planning horizon of three years.

9.3 Landowners’ livelihood strategies and outcomes

As reported in Chapters 5 to 8, and discussed in their summary sections, the adoption and production choices of PNG landowners operate at the interface of two economic systems, the subsistence and cash economies. According to the Sustainable Livelihood Framework (Chamber and Conway, 1991), decisions are made to maximise household welfare through a choices that embody multiple household objectives such as food, security, shelter and provision for other subsistence goods and important purchases. As observed in this study, landowners grow their own food and build their own houses, and - with the money earned from selling their labour or cash crops - purchase clothes and food, educate their children, and buy medical treatment, transportation and communication services. While there are different needs and wants of individual households, there was a high degree of consistency in the outcomes across the case study sites. These comprised subsistence food production, cash income generation, risk management, fulfilment of social obligations, and pursuit of entrepreneurial opportunities. How each of the livelihood strategies influence landowner choices in their land- and resource-use decisions are discussed in turn below.

The land- and resource-use decisions of the landowners focused firstly on food production, largely for subsistence. Here, the primary considerations included adequate supply of the food types consumed, and generation of some surpluses as security in the event of adverse conditions, for sale at local markets, or for customary exchanges. These multi-faceted food production objectives significantly influenced landowner’s choices and their decisions on the variety of food crops grown, production system (where and how to grow crops), and how much
to produce at different times of the year. This further influenced their choices about the management system adopted and applied for food production, including use of land, labour and financial resources. Each of these factors is discussed separately subsequently. Landowners’ overarching objectives in making choices about adoption and food production strategies focussed on household self-sufficiency, prosperity, and security, and in maintaining stability and harmony in the production units (family and community) of which they are part.

The second consideration in the land- and resource-use decisions of landowners focused on generating cash income for the provision of clothing, building livelihood capital assets, and on meeting the costs of education and health and those of transport and communication services. In this context, the cash cropping and monetary cash economy are intimately connected. In this section, I focus only on landowner’s attitudes towards money and how this influences their land- and resource-use choices and decisions about cash cropping activities. Subsequently, in Section 9.4.3, I discuss the role of money in landowners’ livelihood systems, and its influences on their land- and resource-use decisions.

In most of the case studies investigated, varying degrees of cash cropping activity are undertaken as a portfolio in the household income strategy to meet their need for money. The choices of crops and their importance as a cash income-generating activity varied greatly between each of the case study sites. This was a consequence of the different agro-ecological zones, the potential of land for the different cash crop types, and household labour availability and financial resources. Landowner choices about cash cropping activities were further influenced by external factors such as market opportunities and accessibility, infrastructure, and technical information and communication. These factors interacted and influenced land- and resource-use choices of the landowners in complex ways, but the underlying attitudes influencing decisions about cash cropping activities were nevertheless consistent across the household and communities across the case study sites. These are discussed in turn below.

Through the eyes of the landowner, there are a number of different perspectives on money. The first is the importance of money and its role in landowners’ livelihood systems. The land- and resources-use behaviour patterns described in Chapters 5 to 8 clearly express landowners’ need for money and its importance in the household economy, particularly in relation to purchases of a variety of consumer goods and essential services. The second perspective of landowners on money is the perception of it being a way of expressing status and power. This influenced individuals to focus their small entrepreneurial activities on short-term income maximisation rather than sustained wealth creation. Adopting a short-term income maximisation strategy meant individuals had more money available to spend on activities that contributed to status and power recognition. However, this often led to high rate of failure for entrepreneurial activities such as trade store business, PMV’s, or cattle farming and, perversely, to undermining the prospects for longer-term wealth accumulation and the status that accompanies it. Thirdly, landowners perceive money as a means of security against
uncertainties and other risk factors such as food shortages, as well as a means for exchanges in important customary obligations. Finally, money is perceived by the decision-maker as an opportunity to provide leverage in improving their livelihoods. The changing pattern of consumer behaviour and attitude toward the role of money reflects the innate aspiration of the decision-makers to improve their living conditions. In this context, 'changing consumer behaviour' refers to the enhancement of living standards, especially changes in the types of food consumed and clothes worn, the types of shelter preferred, the tools purchased and used in economic production systems, and the accessibility to services that have been ongoing since the colonial era. For examples, many of the domestic dwellings in the case study regions are now constructed partly or wholly of modern building materials such as iron rooves, planed timber, steel posts, and louvered aluminium and glass windows. Many of the research participants now sleep on foam mattresses, and people wear a wide range of fashionable manufactured clothing. These perspectives collectively characterise landowners' perception about money, its importance, how it is obtained, and how it is used to change their livelihood systems.

In addition to food and cash income strategies, land- and resource-use choices also focus on risk management outcomes. It was apparent that landowners' attitudes towards risk and uncertainty, and to their perceived vulnerability to factors such as extreme weather conditions, were important in their adoption and production decisions. As noted in Chapters 5 – 8, landowners choose to grow different types of food crops that can sustain them during floods, droughts and other extreme weather conditions. Different gardening and land management systems observed in this study are part of their risk management strategies. The inclusion of food and nut tree crops in their land- and resource-use systems is an important part of this strategy. On the other hand, growing trees is not risk free, as they are exposed to threats such as fire, theft, and pests and diseases. Landowners manage these risks in a variety of ways: in the Upper Markham Valley, for example, the Ragigumpuan and Marawasa communities grow Eucalyptus pellita trees together with their food crops in a banana garden. This reduces the risks of bushfires, which are common in the region, burning their tree crops. The weed control and management necessary for food gardens also reduce the risk that weeds will suppress the trees.

Landowners' land- and resource-use choices also focus on building social capital and maintaining their extended family network. The Sustainable Livelihoods Framework (Carney and Conway 1991) recognises that social capital is an important asset from which people can draw to sustain their livelihoods. The extended family systems and social network observed throughout this study are important components of landowners' livelihood systems. Across the case study sites, between 14 and 17 percent of both mens' and womens' available weekly time is allocated to rest and social activities. Reciprocally, social networks and the extended family are the main source of labour for those activities that are time bound, such as the harvesting of cash crops or house building, or where high labour input is required during initial crop
establishment. Food and labour exchanges are important mediums in these transactions, but cash is also used at times.

Summary

In summary, the livelihood strategies and outcomes of landowners interface two economic systems: subsistence food production on the one hand, and cash income generation on the other. Food security, risk management, and social and cultural obligations were important determinants in household land- and resource-use decisions. Land- and resource-use decisions are influenced by the needs and wants of the household, with choices generally following the underlying principles postulated by both Maslow’s (1954) Hierarchical Needs theory and the Sustainable Livelihoods Framework (Chamber and Conway 1992). While survival, self-sufficiency, risk minimisation and maximisation of household income streams were the immediate foci of landowners’ decisions, decisions about agricultural and economic opportunities were also made with the objective of addressing the longer-term goals of prosperity, security and the enhancement of social values, while at the same time maintaining stability in both family units and the community.

9.4 Livelihood assets

The livelihoods framework previously proposed (Section 2.2.2) as part of the theoretical basis of this study suggested that there was a close link between the overall asset status of an individual, household or group, and the resources on which they can draw to enhance household livelihood security, or to undertake new activities.

Study findings show that there are three principal assets upon which rural people in PNG draw for a wide range of livelihood provisions; these are, as elsewhere, land, labour and financial resources. These assets, combined with critical decisions about their use, determine the security, prosperity and robustness of their owners and the communities of which they are part. The study results show that households seek to mobilise these resources, and the opportunities associated with them, in order to secure their members’ livelihoods. They do so through a mix of strategies that include subsistence food production, cash income-generating opportunities, participation in labour markets and social networking.

It is clearly evident from the case studies that landowners choose to commit their land, labour and financial resources to various cash cropping activities, particularly in situations where markets for these commodities are readily accessible. The option of commercial tree growing is little different to other choices in this context. The examples observed in the Madang case study region illustrates the willingness of the landowners to participate in commercial tree growing activities, in this case for the export wood chip market. This was because, initially at least, the market was readily available, and because commercial tree growing was a cash income generation strategy that was consistent with other elements of their livelihood system. This
example negates the view that tree crops for wood production are necessarily too long-term in nature to be attractive to landowners as a land-use option, and that this is the primary reason for the low participation by landowners in tree growing. The example of rubber in Western Province further illustrates landowners' willingness to wait seven years between planting and the first return from the harvesting of latex. While, in both cases, these are long waiting times to returns relative to other cash crops, this extended period corresponds to a different decision-planning horizon, as discussed in Section 5.3 (Chapter 5). This relatively long interval between planting and harvesting is a feature characteristic of many of the land- and resource-use choices of landowners, and is not limited to cash cropping options; it is also part of the culture of traditional food production strategies. For example, sago palm (Sagu matrixilon) takes 15 years to reach maturity before being harvested for its nutritive starch. Landowners in both the Madang and Western Province regions planted sago trees, either for themselves or for use by their children and future generations. Successful adoption and production of tree cash crops is partly attributable to this established practice.

However, the inputs required of landowners in growing commercial tree crops have also to be consistent with other elements and demands of their livelihood systems. For example, as discussed in Chapter 2, when ownership of the company purchasing and exporting acacia wood in the Madang region changed, and the new owners changed the production system to require more labour and capital inputs from landowners, landowners responded by reducing their participation in commercial tree growing. This example illustrates the multi-faceted nature of landowner decision-making about tree growing.

9.4.1 Land and livelihoods

As noted in Chapters 1 and 2, and discussed by many authors (Kanowski et al. 2008; Fingleton et al. 2005; Ward 1981), rural people in PNG view their land as the most essential element for their survival, security, stability and prosperity. Land and the decisions about its use are shaped in a number of ways by the landscape in which people live and by the resources and products of that land. While spiritual, recreational, and subsistence values continue to exist, land now also fulfils another important role in the livelihood system of its owners, namely for cash income generation, motivated by aspirations for material wealth and improved quality of life. This is evident in the pattern of adoption of existing agricultural practices observed throughout the case study areas and reported in Chapters 5 to 8.

The choices in the crop adoption and production decisions of the landowners and land users were influenced in a number of ways by their land assets. These included land ownership rights and associated matters regarding long-term crop tenure and security, the potential of land as the basis for agricultural production, and the implications of population pressure for different land uses.
Land tenure and crop production

As observed throughout this study, the customary land tenure system of PNG underlies land use options and decisions. It is characterised by complex systems of rights and obligations, with different categories of owners and users, each with correspondingly different responsibilities of its custodianship (Fingleton et al. 2005). Decisions about land allocation and use are made in accordance with prevailing social and cultural values of kinship and morality. While this tenure system provides greater flexibility for its owners and users in subsistence production, its application in cash cropping is generally less flexible. This was particularly evident in the Western Province, where decisions about choice of cropping, where to grow and for how long were very critical, depending on whether the decision-maker is a landowner or a land-user. In this case study region, the land-user’s choice of cropping is limited to annual or food crops only; the ‘land-user’ cannot grow annual or perennial cash crops, in part because such use denies access to other members of landowning or land-using groups. As Ward (1981) observed, people now make a distinction between using land to grow food for home consumption and using land for commercial purposes; they are typically prepared to give non-owners access to land for food, but not for cash crops. This was a major reason, among others, for the low level of participation in smallholder rubber growing for latex production.

In the case of the Western Province case study, there are many members of community who are in the ‘land-user’ category, principally those whose parents or grandparents were relocated to their present location. Furthermore, while the notion of collective control and use of land still exists, it has taken a more strategic meaning, such as limiting outsiders’ access and use. With cash cropping agriculture, people (especially men) have adopted an individual system of land ownership. For example in the case of rubber, the period of crop tenure exceeds 20 years, which limits other members in the landowning group from accessing or using the land on which rubber trees are grown for this period; rubber growing is thus regarded effectively as individual ownership. With such long-term crop tenure, it is easy for the next generation to understand the land in question as under private ownership. These issues have direct implications for commercial tree growing options and strategies, as discussed in subsequent sections.

Land potential and population density

Choices of crops, their adoption and production practices, and their levels of productivity are often linked to two important attributes related to land. These are the capacity of land for production purposes and the population density. Both of these factors interact in a variety of ways to influence landowners’ land-use decisions (Bourke and Harwood 2009). For example, Hanson et al. (2001) note the land potential in the upper Ramu region as being moderate and constrained by rainfall and frequent flooding. This land potential, combined with the climatic conditions of that region, shape most decisions about crop adoption and production practices. In
this case, the practice of having ‘mountain’ and ‘valley’ gardens, and the types of crops cultivated in the subsistence food production systems, are greatly influenced by the land potential. Apart from subsistence food production, the successful adoption and production of a range of cash crops in the region - including sugarcane, oil palm, peanuts and trees for wood products - attest to both the potential and the limitations of the land’s potential. For example, agricultural cash crops are essentially limited to suitable parts of the valley floor, whereas trees grown for wood can be grown on both hillside and valley floor land.

One of the most common adoption and production behaviours observed throughout the case study regions was the crop integration strategies practised by landowners. This behaviour reflects the landowners’ understating of what potential the land has in relation to the range of expected outcomes from that land. While the primary aims of landowners may include diversifying opportunities and outcomes while at the same time managing risk, the productivity of these outcomes greatly depends on the land potential itself and the extent to which it can satisfy landowners’ expected outcomes. For example, in the lower Madang region, coconut and cocoa - the main cash crops for this region - are frequently planted together on the same parcel of land. Many other economic trees, including the Areca palm, piper vine, tulip (*Gnetum gnemon*), breadfruit, and pandanus are grown in between and along the rows, sago palms are cultivated along nearby creeks, and a variety of other fruit and nut trees are also grown on the same block of land. Such a production strategy requires a thorough understanding about organising the range of tree species involved and matching them to site, their physiological requirements such as shading and spacing, and crop planting densities for each of the different crops that are cultivated. These are all linked together in a sound understanding of the biophysical conditions of the specific area of land, such as soil depth, drainage, fertility and slope.

Population density affects the adoption and production decisions of landowners in very similar ways to the effect of land potential. In terms of agricultural production, population density refers to the number of people depending on a unit area of land for agricultural production and for other livelihood necessities. The most significant impact of population density on land-use decisions is the pressure being applied on the land as result of increasing population and, in particular, the farming practices adopted and implemented in agricultural production. Boserup (1965) used the term ‘population-based model of intensification’ to describe this kind of influence on the farmers’ land-use decision processes in subsistence production.

The principal assumption in Boserup’s (1965) model is that producers are capable of increasing the productivity of their lands by applying appropriate farming methods. However, because such methods typically demand a higher labour input per unit of production, they tend to be adopted only when population pressure and resulting land scarcity makes farmers work harder to maintain their existing levels of subsistence. Population pressure on land can also limit
commercial agricultural activities, by constraining the extent of land that landowners are willing to commit to these non-subsistence activities. However, it was not entirely clear from the data in this study whether or not the production practices that were adopted across the case study regions, especially the mixed farming strategies of landowners, were motivated as a result of scarcity of land, a scarcity in labour, as part of a risk management strategy, or the interaction of the all of these factors. Interviews with the landowners regarding this issue suggested a variety of factors were at play. Allen et al. (2005) similarly observed that determinants of intensification are multidimensional and include social, economic, demographic and environmental factors interacting over time, even though they may appear to be singular for a particular time, place or system.

For example, in the upper Ramu Valley, the low population density of 7 persons per square kilometre (Hanson et al. 2001) implies that an excess of land is potentially available for other uses, including for commercial tree growing. The commercial agricultural activities observed in the upper Ramu region can be partly attributed to this low population density, and partly to the other factors discussed by Allen (2005) and observed in this research throughout the case study regions – primarily landowners’ interest in generating cash income, provided their subsistence food needs could be met. In contrast, in Western Province, although population is low, the potential of land for cultivation is greatly constrained due to high rainfall, poor soil and frequent inundation, thus forcing people into intensive cultivation practices in some part of that case study region. Others, for example McAlpine (2002), note that rural village-based food production in PNG is dependent mainly on crops with low or negligible storage lives. In such cases, the subsistence system has to ensure adequate yields on a daily basis with near absolute certainty of output. That study concluded that food production behaviour is based on risk minimisation, rather than yield maximisation.

While increasing population density can create competition for land between different outcomes, such as between food production and cash income generation, it also offers the prospect of increased, labour being required for intensified agricultural production. This perspective is considered and possibilities are presented below, in Section 9.4.2.

**Summary**

In summary, the choices landowners made about the use of their land assets in the case study regions were influenced by number of factors. The first of these were decision-makers’ status, rights and custodianship responsibilities in the context of the complex PNG traditional land tenure system. These matters greatly influenced, and variously constrained, landowner’s decisions in the choice of crops and land uses. The second factor influencing landowner land-use choice is land potential and population density. These affected, variously, crop productivity, crop integration systems, levels of input and management and tenure systems. Commercial tree
crops have both advantages and disadvantages in these contexts, as discussed further in Chapter 10.

9.4.2 Labour and livelihoods

Following land, labour is next most important asset available to the rural people in Papua New Guinea (Bourke and Harwood 2009). Discussions presented throughout Chapters 5 to 8 provide specific details on how household labour is allocated to the various livelihood activities of those households. Here, I discuss the influence of labour-related factors on the labour-use choices of landowners. These include demographic and socio-cultural factors, and the education, experience and skill levels of the decision-makers. These are discussed in turn below.

Demographic factors

Demographic factors affect labour supply and demand in the household. The adoption and production decisions of those surveyed in this study were directly related to household labour availability. It was evident in all case study regions that households' land-use decisions were constrained primarily by a shortage of labour. The weekly distribution of household labour to various components of livelihood strategies, discussed in Chapter 5 – 8, indicates the relative significance of these components. For the cases studied, subsistence food production and cash cropping were prioritised, with more than 40 percent of the available male labour allocated to these activities. For women, meal preparation, child-care and subsistence food production were prioritised, accounting for 50 percent of available weekly labour. The second aspect of note about the weekly distribution of labour is the large number of activities that constitute landowners' livelihood systems, each with varying household labour demands. On average, both men and women undertake up to 10 different activities in a week as part of household livelihood strategies (Table 5.9, Table 6.6, Table 7.7 and Table 8.8). The allocation of labour to a particular activity depends on individual household judgements of the expected output values of that activity.

Both of these factors, independently or jointly, influence labour-use choices of the landowners in number of ways. For instance, the analyses of tasks and labour allocation in livelihood strategies in Chapters 5 to 8 show that, in the upper Ramu region, a total of 13 percent of both male and female labour was allocated to subsistence food production activities, while 34 percent of labour was allocated to activities associated with cash income generation. The allocation in the upper Markham Valley was almost identical, at 14 and 33 percent respectively, and that for the Madang region was quite similar, at 12 and 42 percent respectively. In contrast, the time allocation in Western Province was different, with 54 percent of household labour allocated to subsistence food production and 11 percent to cash income activities, reflecting the different situation of these communities in terms of both access to land and markets, as discussed above, and labour availability, as discussed below. These results
illustrate, firstly, the importance of cash income for households in all case study locations, as well as the more limited opportunities for cash income generation in Western Province.

Secondly, the large number of livelihood activities means that scarce labour resources are spread thinly across each of them. This has a bearing on the scale of production, e.g. how big or small the gardening or cash cropping area, the (ir)regularity of maintenance schedules, inconsistent harvesting and sale of products, and even neglect. The size and number of gardens, and the scale of cash cropping activities, were proportional to size of the household labour pool. Table 9.1 presents the size of households and the average number of persons living and contributing to the economic activities of the household in the case study locations.

<table>
<thead>
<tr>
<th>Household size</th>
<th>Upper Ramu</th>
<th>Upper Markham</th>
<th>Western Province</th>
<th>Lower Madang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pers./h'hold</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One to three</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Four to six</td>
<td>30</td>
<td>20</td>
<td>50</td>
<td>46</td>
</tr>
<tr>
<td>Seven to nine</td>
<td>240</td>
<td>62</td>
<td>16</td>
<td>113</td>
</tr>
<tr>
<td>Over nine</td>
<td>99</td>
<td>18</td>
<td>9</td>
<td>41</td>
</tr>
<tr>
<td>Total persons</td>
<td>373</td>
<td>104</td>
<td>79</td>
<td>204</td>
</tr>
<tr>
<td>No. of H/holds</td>
<td>50</td>
<td>15</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Mean size</td>
<td>7.5</td>
<td>6.9</td>
<td>5.2</td>
<td>6.8</td>
</tr>
</tbody>
</table>

In Western Province, the average number of persons per household is 5.2, comprising a married couple and an average of 3.2 children. About 65 percent of the available labour in the Western Province case study region was directed to subsistence food production activities, and little labour was available for other activities. In the Upper Ramu region, the average household size was 7.5 persons, comprising a married couple and an average of 5.5 children. This size is relatively high compared to other case study regions; however, 32 percent of members are children aged between 0 – 10 years; that proportion of the population is not likely to be making a direct contribution to the household economy. This has a net effect on the household labour availability for both cash cropping and cash income activities. The narrative of the conversation with RAIL extension officer and landowner presented in Box 5.2 and Box 5.3 is a typical portrayal of the underlying issue, in this region as elsewhere, about competition for labour by competing land use options. In the Lower Madang and Upper Markham regions, the average household size ranged between 6.6 and 6.9 persons, comprising a married couple and average of 4.6 and 4.9 children, respectively. In the Lower Madang region, the labour shortage was not as acute as that in Upper Ramu or Western Province. This reflects, at least in part, the rotational crop integration system of food crops and acacia trees, which results in both labour saving and increased crop productivity. Similarly, the narrative presented in Box 6.1 in relation to decisions by the Ragigumpuan communities to grow trees for their own use is influenced partly by the hardships and the high labour demand associated with collection of house building material.
Social capital and household labour needs

As alluded to earlier, apart from building and maintaining the bonds between kinship and extended family ties, social activities of the landowners - such as exchange of food, other material items and favourable services - also enhance alliances and build important social network systems within their communities. This enables them to invest and draw labour from the community when needed, particularly in situations where the given work assignment is pressing and has to be completed within a given period of time, but the labour for which in the household is inadequate. This situation is quite common for many households in the case studies investigated. The example in the Upper Markham Valley illustrates this, where labour from the Ragigumpuan village youth network alliance was drawn from to collect house construction material from long distances. This activity was particularly suited to that category of the population in the village community.

The study noted that a high number of different social grouping networks formed with specific purposes and operated in the communities. These included categories such as networks of village youth groups, networks of women’s church fellowship groups, and networks of village sport groups. While the primary purpose for these groups focussed on particular interest for which it is formed, the different networks provided an important source from which individuals, households, and small groups within the village communities secure and access the labour resources. In cases where group labour is drawn upon, a set fee is paid and it goes to the group’s fund raising account. For example, as observed in Madang youth groups are hired to carry the logs from the stumps to road side for collection by the delivery truck. These funds are used to finance social and sport activities of the group. As Curry and Koczberski (2009) noted in the smallholder cocoa production in East New Britain Province, activities not related to cash income generation but important to maintaining social cohesiveness and kinship tend to draw significant time and labour away from cocoa production. While this may often be the case, these obligations may also have the opposite effect, namely to motivate smallholders to commit extra time and labour to raise funds for community purposes. Similarly, in the Upper Ramu Valley case study region, labour was drawn away from gardening and cash cropping activities at Bopirumpun village to host a church-related gathering in their community. Apart from both positive and negative impacts on household production, this behaviour contributes to the longer-term stability and maintenance of the community cohesion, to which households attribute a high value.

Skills and experience

The skill of a decision-maker is very important factor on the labour resource–use choice decisions. Adoption and production decisions in any land-use choices are greatly influenced by the skill base, knowledge and experience of the decision-maker. As demonstrated throughout Chapters 5 to 8, decision factors are complex and interact in different ways, but the skills and
experience of a decision-maker are fundamental to the success of adoption and production decisions. Decision about which crops to grow, how to grow them, when to harvest and how to market, depend on the skills and experience of the decision-makers, and some of these depend on their level of education. Literacy and numeracy skills were important in the interpretation of market information, communication, banking, and other external factors that directly influence landowner’s decision-making processes. While access to information is critical in the decision-making process, the education, skills and experience of the decision-maker determine how available information is analysed and used.

**Summary**

In summary, labour availability and constraints in the household may be characterised as follows. Labour availability in the household includes access to the labour of both married and unmarried children, the extended family network system, and social and cultural mechanisms of labour organisation and mobilisation. The head of the household controls both the labour and the opportunities for extra income for those who are engaged in household labour. In terms of constraints to labour supply, households with labour constraints were those with few adults or older children, or where household members had health problems; those experiencing competing demands between farming, employment and other livelihood strategies, which diverted labour to competing non-economic activities, for example, for church programs; those with underutilisation of available labour; those in which there were perceptions that a household head was not fulfilling his obligations to the household; and those which made little use of traditional strategies for labour mobilisation, or did not bring in hired labour. The education, skill and experience of landowners influence their options and choices land- and resource-use decisions, and particularly enable or constrain households’ capacity to engage successfully with income-generating activities such as commercial tree growing. As Pannell et al. (2006) note, the ability to make critical judgements and take risks in a land-use options - including that of commercial tree growing, decision process is greatly influenced by the educational, skill set and experiential attributes of the decision-maker. This issue is discussed further in Section 9.5.2.

**9.4.3 Finance and livelihoods**

Financial assets are the third important category of resource on which people rely for a range of livelihood outcomes. Financial capital includes cash, savings, credit, remittances, pensions and other economic assets, including basic infrastructure, production equipment and technologies (Carney 1998). Financial assets perform an important role in the livelihood outcomes of the people. For example, Rakodi (2002) notes that the ability of households to withstand stresses is greatly dependent on their capacity to accumulate or access financial assets to smooth consumption, cushion shocks and invest in productive assets such as health, the skills of household members, business enterprises and housing. The concept of a ‘financial asset’ can be separated into two broad categories for rural people in PNG. The first of these is the savings
realised from income earned; the second is the range of accessible resources that are readily converted into cash when needed. The sources of financial income in case study households, and how income is earned and spent, have been explored discussed in Chapters 5 to 8.

This section takes a broader focus by examining factors driving rural Papua New Guineans' motivation for money, and how this has affected the land-use choices of landowners. To gain a better understanding of these drivers, it is necessary to explore the role of money in the household economy of PNG landowners, in particular the role of money in food and non-food consumption. Such an understanding is relevant to the overarching drivers that motivate land-use decisions associated with financial opportunities, and the bearing these have on the options for commercial tree growing.

Role of money in food consumption

This study has revealed that the consumption patterns of rural people in the case study regions of PNG have changed in a number of ways as a result of the increased consumption of introduced foods, the purchase of local goods, and the increased use of income for non-food consumption. Specific details have been discussed in Section 2.7, and in Chapters 5 to 8. Bourke et al. (2009) estimated that, in 2006, some 83 percent of energy food and 76 percent of protein food consumed in PNG was domestically produced, with the balance imported. They also note that the purchases of rice and other imported food items have increased from a base of zero since colonisation in 1880's to over 26 percent and 87 percent for rural and urban households, respectively, in 1999. A similar trend in the pattern of consumption is observed for wheat, lamb, mutton and other consumer goods, including clothing, appliances and tools needed by the household. Behavioural change in consumption patterns is strongly associated with the increasing use of money in the household economy. The proportion of fortnightly income spent on food items, both from trade stores and from informal markets, in the case study regions was greatest in the upper Ramu Valley (50 percent), and similar in Lower Madang (45 percent); it was least in the upper Markham Valley (27 percent), and intermediate in Western Province. The high proportion of expenditure pattern between closely neighbouring regions of Upper Ramu and Upper Markham valley is relative to the income earned. This observation suggests that some of the basic foodstuff and consumables are essentially important or are becoming staples for the household livelihood system in these regions and therefore their purchases are necessary, irrespective of the level of income earned. However, in absolute terms, the average fortnightly expenditure was comparable in the two regions of lowest income, Ramu and Western, at K110 and K100, respectively; that in the two regions of highest income, Madang and Markham, was K249 and K159, respectively. These results suggest that households across the case study sites choose to spend a proportion of their income on consumer goods, particularly basic foods such as rice, oil, floor, biscuits, salt, sugar, tea and canned protein, regardless of income level. This in turn suggests some of the purchased foods items are becoming staple for even poor households.
The changing household consumption behaviour follows the assumptions postulated by Maslow’s Needs Hierarchy, in which money is spent on satisfying the basic needs such as food before moving to higher order needs.

More than 75 percent of this expenditure was spent on purchasing trade store foods such as rice, wheat, mutton and other imported food products. Other consumables such as soap, detergents and fuel represented between 15 and 18 percent of the fortnightly income for all case study regions. The cost of transport and health services similarly represented between 15 and 20 percent of the fortnightly income. The remainder was spent on miscellaneous items including cigarettes, tobacco, betel nut and church donations. The changing trends in consumption behaviour observed can be attributed to the increasing ability of the household to acquire trade store goods; this, in turn, is influenced by the capacity of the household to generate and spend cash income. The principal sources of household income were agricultural activities, the sale of labour, and other rural entrepreneurial activities, such as operating PMVs, cocoa drying and trading, trade stores, and cattle and poultry enterprises. The role of money and its influence on resource-use decisions are significant drivers in the land- and resource-use choices of landowners.

Role of money in non-food consumption

Aside from the expenditure on food, the use of money has become increasingly important for a variety of other livelihood outcomes of PNG landowners. The data in Table 9.2 illustrate the role of money in people’s livelihoods, and how significant that role is in certain components of household livelihood systems and economies.

<table>
<thead>
<tr>
<th>Expenditure Items</th>
<th>Upper Ramu</th>
<th>Upper Markham</th>
<th>Western Province</th>
<th>Madang</th>
</tr>
</thead>
<tbody>
<tr>
<td>School fees</td>
<td>1000</td>
<td>1600</td>
<td>1200</td>
<td>1600</td>
</tr>
<tr>
<td>Tractor hire - peanut cultivation</td>
<td>900</td>
<td>1200</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Equipment (generator set, video, DVD etc)</td>
<td>-</td>
<td>3500</td>
<td>-</td>
<td>4500</td>
</tr>
<tr>
<td>New clothes</td>
<td>150</td>
<td>200</td>
<td>150</td>
<td>300</td>
</tr>
<tr>
<td>Kitchen Utensils</td>
<td>125</td>
<td>150</td>
<td>150</td>
<td>500</td>
</tr>
<tr>
<td>Tools</td>
<td>120</td>
<td>180</td>
<td>150</td>
<td>300</td>
</tr>
<tr>
<td>House construction</td>
<td>120</td>
<td>130</td>
<td>150</td>
<td>600</td>
</tr>
<tr>
<td>Customary Exchanges</td>
<td>150</td>
<td>200</td>
<td>4100</td>
<td>150</td>
</tr>
<tr>
<td>Total</td>
<td>2565</td>
<td>7160</td>
<td>5900</td>
<td>7950</td>
</tr>
</tbody>
</table>

For example, the financial requirement associated with education is a very important determinant in land- and resource-use choices. The proportion of educational expenses for children is the highest single cost item of household major expenses. This was highest in the
Upper Ramu region, at 40 percent of the total non-food consumption; in each of the other three regions, the corresponding proportion is around 20 percent. Although the total cost of education for the Upper Ramu region is the least of the four regions, the much higher proportion reflects the relative cost of education against the low level of cash income in this region. In all case study regions, the cost of children’s education is a critical one for households, and has a significant influence on the way land- and resource-use decisions are considered and made by the landowners. In the case of Upper Ramu region, many of the school-age children could not go to school or complete schooling beyond grade five or six, because parents could not afford school fees. While the opportunities for cash income activities in the Ramu valley are high, the land disputes discussed in Chapter 5 have adversely influenced people’s views of cash cropping and limited their involvement in cash cropping activities – illustrating how vulnerable households can be in the face of such constraints.

Re-investment in activities that are likely to generate further cash income was the next most significant cost item after education. For example, in the upper Markham valley 65 percent of their expensed were represented by the cost of tractor hire for cropping, and consumer items such as electric generator sets, videos, and DVD players. All of these activities are associated with making money. Similarly, in the Madang case study, reinvestment accounted for 57 percent of the expenses were associated with the purchase of items that are likely to generate more money. This included purchases of electric generator sets, videos, and DVD players in order to screen movies in the villages to make more money. In the case of Ramu region, the reinvestment accounted for about 35 percent of the annual expenses. This associated mainly with tractor-hire to increase peanut production. Increased product meant greater quantity for sales. In Western Province, the cost of bride prices represented 68 percent of the total annual income. Other major expenditure items were the cost of clothing, and expenditure on customary obligations and duties.

In addition to food and non-food consumption, money also performs an important role as security against the impacts of natural disasters. This was particularly important when natural causes such as flood, drought or frost affect food production. With financial reserves, people can purchase foods such as rice, flour, animal fat and vegetable oil from trade stores to continue until the calamity passes and the situation normalises. Bourke et al. (2001) extensively discussed the role of money in food security in PNG.

In addition to food and non-food consumption, financial assets also play an important role in capital building to enable households to venture into business opportunities. Results from this study suggest that, after satisfying basic needs such as food, clothing and social obligations, landowners also save money towards investing in small business ventures. As discussed throughout Chapters 5 to 8, the most common of these activities include providing transport services (typically a PMV or outboard motor boat), trade stores, poultry-raising, secondary processing of cocoa and other rural entrepreneurial activities.
Summary
In summary, the desire and need for money influences the land- and resource-use choices of landowners. The households allocate what land and labour are necessary to subsistence food production, and then seek to maximise income generation from their remaining assets and resources. Trends in food and non-food consumption, and the cost of education, health, communication and transportation services, are exerting strong pressures on households to generate income. Thus, money is already significant in households' livelihood systems; and the desire to improve living conditions is driving decisions that seek to increase cash income. Potential income-generating opportunities, such as commercial tree growing, have to be seen in this light.

9.5 Knowledge, skills and land- and resource-use choices
This section discusses how the knowledge and skill base of the decision-makers influence and affect livelihood choices and the decision-processes. It focuses firstly on the educational level and opportunities for employment, in particular selling labour. Secondly, it considers the education and skill base of the landowners and how this influences their ability to make informed decision.

9.5.1 Education, labour skills and opportunities for employment
Educational levels and labour skills relevant to formal employment opportunities affect household land-and resource-use choices in two main ways: in opportunities for selling labour into the skilled labour market sector, and in the capacity of landowners to make informed decisions about land- and resource-use options. Although employment opportunities for non-skilled activities were evident and readily available to the local people in all case study regions, the general lack of skills necessary for employment in the formal sector was a significant constraint, leading to the low level of participation in employment opportunities requiring trade or vocational skills, and the higher incomes associated with these opportunities. This was most evident among the Mari people in the Upper Ramu region, where most households could not benefit from the local demand for skilled labour, as they lacked the necessary skills. A similar situation was observed in the Western Province case study region. For Papua New Guinea in general, most rural employment opportunities are for unskilled workers. This means the income generated from selling household labour is relatively low, as unskilled labour is paid at the lowest market wage rate, as directed by the State.

9.5.2 Education and decision-making
The ability to make informed decisions on the adoption and production choices was a major constraint observed across all case study regions. This is an important barrier affecting landowners in their land-use decision-processes. In particular, the poor uptake of and
participation in adoption and production activities was linked to the existing low levels of education and the kinds of awareness raising to which landowners could respond. The study communities remain rooted in an oral tradition of communication. The majority of informants, despite achieving some level of primary and secondary education, lack basic mathematics, reading and writing skills. Furthermore, because opportunities are based on alternative knowledge that is embodied in the modern market and economy, many landowners lack the foundations necessary to acquire the skills needed to achieve good adoption and production decisions in that context. Although the actual education levels varied between each case study region, the general pattern is evident, with the majority of households in all regions characterised by less than eight or less years of education, and little post-secondary education.

Data presented in Table 9.3 provide an overview of education level received by household members. Without basic education, landowners lack skills needed to interpret important information about livelihood-enhancing opportunities.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Ramu</th>
<th>Markham</th>
<th>Western Province</th>
<th>Madang</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 30</td>
<td>35</td>
<td>25</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>31 - 40</td>
<td>25</td>
<td>15</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>41 - 50</td>
<td>15</td>
<td>6</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Over 50</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>n(total number)</td>
<td>50</td>
<td>20</td>
<td>15</td>
<td>35</td>
</tr>
<tr>
<td>Highest level of education</td>
<td></td>
<td></td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Grades 1 - 4</td>
<td>35</td>
<td>5</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Grades 5 - 8</td>
<td>37</td>
<td>30</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Grades 9-12</td>
<td>8</td>
<td>10</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Trade/college</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

As discussed in Chapter 5, the failure of smallholder cattle production after its initial successful adoption in the Upper Ramu Valley was due primarily to landowners’ limitations in making informed judgements and decisions. The Mari viewed smallholder cattle projects when they were first introduced as a new way of expressing prestige, fame and identity. They therefore chose to commit their land and labour resources to implementing cattle projects. However, when cattle projects competed for labour with food production, and with increasing pressure for bank loan repayments, their positive motivation quickly dissipated. The adoption and production behaviour of Mari landowners could be traced to their low levels of education and the associated low awareness of the technical and management requirements of the new enterprise. This impeded the comprehension necessary to understand the knowledge system of how both market economies and cattle production worked. Understanding and achieving this
knowledge was essential for the adoption decision of the smallholders to be successful in the longer term.

Acquiring and internalising this knowledge system required the participants to have basic numeracy, writing and reading skills. In this regard, education and awareness play an important role in the process of internalisation and capacity enhancement in the decision-making process of landowners. Pannell et al. (2006) observe that adoption is a learning process with two distinct aspects. One is the collection, integration and evaluation of new information to allow better decisions about the innovation. The other aspect is improvement in the landholder’s skills in applying the innovation in their own situation. This requires a certain level of knowledge and skills on the part of the decision-maker, to apply and practice new innovation. Rogers (1995) and Pannell et al. (2006) broke this complex and dynamic process of internalisation into stages: relative advantage, observability, compatibility, complexity and trialability. These attributes were discussed in the PNG context in Section 2.5.2. Understanding the critical components of these attributes in the PNG context may offer insights that assist the facilitation of a more rapid and more completed knowledge internalisation process.

9.6 Institutional systems and processes

This section considers institutional systems and processes that influence landowners’ land-use choices. Of primary concern here are customary land tenure systems, relevant government policies, and cultural attitudes and perceptions about new crop, market, and infrastructure systems.

9.6.1 Customary land tenure and its implications for commercial agriculture and forestry development

In rural Papua New Guinea, people and land are intimately connected. The review of traditional land tenure systems presented in Section 2.6.1 discussed the relationship between people and their land. As observed throughout this study, the land tenure systems in PNG are very complex, due in part to the fact that the principles on which the customary tenure systems operate are not written down, but are maintained through time by customary rules and everyday practices. The key characteristics of these systems are: tenure is based on privatised ownership, established on local societal principles (Ward 1981; Fingleton et al. 2005); within this system, there is a wide range of rights vested in customary groups and individuals within them; these groups are based on kinship relationship; kinship group (or clans) are the main landholding units; decisions regarding land and other natural resources can be made at different levels of the groups; or often these are made at the level of the clan. The main land-using units are individuals or small household units. Men, particularly chiefs, elders, or senior men within the customary group have a main say in the decisions over the group’s land matters. As discussed in
Section 9.4.1, the use of land for subsistence production poses few major constraints on the choices of its owners and users. However, the use of land for cash cropping production is more problematic, particularly where cash crops have a longer tenure that restricts access of other members of the landowning group.

In addition, the landholding arrangements within these tenure systems have implications for the scale of production. The landholding of a particular landowning group may not be continuous, but may comprise a large number of pieces of land scattered within a larger territory. The land claimed by families within the groups land may comprise a large number of small areas of land. While land parcels may be used by an individual family, the right to use them probably does not reside in one person, but in a number of close relatives. These factors mean that use of land for large scale commercial agriculture and forestry projects is constrained: firstly, in terms of the scale of activities; secondly, because it is necessary to gain the permission of many different owners, usually requiring complex and lengthy negotiations; and thirdly, land cannot be used as a collateral when a commercial loan is sought. The lease, lease back arrangement discussed below was developed to overcome this limitation.

As observed throughout this study, the customary tenure system does not preclude large scale agricultural or forestry development. Most of these development schemes have been established through ‘lease, lease back’ arrangements under the Lands and Land Groups Incorporated Act 1974, which assists customary landowners to obtain registered titles that facilitate loans for commercial cash cropping. The state leases a defined area of land from customary landowners for an agree period and then leases back to the owners a lease, registered under the land Registration Act for same period of time less one day. In the case study regions, sugar (Upper Ramu), oil palm (Upper Markham) and acacia (Lower Gogol and Naru near Madang) plantations had each been established under these arrangements. These arrangements facilitate customary landowners’ entry into commercial agriculture and forestry activities without placing their land ownership at risk, and to the mutual benefit of both the private investor and the landowners. The landowners gain leverage to financial and other economic development opportunities in return for lease of their land capital, while private investor gains access to customary land and the associated production opportunities. More recently, outgrower schemes, such as those developed between Ramu Agri Industries Limited and landowners for oil palm and sugar, have emerged, as discussed in Chapters 2 and 5. As explained in Sections 2.6.1 and 2.9.7, at Gogol, Naru and parts of North Coast region near Madang, JANT Limited sign agreement with the interested individual landowners within 40 kilometre radius of its wood-chip processing plant to grow Acacia trees on their customary land and buy from them for its export wood chip production. Here, the arrangement is a private one between the landowner and JANT Limited. JANT provides labour and equipment for the establishment, maintenance, and harvesting of logs at crop maturity. It also provides transportation of logs to its processing plant. It pays the landowner after deducting all of its cost. It is more flexible, and is not subject
to the ‘lease, lease-back’ arrangement. The JANT arrangements proved attractive to landowners until the company made a series of changes to the terms under which it would purchase wood from landowners, including increased labour requirements and delivery costs. Other arrangements in forestry include arrangements between the National Forest Authority and customary landowners, who enter into agreement about tree growing on customary land, with the understanding that profit is shared at the end of the crop. An example of this is the Fayantina project in Eastern Highlands Province (pers.com., Project Manager, Fayantina).

In summary, the case studies provided ample evidence that ‘conventional’ agriculture and forestry plantation development could take place on customary land, provided that any disputes over land ownership can be resolved. They also demonstrated that appropriately designed outgrower schemes are an effective and promising way of engaging landowners in plantation crop production, but that landowners will not persist with such arrangements if they feel they are being disadvantaged or if they are no longer compatible with other priorities in their livelihood systems.

9.6.2 Agriculture and forestry policies

A policy is a statement of intent, or a plan to guide decision-making and actions in order to achieve the stated goals (Allen 2009). Policies set principles and guidelines, but are not enforceable in the courts, except through acts of parliament that establish the principles of a policy as laws (Allen 2009). This section presents an overview of national agricultural and forestry policies relevant to smallholder participation in cash crop production, and how they influence landowners’ land-and resource-use choices.

After World War 2, Australian colonial agricultural policies had two main objectives; the first was to promote the commercial plantation sector and provide Australian Settlers with the full benefit of modern agricultural scientific knowledge; and the second was to promote smallholder peasant proprietorship (Allen 2009). This resulted in research, extension and development on tree crops; initially, coffee, cocoa and coconut, and subsequently oil palm. In the past decade, four areas have been emphasized for agriculture sector development:

- Equitable delivery of quality agricultural services including fisheries, and forestry
- Increased food security and nutritional levels for those involved in subsistence agriculture with little cash production;
- The development of export commodities, including diversification into alternative crops in order to reduce vulnerability to price fluctuation of traditional export crops;
- Development of downstream processing for agricultural crops, fish, timber and other resources, including cottage industries

Source; Gwaiseuk (2001)
In the forestry sector, the National Forest Policy expresses the primary policy goals as:

- Management and protection of nation’s forest resources as a renewable natural asset and
- Utilisation of nation’s forest resources to achieve economic growth, employment creation, greater Papua New Guinean participation in industry and increased viable onshore processing.

Source: Papua New Guinea National Forest Policy, Ministry of Forest 1991

Reforestation and eco-forestry policies intended to support these objectives remain in draft form, and have not yet been promulgated (Kanowski et al. 2011). The draft reforestation policy is the more relevant of these: it promotes reforestation and the establishment of ‘woodlots, agroforestry and tree planting, encourages the use of high-value local species and timber production within agroforestry system, and outlines the respective responsibilities of landowners and other parties’ (Kanowski et al. 2011).

Kanowski et al. (2011) reported that policy settings for commercial tree crops were favourable, but that the capacity to deliver on the policy objectives is constrained by the lack of extension services and inadequate basic public sector infrastructure. Where these public services and infrastructure do exist at sufficient levels, or are provided by private sector, e.g., for cocoa and balsa in East New Britain, or oil palm in West New Britain and Ramu, it appears that policies do not provide barriers to successful commercial tree crop enterprises. However, recent evidence of the misuse of Special Agricultural and Business Leases, to convert customary land rights into formal titles which are then allocated to private companies under the pretext as using the land for agroforestry project development (Filer 2012), also illustrates policy loopholes that need to be addressed.

In summary, it is less the policy settings than the lack of other enabling factors, such as basic infrastructure and extension services, that constraint commercial development based on or incorporating commercial tree growing. However, the lack of a formalised reforestation policy means that there is no clear policy framework to guide and facilitate development options based on or including planted trees.

9.6.3 Markets and infrastructure

As observed throughout the case studies reported in this thesis, the successful introduction of new crops their adoption and production decision in the farming system of the landowners were directly linked to the appropriate government policies (Moulik 1973; Shand and Straatmans 1974; McSwain 1977). This was particularly evident in terms of the extension and communication services that went with early cash crop introduction in village smallholder production systems. The examples of the out-grower schemes in the oil palm projects, coffee, cattle project discussed in the Upper Ramu region, rubber in Western Province, cocoa and coconut in various regions of the country. Key factors included making available of suitable
seedlings and planting material, identifying innovative farmers and working through them in disseminating information and organising field days for other landowners, learning by doing, especially in the enhancement of husbandry and management skills. Extension strategies should also include Identification, packaging and providing appropriate and relevant messages in tree farmer training programmes. In addition, identification, training and provision of suitable extension officers to work with farmer on the adoption and transfer of innovation is necessary. Government can empower landowners to participate in commercial tree growing and small scale processing industries such as portable mills, as part of the people's livelihood system, by improving their access to market and market information and by offsetting high transaction costs. This creates awareness and appreciation of the commercial and industrial-use value of trees and forests, and strengthens the motivation and commitment by landowners to the management of forest resources. Government and non-governmental development groups can do more to assist landowners to improve the marketability of their products in local and international markets, and increase their bargaining power.

It is evident from this study, as well as those with cocoa, oil palm, coconut, and rubber (Bourke and Harwood 2009; Byron 2001; Moulik 1973), that PNG smallholders are very open to participating in land-use opportunities that have favourable markets, and for which there is sufficient evidence that adoption is financially and technically feasible; the output price also plays an important part in smallholder motivation to adopt. The return per unit of labour, land, and financial resources input to the production of the commodity is a particularly important criterion (Bourke and Harwood 2009; Byron 2001). Mercer (2004) also notes that agroforestry adoption follows the predictions of economic theory, where farmers will invest in agroforestry or farm forestry when the expected returns from the new enterprise exceed those from current and other alternative uses of land, labour and capital resources. As noted in the preceding discussion, an adequate transport infrastructure is also needed to facilitate sales and marketing of products; and other key conditions, such as secure tenure rights and compatibility with livelihood systems, also need to be satisfied. As discussed in Chapter 2, the successful adoption of cocoa, oil palm, and rubber crop by landowners is largely attributable these principal factors.

Corporate-smallholder partnerships in plantation forestry are increasingly being promoted as a means of facilitated tree growing and ensuring tree growers' access to market (e.g., Nawir 2007). This suggests an opportunity for policy development. As Nawir (2007) points out, the issues that require attention in this regard may include how to secure and maintain markets, obtain rewarding prices for producers, provide technical assistance to ensure adequate product quality and quantity, and develop favourable strategies for the landowners during the period between planting and harvesting. The success of these partnerships depends on company and landowners working creatively to develop incentives for mutual benefits.

In addition, government must develop policies that encourage the private sector to invest in commercial timber tree planting programme. In examples at Open Bay in East New Britain and
Stettin Bay Lumber Plantation on West New Britain, both companies have each planted 10,000 hectares each on state owned land. Further expansion of these plantations was greatly curtailed when the state declined to allocate further land for timber tree growing purposes. Part of the reason, as Hunt (2002) noted, was that landowners were not interested in making land available to project that did not have a reasonably quick return.

9.7 Conclusions

The study investigated the primary research question: *On what basis do Papua New Guinea landowners make livelihood and land-and resource-use choices?* It found that land-and resource-use choices of landowners were influenced by many interacting factors. The key was their needs and aspirations, the livelihood outcomes they sought, their knowledge and skill base, the institutional systems and processes within which the landowners operated, and their capital assets. It was also evident that while the opportunities for landowners differed between case study regions, thus influencing day to day decisions on the specific nature and scale of land use activities, the motives, behaviour patterns and attitudes to land-use opportunities were consistent across regions and with those of the farmers elsewhere.

**Landowner motives and land- and resource-use choices**

The research has shown that Papua New Guinea landowners' land-use decisions integrate two economic systems, the subsistence and the cash economies. Throughout Chapters 5 to 8, the study result shows that key land- and resource-use decisions were focused on feeding and clothing households; on meeting the costs of education, health, transport and communication needs; and other needs and social obligations. While the primary goals of landowners were survival, self-sufficiency, minimising risk, maximisation of household income and fulfilment of social obligations, there were also longer-term foci on longer-term prosperity and enhancement of social values, whilst maintaining the stability of family units and the community at large.

**Livelihood outcomes**

Despite substantial cultural and regional differences, land-and resources-use choices of the landowners were consistent across regions. The results presented in Chapters 5 to 8 show that the principal outcomes landowners sought from their land management activities were subsistence food production, cash income generation, risk management, fulfilment of social obligations, and pursuit of entrepreneurial opportunities. Each of these is pursued with varying degree of commitment of labour and land, depending on the opportunities and personal preferences and values. Landowner behaviour generally followed the underlying assumptions postulated in the Maslow’s Hierarchical Needs Theory.
**Assets and alignment of land-use strategies with household needs**

The study found that key assets of the landowners were land, labour and financial resources. Labour was found to be the most limiting factor constraining landowners' adoption decisions, and their production systems and levels. The key issue for landowners in their land- and resource-use choices is how to align assets and production strategies with the different needs of the household. In response to these aspirations and livelihood necessities, landowners plan and strategise their land-use activities over three different time horizons: the immediate future, principally in terms of food production; annual or similar cycles, principally in relation to recurring cash requirements; and the much longer-term, which is associated with both intermittent cash requirements and legacies for future generations. Commercial tree growing options fit well with the second and third of these time horizons, particularly when labour requirements can be integrated with other work.

**Knowledge and skills base**

The study also found that levels of education and skill were very critical factors in the land- and resource-use choices of the landowners. The knowledge and skill base of the landowners influenced land- and resource-use decisions of the landowners in two ways. The first is related to the level of education of the decision-maker. This had an effect on the opportunity for off-farm employment, particularly for the jobs that required specialised, formally trained skills. Secondly, the ability of the landowners to make informed choices about given opportunities, particularly in relation to adoption and production related choices was influenced greatly by the level of the education of the decision-maker. This was found to be a major constraint on the land- and resource-use choices of the landowners, and is likely to be a constraint to commercial tree growing as a livelihood option for the landowners.

**Institutional systems and processes**

This study found that the institutional processes were critically important in facilitating agriculture and forestry interventions. The key issues were appropriate policies, supported by responsive organisational structures and effective service delivery mechanisms. The study found that successful adoption and production of introduced cash crops were attributed to the effective extension and communication strategies, and that private sector partnership models proved very successful in adoption and production systems. The study also noted that, while PNG's customary tenure system may appear unattractive to some private sector investors in terms of resource security, approaches based on the development of Incorporated Land Groups and use of 'lease, lease-back' arrangements have proven successful in facilitating agricultural development.

However, the study also noted number of issues with institutional processes and capacity that need to be resolved in order to facilitate commercial tree growing activities as a livelihood option for landowners in Papua New Guinea. These are discussed further in Chapter 10.
Chapter 10: Implications for commercial tree growing, and recommendations for research and policy

This concluding chapter drawing from the results summarised in Chapter 9 to consider the implications for commercial tree growing by landowners, focusing on how analysis of each element of the PNG Landowner Decision Environment model (Figure 3.3) informs these issues. The second part of the chapter presents conclusions and recommendations for subsequent work, both to further inform the research topic and facilitate the adoption of commercial tree growing by PNG landowners.

The results reported of Chapter 9 illustrate three very important points relevant to the consideration of commercial tree growing opportunities by PNG landowners. The first is the importance of money as a driver in land-use decision processes. This is illustrated throughout Chapters 5 to 8, especially with the income diversification strategies and the willingness of landowners to adjust their labour and land-use strategies to respond to changes and exploit economic opportunities as they arise. The second is that landowners are willing and choose to re-invest their financial resources in opportunities that can generate more income in the near future, provided that they are well-advised on what opportunities are readily available to them, and that these activities are consistent with their basic livelihood priorities. The third is that landowners place a high priority on land uses that generate cash income in the very short term. For example, the re-investment associated with peanut cultivation and sales in both the Markham and Ramu regions, and into electric generator sets, video and DVD equipment in both those areas, are directly related to the urgency of generating cash income. Opportunities and motivations for commercial tree growing have to be considered in this perspective.

As explained in Chapter 1, a central motivation for the work reported in this thesis, in response to the primary research question, was to illuminate the basis on which PNG landowners might choose to adopt, or not adopt, commercial tree growing. In this chapter, I examine the implications of the results summarised in Chapter 9 for the decisions of landowners relevant to commercial tree growing. As discussed in Chapter 1 and by Kanowski et al. (2008; 2011), there are a number of reasons favouring adoption of commercial tree growing by PNG landowners.

Although the characteristics of each of the case study communities differed in a number of respects, such as access to land, proximity to markets, or access to technical and extension services, the findings of the research in relation to the key livelihood assets of land, labour and finance were similar across the case studies. While the specific reasons for growing crops, the choice of crops, and the production systems adopted and applied varied between individuals and across the regions, there were underlying commonalities to landowners’ decisions. These were
focused primarily on subsistence outcomes, reflecting households’ priority for food production, with secondary but nevertheless significant attention to options for cash income generation. However, there was strong interest in all case study communities in opportunities for enhancing cash income that were consistent with landowners’ other needs and priorities.

Experience from small-scale tree-growing activities elsewhere (as reviewed in Chapter 2) suggests that economic and other market-related objectives are important considerations in the decision processes of landowners about options for growing trees for commercial uses. Farmers are willing to participate in growing trees for commercial wood production provided that there are favourable markets, evidence that the options for commercial tree cultivation are financially and technically feasible, secure tenure and rights arrangements for the land and for tree crops, and adequate transport infrastructure to facilitate marketing of products. The output price also plays an important part in smallholder motivation for tree growing; for smallholders, returns on investment are likely to be judged in terms of the returns on labour inputs into tree growing activities.

It is clear from the results of this research that strategies for promoting commercial tree growing activities in PNG should, as elsewhere, take into account the motivations of landowners relevant to tree growing, and the needs and constraints of the landowners as tree growers; strategies should also recognise the market demand and requirements for wood products, and the need to target markets accessible to smallholder production. Amongst other considerations, this requires new partnerships and new methods of doing business than have been the case in PNG, and should be facilitated by appropriate communication and extension strategies. These factors are explored in the next sections, for each of the elements of the PNG Landowner Decision Environment model (Figure 3.3).

### 10.1 Linking commercial tree growing to landowner needs

As demonstrated throughout this study, the principal outcomes landowners sought from their land management activities are subsistence food production, cash income generation, risk management, fulfilment of social obligations, and pursuit of entrepreneurial opportunities. Landowners’ land-and resource-use choices in relation to these outcomes focused on three time horizons: the immediate future, principally in terms of food production; annual or similar cycles, principally in relation to recurring cash requirements; and the much longer-term, which was associated with both more intermittent cash requirements and the establishment of legacies for future generations.

The production and planning horizons of the landowners illustrate two important points relevant to the options for commercial tree growing. One is that the long time period between establishing and selling many commercial trees is not necessarily a disincentive to tree growing. For example, sago is a food crop that takes 15 years to mature, but - as the observations in this
study show clearly - landowners in the Western Province and Madang regions do cultivate sago palms with the intent that their children can benefit from them in the future. In fact, the extended period to harvest can be seen as positive attribute for tree growing, because trees are a crop which complements others grown by the household. The research revealed that tree growing as a land-use option is quite compatible with the longer-term elements of landowners’ thinking and planning time horizons. An added bonus for tree crops, from landowners’ perspective, is that they are more robust to the fluctuating commodity prices commonly experienced with most other crops, as they can be ‘stored on the stump’ if prices are not favourable. One of the attributes of rubber that has favoured its adoption in Western Province is the long storage life of the cup lumps once latex is harvested from the rubber trees. People do not have to worry about delays in bringing their harvest to the market. In the case of timber trees, trees can gain volume and monetary value while still standing in the field, while their owners wait for price improvement or such other time when it is convenient to harvest and sell the tree.

The second important point is that such multi-staged planning horizon offers both landowners and proponents of tree growing a degree of flexibility and a variety of pathways for integrating commercial tree growing activities with existing production systems. Trees with different attributes can deliver benefits to landowners at different phases of their planning horizons. However, realising these benefits requires careful planning, identification and purposeful selection of tree species that serve different end-uses and market segments.

On the basis of these results, it is apparent that strategies for commercial tree growing should be articulated and aligned with landowners’ production systems and planning horizons. Short-term tree crops can be directed at landowners’ immediate and mid-term time horizons, while longer-term tree crops, which are typically of higher-value species, can be directed at landowners’ longer-term time horizons and fulfilling the goals associated with these. For example, fast-growing species such as Acacia mangium and Eucalyptus pellita could be grown for end-uses such as fuelwood, pulpwood and poles over production cycles as short as two to four years, while higher-value species such as teak (Tectona grandis) or kwila (Instia bijuga) could be grown for sawn or veneer wood products over longer cycles consistent with the longer-term planning horizons of landowners. Assuming access to markets, both short- and long-term tree crops offer income-generation opportunities for landowners over their different time horizons. Commercial tree growing offers options for diversification of household income streams because it is compatible with landowners’ production systems, flexible in term of labour inputs, and provides access to different markets from those for other crops. Thus, the results of the study suggest considerable potential for commercial tree growing by landowners in Papua New Guinea.
10.2 Livelihood assets for tree growing

10.2.1 Land, planted trees, ownership and risks

The discussion in Section 2.6.1 canvassed a range of aspects of the traditional land tenure systems and the bearing these have on the livelihood systems of rural people in the four case study areas of Papua New Guinea. The traditional land ownership and management system play a significant role in the adoption and production decisions of rural people. As observed across the case study regions in this study, the choices of crops, decisions regarding both where to grow them, and the duration of the occupancy period for a particular crop, are based on the norms of the traditional land ownership tenure systems. Clan leaders generally allocate land to households for subsistence food production. A household retains the rights to a specific parcel of land only as long as it contains economically valuable plants. While use rights to land can be shared by a number of individual and households, the ownership of cultivated plants is considered to be permanent and private. Thus, the individuals who cultivate trees or other perennials secure tenure rights to these for decades.

While these traditional arrangements continue to prevail, concepts of ownership that are more closely tied to individuals rather than to kin groups are gradually emerging. This shift began during the 1950s with the Australian colonial administration’s policies that were driven by a number of influences, including population growth, government-promotion of cash crops and an increase in the availability of foreign consumer goods (Mullins and Flaherty 1995), and the administration’s promotion of individualism. Changes in and as a result of these attitudes, along with population pressure on the land, have affected how people view land and ownership rights. These attitudes were most strongly evident in Western Province. Here communities were divided in status between landowners and land-users, with the former demanding requests for approval and expecting cash payments from the latter for granting permission to make gardens, gather bamboo, collect vines and other forest products from landowners’ land. This also led to an increase in other forms of payment, such as land-users exchanging their labour services for permission from landowners to access and use specific areas of land. This tension has often led to conflict and dispute, as well as bringing about competition between different land-uses.

The magnitude of these land ownership and access issues varied between case study regions, although the land tenure and land use systems that control land ownership, tenure and security of occupancy were generally consistent. However, the shift from subsistence use of land to a more intensively managed commercial-scale agricultural production does create the conditions for possible conflict and rivalries among different landowner/land-user factions within the communities. This is particularly the case when cash benefits are involved.

The case studies also illustrated other challenges with land matters that need to be considered in the development of any commercial tree growing strategies. The principal one was the ownership conflict between rival land groups within the upper Ramu Valley.
communities. This is manifested as competing interests over the fees due for payment for the use of land on which sugarcane grown under the RAIL outgrower scheme. This dispute has eroded the motivation, confidence and aspirations of the Mari people in their decisions about their participation and involvement in sugarcane cultivation in partnership with RAIL, and is indicative of problems that could arise for any similar activity for which ownership rights were not clearly defined. This demonstrates the critical importance of clarity of ownership for any interventions involving commercial tree growing. Given the long-term investment nature of the tree-growing business, the risks associated with the long-term resource security and tenure is also greatly increased; as such, clarity around ownership and benefit sharing become an important determinant in the consideration of such interventions.

10.2.2 Labour requirements for small scale commercial tree growing

The main labour inputs necessary for landowner adoption of commercial tree growing are raising the seedlings, planting trees in the field, maintaining the trees while they are growing, and harvesting trees when they have realised the desired end-product qualities. Seedling production and harvesting operations are both relatively technical and can be capital intensive; they can also be outsourced if necessary or desired. The labour requirements for tree growing activities were estimated based on the assumptions described below.

As explained in chapters 5 to 8, for the purpose of this study, the labour resources of rural Papua New Guineans are defined in terms of their total available time. The total available adult labour time in the rural PNG context was assumed to be 105 hours per week. This is slightly higher than the 91-98 hours per week used by Moulik (1973) and Shand and Straatmans (1973) in their studies of PNG household labour; the use of 15 hours per day reflects my observation of the extended period in each day that are devoted to livelihood activities. The labour requirements for each of the activities associated with commercial tree growing were expressed as a proportion of the total available time in a week, as a basis for comparison with other household activities. This approach assumes that activities in any particular week are independent and not continuous across weeks, which is of course a simplification. However, such a pattern of behaviour was observed in the case study analyses presented in Chapters 5 to 8, and is common more generally throughout many rural Papua New Guinea communities; the livelihood activities of the household are performed on a daily or weekly basis, rather than as routine or regular pattern over a more extended time period.

Table 10.1 provides indicative labour requirements needed for each activity in a commercial tree growing activity. Data presented in Table 10.1 suggest a number of important points in relation to the question of the extent to which tree growing impinges on household labour resources. Each individual activity associated with tree growing demands, on average, 8 percent or less of the household labour. They also provide a basis for assessing how labour
requirements for commercial tree growing activities compare with, and may impinge upon, labour requirements for the existing livelihood strategies.

Nursery activities to raise tree seedlings require less than 3 percent of the total available household labour. The commercial tree growing activities requiring greatest labour input are tree plantation establishment and maintenance operations. Both of these activities account for up to 8 percent of the total household labour. It is important to note that the tree growing activities are conducted as single activity operations. When the operation is completed, labour is returned to other livelihood activities in the household. These analyses assume that labour is committed to tree growing on an ongoing basis; for most landowners, who might establish trees intermittently rather than regularly, the estimated diversion of household labour to tree growing activities of up to 8 percent of available labour is likely to be an upper bound estimate of the time actually required.

These analyses also assume that various livelihood activities are performed independently, and therefore require withdrawing labour from other tasks. However, as observed in Chapters 5 to 8, landowners adjust their adoption and production strategies to accommodate new opportunities while at the same time maintaining those activities that support their extant livelihood systems. The example observed in Madang, where landowners adjusted their livelihood strategies to accommodate both food production and growing trees for cash income, illustrates how landowners can balance both food production and cash income opportunities satisfactorily. As illustrated throughout the case studies, food production and the first few years of tree-growing activities are strongly compatible, and therefore labour can be simultaneously expended on both tasks in a complementary way when food and crops are grown on the same parcel of land. For instance, land clearing, planting both food and tree crops, and the first few years of weeding of food and tree crops on the same parcel of land are effectively single activity tasks leading to outcomes for each component of the cropping system, rather than separate activities.

### 10.2.3 Financial implications of growing commercial trees

The financial implications for commercial timber tree growing depend on the balance of costs and returns. The data presented in Table 9.2 and other data presented throughout Chapters 5 to 8 show that households typically have very limited financial resources. For example, clothing is a basic need; however, expenditure on new clothing represented only between 2.5 and 6 percent of total expenditure for the four regions, reflecting primarily the lack of household financial resources to be able to direct to this need. A similar situation was observed for other basic needs such as kitchenware, tools and house construction. Thus, it can be expected that most households will have little cash available to invest in tree growing.
Table 10.1 Labour requirements for commercial tree growing activities

<table>
<thead>
<tr>
<th>Major cost factors for commercial tree growing options</th>
<th>Labour requirement (man days/ha)</th>
<th>Probable percentage of h/hold labour for forestry activity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seedling production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seeds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nursery operations</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Seedling maintenance</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Sub total</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Establishing plantation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site preparation</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Burning</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Picketing and planting</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Transportation cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub total</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Plantation maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeding at year 1</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Weeding at year 2</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Weeding at year 3</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Pruning 1</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Subtotal</td>
<td>32</td>
<td>32</td>
</tr>
</tbody>
</table>

Sources: The figures for the labour requirements associated with tree growing activities were extrapolated from interview notes with PNG Forest Authority field staff, contract records and other sources including author's own observation and record on various nursery and forest plantation operational activities over the past 6 years.

10.2.4 Costs of growing trees

The major financial expenses involved in commercial tree growing are the costs of seedlings, of establishment, and of maintenance. Table 10.2 presents an indicative summary of the unit cost of growing commercial trees in PNG, based on routine plantation practice of 833 trees/ha.

The total cost of tree growing is K428/ha, of which K172 is required in year 1 (including the cost of seedling production). This compares favourably to other major expenditure on cash cropping in the case study regions – for example, it is less than a third of the cost of tractor hire for peanut, or equivalent to the total annual expenditure on utensils and tools in Upper Markham Valley case study region.

In practice, the actual cost is likely to be less than that shown above because family or other unpaid labour will be used, and confined to the costs of seeds and nursery inputs, or seedlings and their transport from the nursery to the landowner. This in turn suggests that funds required for tree planting are likely to be within the capacity of household budgets. While experience in the Upper Markham region demonstrates that adoption of commercial tree growing is facilitated by the provision of free or subsidised seedlings (Lastus Kuniata, RAIL,
pers.com.), this is not surprising nor inconsistent with the conclusion above that households could afford to purchase seedlings, or invest in raising them if they have the necessary knowledge and skills.

<table>
<thead>
<tr>
<th>Major cost factors for commercial tree growing options</th>
<th>Labour and material requirement (Kina/ unit labour or item)</th>
<th>Financial requirement Kina/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Seedling production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Cost of seeds</td>
<td>K120/kg</td>
<td></td>
</tr>
<tr>
<td>(ii) Cost of material</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>(iii) Cost of maintaining seedlings</td>
<td>6 man days x K4/ha</td>
<td>24</td>
</tr>
<tr>
<td>(2) Cost of establishing plantation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Site preparation</td>
<td>7 man days x K4/ha</td>
<td>28</td>
</tr>
<tr>
<td>(ii) Burning</td>
<td>3 man days x K4/ha</td>
<td>12</td>
</tr>
<tr>
<td>(iii) Picketing and planting</td>
<td>6 man days K4/ha</td>
<td>24</td>
</tr>
<tr>
<td>(iv) Transportation cost</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>(3) Cost of plantation maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) Cost of weeding at year 1 x 4 application/year</td>
<td>8 man days x 4xK4.00/ha</td>
<td>128</td>
</tr>
<tr>
<td>(ii) Cost of weeding at year 2 x 2 application</td>
<td>8 man days x 2 x K4.00/ha</td>
<td>64</td>
</tr>
<tr>
<td>(iii) Cost of weeding at year 3</td>
<td>8 man days x 1x K4.00/ha</td>
<td>32</td>
</tr>
<tr>
<td>Pruning 1</td>
<td>8 man days x K 4.00/ha</td>
<td>32</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>428</td>
</tr>
</tbody>
</table>

Source: These estimates are drawn from the Papua New Guinea National Forestry Authority guide for contract work on various operational activities with seedling production and plantation establishment.

10.2.5 Income from tree growing

The preliminary investigation reported in Chapter 2.9.2 explored the option of commercial tree growing as one several household livelihood strategies for PNG landowners. Discounted cash flow analyses were conducted for a range of species and product options. The purpose was to investigate how financial returns for wood products from planted trees compared with those from other lowland land crop products. Tree species and products tested were acacia grown for either fuelwood or sawlog, and eucalypt, teak and hoop pine grown for sawlog. The results from this analysis are presented in Table 10.3.
Table 10.3 Summary of discounted cash flow analysis of selected species and products suitable for use in PNG agroforestry systems

<table>
<thead>
<tr>
<th>Discount Rate (%)</th>
<th>Acacia fuel wood (5 year rotation)</th>
<th>Acacia sawlog (10 yr rotation)</th>
<th>Eucalyptus saw log (15 yr rotation)</th>
<th>Teak sawlog (15 yr rotation)</th>
<th>Hoop saw log (20 yr rotation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>6335</td>
<td>877</td>
<td>8569</td>
<td>22410</td>
<td>6354</td>
</tr>
<tr>
<td>10</td>
<td>5638</td>
<td>306</td>
<td>6323</td>
<td>17581</td>
<td>4520</td>
</tr>
<tr>
<td>15</td>
<td>4463</td>
<td>-488</td>
<td>3258</td>
<td>11428</td>
<td>2262</td>
</tr>
<tr>
<td>20</td>
<td>3523</td>
<td>-976</td>
<td>2005</td>
<td>7940</td>
<td>1053</td>
</tr>
<tr>
<td>NPV (Kina/ha)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1566</td>
<td>1487</td>
<td>1331</td>
<td>971</td>
<td>2539</td>
<td>623</td>
</tr>
<tr>
<td>1497</td>
<td>1331</td>
<td>128</td>
<td>831</td>
<td>2311</td>
<td>531</td>
</tr>
<tr>
<td>1331</td>
<td>1178</td>
<td>-97</td>
<td>603</td>
<td>1954</td>
<td>361</td>
</tr>
<tr>
<td>1178</td>
<td></td>
<td>-233</td>
<td>429</td>
<td>1698</td>
<td>216</td>
</tr>
<tr>
<td>AEV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>64</td>
<td>12</td>
<td>39</td>
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<td>39</td>
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<td>29</td>
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<tr>
<td>64</td>
<td>64</td>
<td>12</td>
<td>39</td>
<td>95</td>
<td>29</td>
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<tr>
<td>IRR (%)</td>
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<tr>
<td>64</td>
<td>64</td>
<td>12</td>
<td>39</td>
<td>95</td>
<td>29</td>
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<td>64</td>
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<td>95</td>
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<td>39</td>
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<td>29</td>
</tr>
<tr>
<td>64</td>
<td>64</td>
<td>12</td>
<td>39</td>
<td>95</td>
<td>29</td>
</tr>
<tr>
<td>Return to inputs (Kina per ha/person/day)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61.6</td>
<td>57.8</td>
<td>50.9</td>
<td>16.6</td>
<td>26.8</td>
<td>40.2</td>
</tr>
<tr>
<td>57.8</td>
<td>50.9</td>
<td>16.6</td>
<td>15.6</td>
<td>24.8</td>
<td>37.5</td>
</tr>
<tr>
<td>50.9</td>
<td>16.6</td>
<td>15.6</td>
<td>13.9</td>
<td>21.8</td>
<td>33.2</td>
</tr>
<tr>
<td>16.6</td>
<td>15.6</td>
<td>13.9</td>
<td>12.3</td>
<td>19.6</td>
<td>30.2</td>
</tr>
<tr>
<td>Compare to current wage rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>3.9</td>
<td>3.4</td>
<td>1.1</td>
<td>1.8</td>
<td>2.7</td>
</tr>
<tr>
<td>3.9</td>
<td>3.4</td>
<td>1.1</td>
<td>0.9</td>
<td>1.7</td>
<td>2.5</td>
</tr>
<tr>
<td>3.4</td>
<td>1.1</td>
<td>0.9</td>
<td>0.8</td>
<td>1.5</td>
<td>2.2</td>
</tr>
<tr>
<td>1.1</td>
<td>1.0</td>
<td>0.9</td>
<td>0.8</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>1.0</td>
<td>0.9</td>
<td>0.8</td>
<td>1.5</td>
<td>2.0</td>
<td>1.6</td>
</tr>
<tr>
<td>Break even price</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42.6</td>
<td></td>
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</tr>
</tbody>
</table>
Results summarised in Table 10.3 demonstrate that, for the assumptions made, growing teak sawlog offers the highest Internal Rate of Return to the grower, at 95 percent. The Return to Labour for teak sawlog production ranges from 30 to 40 Kina per hectare per day for the range of discount rates applied. This is high compared to return for cocoa and coffee, which are estimated at about 16 Kina per hectare per day (Bourke et al. 2009), and which are currently the most attractive cash cropping activity available to many landowners. However, the extended period before a return is received from growing trees for sawlogs represents a countervailing disincentive. Given the preference of PNG landowners for quicker returns, they are more likely to find the shorter interval associated with growing acacia for fuel wood, or similar options, to be more appealing. The adoption of balsa in East New Britain (Midgley et al. 2010) demonstrates this time preference. However, as discussed in Sections 9.6 and 9.7, growing longer-rotation higher-value tree crops such as teak may have a particular niche in landowners’ planning horizons.

10.3 Compatibility with other elements of livelihood systems

As observed throughout the study, household labour supply is a constraint limiting the adoption and production strategies for many rural households in PNG. As noted in earlier chapters, landowners have a wide range of tasks to perform in a single working day or week. This implies that the decision to adopt a particular land-use activity is very dependent on the demands it places on the landowner’s labour. For example, the cases observed in Box 5.2 and Box 5.3 illustrate the labour constraint experienced by the Mari sugar cane outgrowers in the Upper Ramu region. The study results suggest that, as for cash crops, adoption and production strategies for commercial trees should be developed with the conscious understanding that these activities should not compete for labour with subsistence food production needs and other important elements of livelihood strategies of the households. The crop integration system observed in each of the case study region was in part motivated in response to the low labour availability of households, as well as the desire to increase and diversify livelihood outcomes.

The results of this research demonstrate that landowners have a good understanding of the labour constraint in their household, and have planned their production activities strategically over different time horizons. Food production and immediate cash needs such as children’s education have absolute priority, and appropriate activities are planned and resources (i.e., labour, land and finances) allocated accordingly towards these outcomes on a seasonal or other cyclical (e.g. annual) basis. This illustrates the importance of subsistence food production in the household economy, and is consistent with Maslow’s (1954) Needs Hierarchy, which assumes that basic need such as food and water must be satisfied before attention is directed to higher order needs. These other needs, including cash income for non-food consumption, and for security and social obligations, are second in the ranking of priorities, with their activities...
planned and executed over period of between two to three years. Other social and intergenerational obligations are planned and executed over period of three or more years. Strategies for commercial tree growing activities could and should be planned and aligned with these different time horizons of the landowners.

Agroforestry production systems in which both short and long-term tree crops are combined with food production will be appealing to landowners, and can be specifically designed and developed for particular locations. In such systems, food and short term tree crops are directed at the immediate and mid-term time horizons of landowners, while longer term tree crops of higher unit value can be directed to fulfilling the longer term goals and time horizons. Landowners in the Upper Markham case study region were already developing such systems, with short-term fast-growing species like *Acacia mangium* and *Eucalyptus pellita* being grown for end-uses such as fuelwood, pulpwood and pole production over periods of three to five years; they were also planting teak (*Tectona grandis*), which has an expected time to harvest of 15 years or more. Both short and long term tree crops offer opportunities to provide income for the tree grower over at least the two longer time horizons described earlier, and a variety of options for diversification of households’ income streams are greatly enhanced with such compatibility and flexibility within each production system. However, knowledge about potential production systems is currently very limited in PNG, and requires field trials in conjunction with landowners to establish feasible and effective integrated production systems.

There are many factors that encourage PNG landowners to generate cash income. As well as predictable commitments, PNG landowners are mindful of the impacts of climatic variability and natural disasters such as drought, frost, cyclone, or floods, and the benefits of cash reserves to cope with these events. The money earned from cash cropping activities enables landowners to purchase food from store in order to sustain themselves during such periods. From this perspective, as well as from others, the options for tree growing should also be considered as a risk management strategy for landowners. The generally higher levels of robustness and tolerance of trees of such natural events, compared to other crops, offers advantages to landowners, although risks such as fires have to be managed (as landowners in the Upper Markham case study region had begun to do, in a variety of ways). In the case of such natural events, or those that might arise from other causes, tree crops can be converted into cash incomes to meet the need for food and other necessities.

Diversification of production systems and incorporation of different tree crop and food production regimes require awareness, and good communication strategies based on good information.

10.4 Knowledge and skills available for tree growing

As observed throughout in this study, adoption and production decision were strongly linked to the type and quality of information received by rural landowners. The review for this
study illustrate that good awareness campaigns, effective communication strategies and
effective extension delivery and support services were most critical in the successful adoption
and incorporation of important cash crops such as cocoa, oil palm, and coffee in the livelihood
systems of the people. The lesson learnt from these experiences with other crops should inform
strategies for promoting and encouraging landowners to participate in commercial timber tree
growing. While tree growing for subsistence uses have been the primary focus for many
landowners, pursuing options for commercial tree growing requires a shift in purpose. Firstly,
this difference should be emphasised and communicated to the landowners. Key information,
such as choice of species, market availability, how trees should be grown, the end-use
requirement and technical specification for timber products, needs to be tailored and
communicated to the landowners. Landowners need to be made aware of this information, as
their choices and land-use decision will ultimately depend on that. The second aspect to be
communicated is the production strategies, including information about raising seedlings,
planting, weeding, pruning, thinning of tree crops and when and how these silvicultural
operations should be carried out. In other words, tree growing should be viewed as a land-use
option that will earn financial income for the tree growers, and therefore they need to provide
the necessary attention required to realise that potential. This means that their approach and the
production strategies also need to change, while not prejudicing their core goals of food security
and risk management.

10.5 Institutional processes to support commercial tree
growing

Institutional systems and processes are important catalysts in facilitating successful
agriculture and forestry interventions. According to the Sustainable Livelihood Framework
(SLF) (Chambers and Conway 1992), the institutional systems and processes refer to the policy
environment and the organisational systems in which people operate. The SLF assumes that
rules, procedures and policies do provide guidance and enable people to access important assets
and consequent opportunities in order to better their conditions. As observed throughout this
study, the land- and resources-use choices of the landowners are influenced, in part, by the
interaction between a number of key institutional systems and processes. Those likely to
influence decisions about commercial tree growing include the government policy environment;
the functional roles and responsibilities in the service delivery organisations; cultural norms and
values controlling and influencing customary land tenure systems; and the relationships
established by corporate and private partnerships. These actors have been already discussed in
terms of their influence on the choices made by landowners in their land- and resource-use
decisions.

Observations throughout this study demonstrate a clear linkage between these institutional
systems and processes and landowner responses to land -and resource-use opportunities. For
commercial timber tree growing options in Papua New Guinea, this means there has to be in place a clearly stated policy objectives that encourage participation by relevant stakeholders. In addition, these should be supported by administrative and organisational structure with a clear definition of roles, responsibilities and mechanisms for service delivery. These policies and procedures need to focus on the issues such as land and resource tenure, market and infrastructure, extension and communication and linking it to other sectoral policies. As Nawir et al. (2007) noted for the cases regarding smallholder participation in tree planting programmes across Africa and Asia, the key factors for the successful adoption and production in small scale forestry include favourable policies across different aspects of management and marketing, clear and secure land tenure and rights over crops, including for management, harvesting, transport and marketing of wood. As an example, Preda (2003) and Godoy (1992) reported that, for farmers in Philippines to participate in commercial fuel wood production, they need both favourable markets and to be persuaded that fuelwood cultivation is financially and technically feasible option. Schirmer et al. (2002) found that Australian landholders evaluate economic cost and returns to be associated with farm forestry when making land-use decisions, and Byron (2001) notes that farmers generally are readily willing to grow trees whenever they perceive the expected returns per unit of labour input are higher than the alternative choices. Similarly, Van Der Poel and Van Dijk (1987), in a study in Central Java, Indonesia, observed that interventions in tree production system would only be adopted by farmers if they gave sufficient returns.

The uncertainty of future market prices, market structures and access also affect attitudes towards tree growing. Byron (2001) noted that in the Central New South Wales, Australia, smallholder plantation development ceased because timber from small private plantations could not gain access to local markets. Similarly, Vermeulen and Nawir (2008) observe that market access and development are often significant barriers to the adoption of commercial tree growing. Farmer motivation and other incentives that have direct influence on attitudes and decision-making also needs to be understood and addressed in policy design.

In Papua New Guinea, as reported by Kanowski et al. (2011) and discussed in Chapter 9, while the policy settings are not unfavourable for commercial tree growing, the capacity to deliver on the policy objectives is constrained by the lack of extension services, and inadequate basic infrastructure, among others. The 1991 National Forest Policy is largely focused on natural forest logging and the associated log export industry. However, this is a too narrow a view of what forestry can or could do. As Jack Westoby, a famous forester once said, ‘forestry is not about trees, but about people’ (Leslie 1987). Papua New Guinea’s forestry sector needs a paradigm shift, from a focus on a log export oriented industry to one of forest resource creation and management on the basis of its relative advantages. These includes customary land tenure systems, favourable climatic conditions suitable for growing some of very valuable tropical timber species such as teak, kwila, taun and tropical pines, and the close proximity to growing markets, such as China and India. This requires multi-disciplinary thinking about policy and
implementation, recognising and accommodating the land- and resource-use and livelihood systems of landowners.

Another key element of institutional systems and process relevant to commercial tree growing is the provision of research, extension and communication services. Experience elsewhere suggests that public sector provision of research, extension, and development services encourages smallholder participation (Nawir et al. 2007). For example, in the case of Indonesia (Nawir et al. 2007), the government provides subsidies or financial incentives in a range of packages that include plantation establishment funds, physical inputs, free seedlings, paid labour for government projects, and loan schemes. In Indonesia, these costs are usually sourced from reforestation funds, which are generated from timber concession companies to finance rehabilitation of degraded forest (Nawir et al. 2007). In Papua New Guinea, a reforestation levy of K2.00 per cubic meter is collected from timber concession areas, but there is no clear policy on how this money should be used. At least a proportion of these funds could be used to finance research, extension and communication services relevant to commercial tree growing. Communication is also important, and particularly critical in the adoption process; it involves packaging of relevant and key messages in forms that can be easily taken up, and effective communication and delivery mechanisms. For farmers to manage their tree crops, they need sufficient technical knowledge about and skills establishment and management, and some understanding of harvesting, processing and post harvest knowledge. For example, Jenkin (unpublished ACIAR report) notes that balsa (Ochroma lagopus) is a time-bound timber tree crop; if not harvested and processed within a specific period, it deteriorates and loses its commercial value. Information on the silvicultural requirements of particular tree crops is important and needs to be clearly communicated to tree growers. Where trees are grown as part of agroforestry systems, these systems need to be formally researched, the findings disseminated, and knowledge gaps and research needs identified.

As discussed in Chapter 9, experience in agricultural cash crops, such as coffee, cocoa, coconut and oil palm, clearly demonstrate that impacts of these factors on adoption: access to information, financial capacity, and being connected to agency or a local network of farmers were critical (Moulik 1973; Finney 1973). In this study, access to information was very important for Acacia growers in the Gogol and Naru areas in Madang. Up to 50 percent of these tree growers declined or decreased their involvement in tree growing when the company promoting tree growing could not explain to their satisfaction how the timber prices they received were calculated. One of the primary attributes in the success of out-grower oil palm production around PNG is the good connection and relationship built between the outgrowers and estate owners (Bourke et al. 2009).

In addition, the study results also show that corporate or other private sector partnerships do have an important role in the adoption and expansion of commercial cropping activities. This was evident both for trees and other cash crops. Bourke and Harwood (2009), among others,
attributed the high success rate with the smallholder outgrower schemes in the oil palm development schemes to the corporate partnership model. There are number of important features about these models that are of direct relevance to the options for commercial tree growing. Firstly, private investors maintain good extension and communication dialogues with the outgrowers. This allows trust and longterm commitments to establish, to mutual benefit between the parties in the long run. This is funded and maintained mostly by the estate-based private plantation investors. Secondly, the corporate partner provides the key infrastructure, transport and a guaranteed market for produced crop. For example, smallholder adoption of *Acacia mangium* for industrial pulp wood production in the Madang region was successful because JANT provided a ready market for the trees grown by the landowners. Similarly, the outgrower participation by the Mari people with sugarcane production is attributable to the market and services provided by RAIL, and a similar situation applies for smallholder rubber production in Western Province. Thirdly, building trust and open communication between the different partners fosters a long, healthy and lasting relationship, as Nawir *et al.* (2007) describe in their observation of the outgrower schemes in Africa and Indonesia. Midgley *et al.* (2010) discuss these issues for the case of balsa growing in East New Britain.

Land tenure and resource insecurity is another institutional factor inhibiting commercial timber tree growing opportunities (Nawir *et al.* 2007; Byron 2001), often associated with land tenure arrangements. The particular characteristics of PNG’s land tenure system, as reviewed in earlier chapters, is often seen as a constraint to long term investments such as commercial tree growing. However, as discussed in previous chapters, there are established mechanisms that address these constraints, notably as the Incorporated Land Group Act (Holzknecht, *ed.* 1994; Power 2008), a legal instrument that allows customary landowning group to form entity that has legal status under the formal legal system. As an incorporated group, the landowning group can then organise finance for commercial agriculture and forestry development under ‘lease, lease-back’ land arrangements. The examples of tree growing in Madang, by Gogol Reforestation Company and Open Bay and West New Britain described earlier were based on this mechanism. The lessons from these experiences, as well as those from the oil palm sector, provide a wealth of experiences to draw from in policy development.

In summary, on the basis of material presented in this and preceding chapters, it is evident that existing institutional systems and processes are not unfavorable to the promotion of landowner participation in the commercial tree growing activities. However, also as discussed previously, there needs to be further development and refinement of relevant policies — for example, finalization and promulgation of the Reforestation Policy. The lack of extension services and of basic physical and market infrastructure, including market information, are also evident constraints to landowner adoption of commercial tree growing. How these constraints might be addressed is discussed in the following section.
10.6 Conclusions and recommendations for research and policy

The research results reported in earlier chapters emphasise the fundamental importance of fitting commercial tree growing option with livelihood outcomes and strategies. As evident throughout this study, there is a strong inter-relationship between different motivational factors and land- and resources-use choices of landowners. PNG landowners exhibit attitudes and behaviour in relation to adoption choices that are largely consistent with those of farmers elsewhere, with the level of participation and involvement in particular activities influenced by personal preferences and values. Decisions about options for commercial tree growing need to be linked to these factors, and to the different planning horizons for various livelihood outcomes that PNG landowners pursue. The study found that options for commercial tree growing fit well with the two longer time horizons characteristic of PNG landowners, and developing strategies based on this would be most likely to facilitate adoption of commercial tree growing that enhances household livelihoods. Contrasting results for adoption of and withdrawal from commercial tree growing in two of the case study regions illustrate these conclusions. The study also demonstrated that opportunities for commercial tree growing activities show that the return to labour for high value tree species such as teak are high compared to those for established crops, although the extended period before a return is received from growing trees for sawlogs represents a countervailing disincentive. In many cases, the low adoption of commercial timber tree growing could be attributed by the lack of awareness of the potential contribution tree growing activities could make to the landowners’ needs and the other livelihood goals they seek. Furthermore, while the benefits of subsistence-focused agroforestry and its contribution to household economy are well acknowledged and accepted by smallholders, incorporation of an element of commercial tree growing within their production system has still to be internalised by most landowners. This is due to a combination of factors, including but not limiting to institutional systems and processes within which landowners operate, the education and skill levels related to adoption and production decisions for commercial tree growing, and deficiencies in market, infrastructure and transport conditions. The recommendations below are formulated to address these constraints.

10.6.1 Recommendations for research and policy

The study findings provide an adequate understanding of the relationship between landowners’ motives, livelihood assets and strategies, desired outcomes and land- and resource-use decisions. The study findings also suggest that commercial tree growing activities can be conceived and designed so as not to compete with food and other cash income-earning activities, or with the important livelihood assets of land and labour. However, there are needs for further research in the areas of knowledge and skills, and institutional systems and processes, and in policy development.
**ISSUE 1  Technical knowledge and skills relevant to commercial tree growing**

As this study noted, whilst subsistence-based agroforestry is well established within the production system of the landowners, its application for commercial timber growing is very limited due to lack of technical knowledge and skills about commercial and lack of business and marketing skills. To address these issues, it is recommended that programs be developed to communicate to interested growers:

1) Basic knowledge about commercial tree species nursery production, establishment and management;

2) Basic knowledge about commercial decisions related to tree growing within the context of landowners' livelihood systems, and about markets for tree products.

**ISSUE 2  Institutional Systems and Process**

These vary in scope, scale and urgency. Those of most immediate importance the lack of appropriate policies, the lack of extension and service delivery mechanisms, the lack of physical and market infrastructure, and strategies for best accessing and using the traditional land tenure system. To address these, it is recommended that the relevant agencies of government, particularly the Papua New Guinea Forest Authority:

1) Complete and have promulgated the Reforestation Policy that is currently in draft form, and that policy be informed by the results of this study;

2) Create a forest extension division headed by social scientist within the National Forest Service within the PNGFA, to provide forest extension and communication delivery services;

3) Explore options for funding the activities proposed above, including the use of the reforestation levy or other public funds or levies, or from externally funded assistance; and

4) Explore options and strategies for strengthening and fostering tree growing through various incentives schemes.

Addressing these institutional issues will provide a stronger foundation from which the potential for commercial tree growing by PNG landowners can be realised and in ways that enhance livelihoods and contribute to realising their aspirations.
References


Ase, D. and 27 others (2011). The Cairns Declaration. actnowpng.org/category/tags/cairns-declaration


ODI (2006) Papua New Guinea (Papers 1, 2 and 3). Overseas Development Institute, London UK.

Ok Tedi Mining Part 4 2006 Social and economic report - 2006 draft mine closure plan.


Pers. comm. Mr B. Chiu, General Manager, North Fly Rubber Limited, meeting held on 09/07/2008.

Pers. comm. Mr Francis Essacu, Ok Tedi Foundation, meeting held on 15th /07/2008


Appendix 1: Field Survey Questionnaire

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. What is your gender?</td>
<td>Male, Female</td>
</tr>
<tr>
<td>3. What is your education level?</td>
<td>High School, Bachelor, Master, Doctorate</td>
</tr>
<tr>
<td>4. What is your occupation?</td>
<td>Student, Teacher, Worker, Manager, Business Owner, Employee, Retired</td>
</tr>
<tr>
<td>5. What is your annual income?</td>
<td>$0-$10,000, $10,001-$20,000, $20,001-$30,000, $30,001-$40,000, $40,001-$50,000, $50,001-$60,000, $60,001-$70,000, $70,001-$80,000, $80,001-$90,000, $90,001-$100,000, $100,001-$150,000, $150,001-$200,000, $200,001-$250,000, $250,001-$300,000, $300,001-$350,000, $350,001-$400,000, $400,001-$450,000, $450,001-$500,000, $500,001-$600,000, $600,001-$700,000, $700,001-$800,000, $800,001-$900,000, $900,001-$1,000,000, $1,000,000+</td>
</tr>
<tr>
<td>6. Do you own a car?</td>
<td>Yes, No</td>
</tr>
<tr>
<td>7. What is your primary source of income?</td>
<td>Employment, Self-employment, Rental Income, Investment Income, Government Benefits, Other</td>
</tr>
<tr>
<td>8. What is your favorite hobby?</td>
<td>Reading, Painting, Dance, Sports, Music, Gardening, Travel, Cooking</td>
</tr>
<tr>
<td>9. What is your preferred mode of transportation?</td>
<td>Walking, Biking, Car, Public Transport, Bicycle, Motorcycle, Train</td>
</tr>
<tr>
<td>10. What is your favorite cuisine?</td>
<td>American, Italian, Mexican, Indian, Chinese, Japanese, Thai, Argentinean</td>
</tr>
<tr>
<td>12. Do you have any pets?</td>
<td>Yes, No</td>
</tr>
<tr>
<td>13. What is your favorite animal?</td>
<td>Dog, Cat, Bird, Fish, Reptile, Other</td>
</tr>
<tr>
<td>14. What is your favorite sport?</td>
<td>Football, Basketball, Baseball, Tennis, Soccer, Cycling, Swimming</td>
</tr>
<tr>
<td>15. What is your favorite season?</td>
<td>Spring, Summer, Autumn, Winter</td>
</tr>
<tr>
<td>16. What is your favorite holiday?</td>
<td>Christmas, Thanksgiving, New Year's, Independence Day, Memorial Day, Labor Day</td>
</tr>
<tr>
<td>17. What is your favorite book?</td>
<td>Fiction, Non-fiction, Science Fiction, Fantasy, Mystery, Romance, Horror</td>
</tr>
<tr>
<td>18. What is your favorite movie?</td>
<td>Horror, Romance, Action, Comedy, Documentary, Sci-Fi, Thriller</td>
</tr>
<tr>
<td>19. What is your favorite TV show?</td>
<td>Comedy, Drama, Reality, News, Sports, Movie, Other</td>
</tr>
<tr>
<td>21. What is your favorite country?</td>
<td>United States, United Kingdom, Canada, France, Japan, China, Australia</td>
</tr>
</tbody>
</table>

If you have any other questions or comments, please feel free to share them below.
<table>
<thead>
<tr>
<th>Case study region</th>
<th>Village/Census unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District</td>
<td>Altitude</td>
</tr>
<tr>
<td>Province</td>
<td>Date</td>
</tr>
<tr>
<td>LLG</td>
<td>Surveyor</td>
</tr>
<tr>
<td>GPS reference</td>
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</tr>
</tbody>
</table>

**SURVEY DESCRIPTION:** (summarise route (transect), number and types of gardens, cash crop plots seen, informants talked to, overall time spent)

**PART 1**

**BACKGROUND**

<table>
<thead>
<tr>
<th>Section A</th>
<th>Participant Particulars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1. Year of Birth:</td>
<td>m  d  w  s</td>
</tr>
<tr>
<td>Q2. Marital Status (married, divorced, widowed, single):</td>
<td>Grade yr compl.</td>
</tr>
<tr>
<td>Q3. Highest grade completed at school:</td>
<td>Vocational Professional Others</td>
</tr>
<tr>
<td>Q4. Other training (specify):</td>
<td></td>
</tr>
<tr>
<td>Q5. What is your occupation?</td>
<td></td>
</tr>
<tr>
<td>Q6. Number of Children included those adopted: (Indicate age, with &quot;B&quot; for boys &amp; &quot;G&quot; for girls) from eldest to youngest</td>
<td></td>
</tr>
<tr>
<td>Q7. What level of school grades did your children as listed in q6 completed? (entries to correspond with the same order of entry to q6)</td>
<td></td>
</tr>
</tbody>
</table>

**Participant Reference number:**
<table>
<thead>
<tr>
<th>Q1 Name of your Clan:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q2 How are business ventures currently operate in the community? Provide description of business holding, and arrangements in the community</td>
</tr>
<tr>
<td>Q3 Reason for q2</td>
</tr>
<tr>
<td>Q4 Are you affiliated to any business, religious or social groups in the community?</td>
</tr>
<tr>
<td>Q5 Are there other groupings in this community which you are not part of?</td>
</tr>
<tr>
<td>Q6 Are there any Incorporated Land Group operating in your community and state what it does?</td>
</tr>
<tr>
<td>Q7 What circumstances oblige you to give (or not) food and money to others?</td>
</tr>
<tr>
<td>Q8 What circumstances oblige you to receive food or money from others?</td>
</tr>
<tr>
<td>Q9 What would happen, if you don't give or receive? (food or money)</td>
</tr>
<tr>
<td>Q10 How is use and control of land organised in the local community?</td>
</tr>
<tr>
<td>Q11 What do you believe will happen to you if you have more money than other members in the community?</td>
</tr>
<tr>
<td>Q12 Do the things discussed in question 11 discourages you from undertaking business and other activities such as building a permanent house?</td>
</tr>
<tr>
<td>Q13 What would others think of you if you attempt to become more affluent?</td>
</tr>
<tr>
<td>Q14 Would some people in the community think well of you if you started a business activity?</td>
</tr>
<tr>
<td>Q15 Explain answer to 13</td>
</tr>
<tr>
<td>Q16 Are you land owners or user?</td>
</tr>
</tbody>
</table>
### Section A: Livelihood Strategies

#### Food

1. Where do you obtain your food from? (circle)
   - garden
   - market
   - store
   - friends
   - relative
   - forest including fishing & hunting
   - Others (specify)

2. How do you select site when making a new garden?

3. Explain your reason on q2?

4. List most important food grown in your garden?

5. Which ones in q4 are more important (staple)?

6. Explain ans to Q5?

7. What proportion of food do you get from?
   - friends
   - relatives
   - store
   - trading
   - other

#### Shelter

8. Where do you obtain material for house construction?
   - hardware
   - forest
   - friends
   - purchase from others

9. Which component of house material you obtained from?
   - You & family
   - Friends
   - V/groups
   - Contract

10. Who helps you with making your house?

11. What is the usual life span (in years) of your house?

#### Water

12. Where do you obtain your water from?
   - creeks/river
   - supplied
   - water container
   - well
   - Other (specify)

13. Who fetches water?
   - m/children
   - f/children
   - mother
   - father

14. How far do you have to travel to collect drinking and cooking water?
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q15 Are trees planted as garden ages or left to fallow. If yes, describe tree species planted</td>
<td></td>
</tr>
<tr>
<td>Q16 In reference to the planted tree(s) in Q15, what is (are) it (they) used for? (for each species describe their uses)</td>
<td></td>
</tr>
<tr>
<td>Q17 What type of plants or forest products you collect from forest to sell for money? Provide list and description of the products of plants collected and sold without processing</td>
<td></td>
</tr>
<tr>
<td>Q18 Is there any particular plant or a part of plant material that you collect from forest to make other products (eg basket, bags etc) to use or sell for money? If yes, describe types of plant species used and types of products made from that species</td>
<td></td>
</tr>
<tr>
<td>Q19 Apart from cash crops, what other tree species have you planted? If so, describe the tree species and its/ or their purpose for planting</td>
<td></td>
</tr>
<tr>
<td>Q20 How do you satisfy your fuel energy need? Describe type and sources</td>
<td></td>
</tr>
</tbody>
</table>
### Section B  Family labour organisation and distribution to various activities

(subsidiary bullet point # 1 paragraph 2.2)

<table>
<thead>
<tr>
<th>Q1 Time spent in working in the garden? (estimate average number of days each week spent on each activity by each family member for each activity)</th>
<th>Father</th>
<th>Mother</th>
<th>m/Child</th>
<th>f/Child</th>
<th>friends</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>clearing garden (get estimates on size of garden plot)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tilling/ploughing land</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>weeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>harvesting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Labour in cash cropping**

<table>
<thead>
<tr>
<th>Q2 List types of cash cropping in the last five years?</th>
<th>Planting</th>
<th>Tending</th>
<th>harvesting</th>
<th>Post/harvt.</th>
<th>Packaging</th>
<th>Transportation</th>
<th>Marketing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q3 What are the main cash cropping activities have you undertaken?</th>
<th>Father</th>
<th>Mother</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Q4 In reference to q3, who does what? estimate time spent by each member per week for each activity</th>
<th>father</th>
<th>mother</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Other (eg youth group) Describe the group and in what ways is the group rewarded</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q5 How much money do you need to make from cash cropping for it to be worth continuing it?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Labour Distribution and activities over time**

(Separate table needed for this)
### Section C  
**Cash cropping & cash income opportunities**  
(subsidiary objectives bullet point #1 and 2)

<table>
<thead>
<tr>
<th>Question</th>
<th>Cash crops</th>
<th>market</th>
<th>employment</th>
<th>remittance</th>
<th>Compensation</th>
<th>Business activities</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 What are your main sources of cash income?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q2 What do you need the money for?</td>
<td>School fee</td>
<td>clothing</td>
<td>food</td>
<td>Perm. House</td>
<td>Status</td>
<td>Customary duties</td>
<td></td>
</tr>
<tr>
<td>Q3 Which of the reason in q.2 is most important to you?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q4 What cash crops have you planted on your land?</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Q5 What other income generating activities do you do, (eg fishing)?</td>
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<td></td>
<td></td>
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<tr>
<td>Q6 Are you satisfied with your current cash earning opportunities?</td>
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<td></td>
</tr>
<tr>
<td>Q7 Why or why not?</td>
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<td></td>
</tr>
<tr>
<td>Q8 What external factors are necessary to encourage you into cash cropping? (indicate as important, not important or not sure)</td>
<td></td>
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</tbody>
</table>

**Commercial Tree growing**

<table>
<thead>
<tr>
<th>Question</th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Q9 Would tree growing for cash be of any interest to you?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q10 Why or Why not?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q11 If you havn't been growing trees for cash opportunities as yet, what must occur before you can make that decision to start planting trees for commercial reasons?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q12 What factors discourages you from engaging in commercial tree growing?</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 2: Human Research Ethics Committee Application Form
HUMAN RESEARCH ETHICS COMMITTEE
Application Form

Created by: u3823414
Record number: 2198
Protocol type: Expedited Ethical Review
Protocol number: 2007/2198

Date entered: 26/10/2007
Ethics program type: Postgraduate
Requested start date: 20/11/2007
Requested end date: 20/01/2008

Protocol title: Land owner decision-making processes in relation to commercial tree growing in Papua New Guinea

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kanowski, Peter</td>
<td>Supervisor</td>
<td>School of Resources Environment and Society, Fenner School of Environment and Society, ANU</td>
</tr>
<tr>
<td>Mulung, Kulala</td>
<td>Primary Investigator</td>
<td>School of Resources Environment and Society, Fenner School of Environment and Society, ANU</td>
</tr>
</tbody>
</table>

Investigators Detailed

Name: Kanowski, Peter     Role: Supervisor

Expertise:
Professor of Forestry
Forest and environmental policy, forest genetics, forestry and environmental education

Peter Kanowski is Professor of Forestry and Deputy Director of the Fenner School of Environment and Society; he is also Deputy Convenor of the ANU Institute for Environment. Peter was appointed the Chair of Forestry at ANU in 1995, after 7 years as Lecturer at Oxford University's Forestry Institute, and work as a forest manager and researcher in Queensland. He is a 2007 FWPRDC Denis Cullity Fellow and a member of the Steering Committee of The Forests Dialogue. Peter was a panel member of the 2003/4 Council of Australian Governments' National Inquiry into Bushfires, and of the Steering Committee for the ACT's post-bushfire Non-Urban Land Use Study in 2003; he was also a member of the ACT International Arboretum Jury and Interim Board in 2004-6.

Professional Activities
My research and teaching interests and activities cover both forest and environmental policy, and forest genetics. My work in policy addresses a range of topics, including plantation and farm forestry, forest conservation and management, and forest policy processes. My research in forest genetics began with Honours and Doctoral work in
quantitative genetics and its implications for tree breeding strategies.

Some of my work in forest policy is now part of the research program of the Cooperative Research Centre for Forestry, for which I also chair the education program. I lead an ACIAR-sponsored research project addressing constraints to incorporating commercial tree growing into PNG farming system, and co-lead development of an Australian national forestry masters program.

My teaching reflects my diverse interests: I coordinate or contribute to undergraduate and graduate courses in Australia's environment, forest and environmental policy, and forest genetics.

Name: Mulung, Kulala       Role: Primary investigator

Expertise: Experience: Mr Mulung in his previous employment worked as a government forestry extension officer for various government agencies in Papua New Guinea. In that capacity he worked with various community groups, advising and providing technical assistance in tree farming and related activities. He is quite familiar with the social and cultural context of the different societies in PNG. Mr Mulung currently whilst preparing his research proposal, is also attending lectures to the following subjects; Qualitative Research Method for Sustainability (SRES 2014/ SRES 6014) and Participatory Resource Management: Addressing Environment Conflict (SRES 3007/ SRES 6021), to enhance his understanding in theoretical framework in those areas of discipline and learning methods of data collection and ethical requirements of conducting research in social relationship processes studies. His research study includes qualitative and quantitative surveys aiming to understand economic benefits to small holder farmers from agroforestry, as well as household surveys on community forest relationship and the extent of efforts to use and conserve resources by people.

Supervisor: Professor Peter Kanowski

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

External Investigators

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Departments

<table>
<thead>
<tr>
<th>Primary</th>
<th>Department</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>General</td>
<td>Research Office</td>
</tr>
<tr>
<td>Yes</td>
<td>School of Resources Environment and Society</td>
<td>Fenner School of Environment and Society</td>
</tr>
</tbody>
</table>

Page 2 of 14
### High Risk One Summary

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is this a clinical trial?</td>
<td>No</td>
</tr>
<tr>
<td>Does this research involve the intentional recruitment or issues involving Aboriginal and Torres Strait Islander Peoples?</td>
<td>No</td>
</tr>
</tbody>
</table>

### High Risk Two Summary

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does this research involve Human Genetics?</td>
<td>No</td>
</tr>
<tr>
<td>Does this research involve Human Stem Cells?</td>
<td>No</td>
</tr>
<tr>
<td>Does this research involve women who are pregnant and the human foetus?</td>
<td>No</td>
</tr>
<tr>
<td>Does the research involve people highly dependent on medical care who may be unable to give consent?</td>
<td>No</td>
</tr>
<tr>
<td>Does the research involve people with a cognitive impairment, an intellectual disability or a mental illness?</td>
<td>No</td>
</tr>
<tr>
<td>Does this research involve an intention to study or expose or is likely to discover illegal activity?</td>
<td>No</td>
</tr>
</tbody>
</table>

### Expedited Questions Summary

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third Party Identification</td>
<td>No</td>
</tr>
<tr>
<td>Children or Young People</td>
<td>No</td>
</tr>
<tr>
<td>Dependent or Unequal Relationship</td>
<td>No</td>
</tr>
<tr>
<td>Membership of a Group, or Related Issues</td>
<td>Yes</td>
</tr>
<tr>
<td>Physical Harm</td>
<td>No</td>
</tr>
<tr>
<td>Psychological Harm (includes Devaluation of Personal Worth)</td>
<td>No</td>
</tr>
<tr>
<td>Social Harm</td>
<td>No</td>
</tr>
<tr>
<td>Economic Harm</td>
<td>No</td>
</tr>
<tr>
<td>Legal Harm</td>
<td>No</td>
</tr>
<tr>
<td>Covert Observation</td>
<td>No</td>
</tr>
<tr>
<td>Deception</td>
<td>No</td>
</tr>
<tr>
<td>Sensitive Personal Information</td>
<td>No</td>
</tr>
<tr>
<td>Overseas Research</td>
<td>Yes</td>
</tr>
</tbody>
</table>
## Questions Detailed

### Membership of a Group, or Related Issues
- **Yes**

### Has there been full consultation with the community?
- **Yes**

### Does the research team include member(s) of a group?
- **No**

### Will there be appropriate reporting back to the group and/or a direct flow of benefits to the community?
- **Yes**

### Overseas Research
- **Yes**

### Will the research be conducted in a politically stable country where perceived criticism of the government or institutions would not attract punitive action?
- **Yes**

### Will details of a Local Contact be provided for participants to contact after the researcher has left the area?
- **Yes**

### Will there be appropriate reporting back to the community and/or a direct flow of benefits to the community?
- **Yes**

## Project Questions Detailed

### Description of Project

Describe the objectives of the project in terms easily understood by a lay reader, using simple and non-technical language.

The research aims to develop an understanding of the relationship between PNG landowners and their agroforestry system, and how they make land use decisions regarding production and utilisation of their resources. This research study explores the land owner decision-making processes to inform an understanding of key factors which are relevant to decision to grow commercially valuable trees. This is achieved by examining the productions system (subsistence & cash) to ascertain the land owner behaviour and decision out comes associated with land use decisions in responses to changing socio-economic and cultural imperatives. Based on the contextual background...
a research question has been framed as an objective of this research.

The immediate outcome of this research will be production of thesis, conference papers and other contribution such as articles for journals and news letters in agroforestry for public interest and consumption.

Apart from academic interest and outcome, practical contribution of this research study will provide recommendations to the PNG Government and other interested parties including Papua New Guinea National Forestry Authority, the strategies to be incorporated into policy development to facilitate and encourage commercial tree growing initiatives that are established and owned by the land owners. This will in the long term contribute to broader economic, social and environmental development goals.

Location of Data Collection

Australia No
Overseas Yes

Provide country / area where data collection will be conducted

The research is located in Papua New Guinea. Specific location of study site is Ramu Valley, Madang Province, Papua New Guinea.

Aims of the Project

List the specific aims and potential significance of the problems to be addressed in the research project.

The research aims to;
(1) Establish an understanding of the relationship between PNG landowners and their agroforestry system, and how they make land use decisions regarding production and utilisation of these resources. This research study explores the land owner decision-making processes to inform an understanding of key factors which are relevant to decision to grow commercially valuable trees.

(2) Other outcomes include; (a) production of thesis, (b) conference papers and other (c) contribution such as articles for journals and news letters in agroforestry for public interest and consumptions.

(3) Other contributions may include recommendation to the government and other agencies to develop policy decision that will facilitate the participation of commercial tree growing activities by customary land owners on their own land. This will have number of chain reaction benefits to the land owners and forestry sector in general, including; new opportunities for cash income to the land owners and contribution to other functional role forestry sector provides. Under the current forest policy and customary land tenure systems, these opportunities are not possible.

The research study ultimately will contribute to broader economic, social and environmental development goals and improvement to the livelihood of the local people and PNG as a whole.
Methodology

In language appropriate for a lay reader, provide the following details:

the nature of the research;
the scope and limitations of the project;
the procedures and method to be used, and
the sequence of research activities.

Explain why the methodological approach minimizes the risk to participant (for surveys, include a justification of the sample size).

The research study involves applying both qualitative and quantitative research methods in querying and collecting data ranging from traditional & cultural knowledge, social systems and processes in relation to decision making in terms of production and use of natural resources, power structures and relationships, perception and attitudes to adoption of commercial tree growing activities.

Project sequence:
Pre-study field work. An initial pre-study field work to pilot the proposed methodology will be carried from mid or late November 2007 to January 2008. Two village communities, one representing the Mari villages and the other near Ranara, are selected for this purpose. Both communities, numbering about 15 to 30 household members on average in each community are to be interviewed or observed over the period between Mid November 2007 and January 2008. The communities are located at Ramu Valley, in the Madang Province of Papua New Guinea.

Data collection techniques include semi structured interview, participant observation, time line analysis, focus group meetings. Both qualitative and quantitative data will be gathered. Broad category of data set required include; level of educational, demographic characteristics, economic activities, perception and value system relating to production, use and management of resources, community organisations and processes, power relation, social structures etc.

The data collection techniques engaged in this research work will have no risk to the participants.

Two communities are selected on the basis of influence in terms of involvement as active and not so active participants in the lease arrangement of their customary land to Ramu Sugar Limited for sugar cane production under the out-grower scheme. The later is private enterprise involved in production and processing of sugar in the area. Four village community leaders, representing each of the villages within communities have consented by signing prior informed consent statement to permit research work undertaken in the selected communities. Copy of the statement is attached. The Madang Provincial Administration, whose administrative jurisdiction the researched community comes under, has been notified of the research work taking place in their community.

At this stage, I do not anticipate any problems or limitation to the methods described above.
This study explores how an understanding of landowner decision making process in their production system can inform understanding of key aspects that will facilitate decisions to grow commercially valuable trees. To develop these understanding the study is asked this basic question:

**How do the motives and land-use choice behaviour of PNG smallholders' affect decisions that are relevant to options for commercial tree growing?**

Answering this research question requires dividing the broad questions into subsidiary components to explore the topic in a greater detail. Three sub themes were identified and these included issues related to how land use decisions are made, what factors influenced decisions outcomes and what factors are considered as constraints in the adoption processes of commercial tree growing activities. Accordingly, the following subsidiary questions were framed to address these issues.

1) What motivates land use decision of PNG smallholders?
2) How do these affect decision about commercial tree growing?

**What mechanisms do the researchers intend to implement to monitor the conduct and progress of the research project?**

Some of measure I will observe during the survey work.

(1) Good Communication technique: I believe with good communication skill and appropriate language applied will create good understanding between the participants and me. I will always ensure that community leaders and participants are always informed fully at every stages of the research on the details of activities of what I will be doing. I will also inform the participants that this is a volunteer activity and they should not feel obliged to participate. In this respect, I will tell the participants from the very beginning that they may withdraw at any stage in the process of interview, group meeting or other activities of the research, should they feel uncomfortable.

(2) Timing: I understand that participants will be giving time off to participate in my research and as such I will be conscious of this in terms of my timing with interviews or meeting. The issue of timing is factored in my research question, by way of number of questions being asked.

(3) Respecting community and cultural systems: As a Papua New Guinean I will be always sensitive and be watchful to notice if there are cultural barriers that warrants observing.

(4) Unspoken languages: Papua New Guinean people, out of politeness and respect of others, may not mean what they say but a culturally conscious person can read signal
HUMAN RESEARCH ETHICS COMMITTEE
Application Form

from body languages or gestures to indicate their state of mind. I am aware of this and will always use my judgement make decisions when confronted in such situations.

(4) Interview process and planning of survey activities: After completion the formalities of introductory processes with community leaders, I will then ask the willing participants as to when they can and are able make themselves available for the interview or attend the group meetings that are organised. From this I will then set a detailed plan for the field work. The interview timing and location will be decided at the convenience of the participants through a consultation process. The actual interview processes will commence with an introduction including who I am and what I will be doing in the interview and what the purpose is for my research and what may be a possible benefit to them of the work that I am engaged into doing. At the end of the interview I will say thank you and move onto the next participant. I will make prior arrangement with participants as to when I will be interviewing them previous night so that they are prepared before my fronting up at them.

(5) Change of mind: I am aware of the fact that some members may have consented or agreed initially to participate in the interview because of the presence or as a result of the community leaders influence, but may not be really willing to participate. To ensure that I do not interview anyone without his or her consent I will ask again if they are willing to participate in an interview or not before commencing with an interview. In cases where they are in the middle of an interview and do not wish to continue on, as a result of discomfort or change of mind, I will inform them at the very beginning that they may at any stage disengage themselves from participating.

Participants

Provide details in relation to the potential participant pool, including:

target participant group;
identification of potential participants;
initial contact method, and
recruitment method.

This study is part of a joint research project implemented by number of stakeholder partners from PNG and Australian. As such, my entry engagement to the communities and individual participants in this study is already established through the existing community network connections established by PNG project partners.

For the upcoming initial field work at Ramu valley, I will draw on the local community network connection of Ramu Sugar Partners to help establish the initial contact and introductory process. This process is necessary as it will enable me to know the community and also for the community to know me and what I will be doing in their community. After the introductory process is completed, the next step is to inform the Mari and Ranara village community leaders of my nominated survey sample area - two communities are selected at this stage, one each from Mari and Aranara communities. If my nominated choice is approved, I will proceed to the next stage. If not, then I will request the leaders to assist identify alternative communities based on my research requirement. Next step is to provide awareness and inform communities of what I will be doing through an organised meeting. This process will be facilitated by the community
leaders and I will explain in a clearest way possible as to what my research work is about and what my expectations are from them. In this meeting I will also ask them to tell me clearly what their expectation are from me. In these meeting I will also tell them that it is optional and not obligatory that they should be interviewed if they feel otherwise. I will also tell them that under no circumstances that they should feel compelled to participate because of their leaders presence or influence.

Recruitment of participant
Since the selected village communities are relatively small, consisting about 15 to 30 households and I intend to do a 100 percent sampling, provided that all participants in the nominated community are willing to participate. I will only approach willing family head and other adult members who are also leaving within the same household to conduct interviews. I will make decision on the spot to include, if there are interest and willingness by women and other category (youths) community members as participants.

Focus group meeting
In the case of focus groups meetings, I will utilise local cultural protocols for organise meetings. This will generally involve consulting village leaders such as Councillors, Village Court Magistrates or senior members of the community to organise this meetings but I will either facilitate the meeting myself or ask another neutral person to do this for me.

Proposed number of participants (or records). 50

Provide details as to why these participants have been chosen?

The community identified for this survey was based on the sampling strategy that was devised as part of the research method for this study. The two communities were identified as a sampling area on the basis of the degree of influence by the Ramu Sugar Limited Out grower scheme. Ramu Sugar Limited is a private sugar producing enterprise based in Ramu Valley of Madang province. The Out grower scheme involves leasing of customary land for the cultivation and production of sugar cane. The land owners benefit by receiving fees for the leased land. This has some degree of influence on the land use decision making process. One community is within the defined boundary of leased area while the other community is outside the boundary. Assumption one is that the community within the lease area boundary is more influenced by out grower programme in terms land use decision making processes than one that is outside. Assumption 2 is all other factors; environmental, cultural, soil and other physical factors are same.

Cultural Considerations

What cultural or social considerations / sensitivities are relevant to the participants in this research project?

The main social consideration is ensuring that the interview survey is understood by the villagers, including any who may have low literacy skills. Mr Mulung will ensure that questions are interpreted in Pidgin (lingua franca), the language normally used by most of the people in PNG. Mr Mulung with his background as a forest extension officer will use his extension skill and experience to communicate in the interview and focus group meeting processes.
HUMAN RESEARCH ETHICS COMMITTEE
Application Form

Incentives

Will participants be paid or any incentives offered? If so, provide justification and details.

NO payment is envisaged, but in situations were tea and coffee are usually provided as it normally happens in many of the rural villages in PNG, Mr Mulung will obliged to contribute and partake in such gestures.

Benefits

What are the anticipated benefits of the research? The benefits of this research project will be considerable and will outweigh the possible discomfort and risk to the participant. Experiences with tree crops such coffee, cocoa, coconut suggests that smallholder growers produce 80 percent of the total production of these commodities in PNG. Given the land tenure system the country has, the small holder grower sector will continue to be the deciding factor, particularly in terms of the decision consideration factors and decision-making, for long term productivity and sustainability of country's economic development. Although critical and a leverage factor, at present there are only limited in-depth independent analysis of adoption and the impacts of land owner decision making process have been done, therefore the outcome of this study will reveal some understanding of the factors that influences and facilitates the decision by land owners to participate in small holder farming including commercial tree growing activities. The tree growing activities will provide new economic opportunity for the land owners. In addition to economic opportunities, other benefits including variation to policy advice in forestry activities and address some of the environmental problems country has as far as forestry activities are concerned.

To whom will the benefits flow?

Firstly to me as the research will enable me to write thesis for my study. Secondly by writing and contributing articles in journals and other materials as newsletters for public consumption and awareness. Thirdly to the landowner communities in PNG through engagement and participation in commercial tree growing activities as a result of policy changes through recommendations from the research findings.

Informed Consent

Indicate how informed consent will be obtained from participants.

In writing Yes

Return of survey or questionnaire No

Orally Yes

Other No

If Other, provide details. NA
Confidentiality

Describe the procedures that will be adopted to ensure confidentiality during the collection phase and in the publication of results.

The questionnaires are designed in such a way that the identity of the participant is not revealed. In this way the confidentiality of information provided and identity of the person providing information is also kept unanimous.

Data Storage Procedures

Provide an overview of the data storage procedures for the research. Include security measures and duration of storage.

Data will be used strictly for the purpose of this research and will be kept by the researcher for the duration of the study.

Feedback

Provide details of how the results of the research will be reported / disseminated, including the appropriate provision of results to participants. If appropriate, provide details of any planned debriefing of participants.

Through organised meetings, and by written awareness through newsletters to the participants via the established extension networks of the partner organisations. The outcomes include publication in terms of thesis and article contribution in journals.

Supporting Documentation

Please ensure electronic copies of any supporting documentation have been uploaded the documents tab of the relevant protocol. This may include:
Please ensure electronic copies of the supporting documentation have been uploaded into the documents tab of your protocol.

These may include (please circle the relevant answer):

- List of indicative questions
- Copy of questionnaire / survey
- Invitation or introductory letter/s
- Publicity material (posters etc.)
- Information sheet
- Consent form
- External approval documentation
- Research visa (if applicable)
- Other (specify below)

For other, please specify:
HUMAN RESEARCH ETHICS COMMITTEE
Application Form

SIGNATURES AND UNDERTAKINGS

PROPOSER OF THE RESEARCH

I certify that all the persons listed in this protocol have been fully briefed on appropriate procedures and in particular that they have read and are familiar with the national guidelines issued by the National Health and Medical Research Council (the National Statement on Ethical Conduct in Human Research 2007).

I certify that the above is as accurate a description of my research proposal as possible and that the research will be conducted in accordance with the National Statement on Ethical Conduct in Human Research 2007. I also agree to adhere to the conditions of approval stipulated by the ANU Human Research Ethics Committee (HREC) and will cooperate with HREC monitoring requirements. I agree to notify the Committee in writing immediately of any significant departures from this protocol and will not continue the research if ethical approval is withdrawn and will comply with any special conditions required by the HREC.

Signed:.................................................. Date:.....................
HUMAN RESEARCH ETHICS COMMITTEE
Application Form

ANU SUPERVISOR

I certify that I shall provide appropriate supervision to the student to ensure that the project is undertaken in accordance with the undertakings above:

Signed: ................................................. Date: .................. .

HEAD OF ANU DEPARTMENT/GROUP/CENTRE:

The Head of ANU Department/School/Centre is asked to certify that this proposal has his/her support:

I certify that:

:- I am familiar with this project and endorse its undertakings;

:- the resources required to undertake this project are available; and

:- the investigators have the skill and expertise to undertake this project appropriately.

Please print name and title ........................................................................................................................................

Signed: ................................................. Date: .................. .
Appendix 3: Permission Letter to conduct research and the Consent letter
The Chairman,
Provincial Research Committee
Department of Western Province
PO Box 347 Kiunga, Western Province
Papua New Guinea.

Attention: Mr Willie Kokoba, The Deputy Administrator

Dear Sir,

Seeking Permission to Conduct Research in the Middle Fly Area of Western Province

Further to our discussion Kokoba/ Hartmut and Mulung at our brief Meeting in Kiunga about November 2007. I wish to formally seek your endorsement to conduct a social research work during the months of August and September 2008 in North and Middle Fly region of Western Province.

My research study focuses on land-use decision-making processes by land owners and farmers in relation to adoption decision on cash cropping activities and other subsistence activities. Major component of the study requires carrying out field work that will entail conducting interviews, group meetings, observation of group dynamics and interaction with selected village communities in PNG, including Yeteni, Komovai and villagers along the Middle Fly River region. I anticipate conducting this work around September 2008.

The work I am doing is part of the ACIAR/PNG agroforestry project, titled value adding to PNG agroforestry project, of which I hope you are familiar with, is channelled through OK Tedi Development Foundation as PNG counterpart for the component in Western Province. One of the possible outcomes, among others, from this study will be the possibility of increased participation of commercial tree growing by the landowners.

Since the identified community for this purpose comes directly under your administrative jurisdiction, I firstly wish to inform you of my research intent and secondly in seeking your endorsement to conduct this research work. Some communication to the effect had already taken place with the concerned communities through OK Tedi Development Foundation staff and they (community members) have given their consent for this work to take place.

Sincerely,

Kulala Mulung
PhD Scholar, ANU
Consent Form

(a) We, Steven Wembut (Chairman of Middle Fly River Community Trust) and Rody Ivan (Village Planning Committee Chairman and Project Leader of Yetenl Agroforestry Project) of the Middle Fly villages, Middle Fly District of Western Province of Papua New Guinea, on behalf of the Yulawas/Molian village community and people consent to,

(b) Mr. Kulaln Mulung of the Australian National University, Australia in engagement and participation in his research activity, our agreement is restricted to the following areas;

(i) Permit Mr Mulung or his assistant(s) to conduct a social survey work of community and individual members;
(ii) Permit Mr Mulung to interact with members of the Yulawas/Molian community of Middle Fly River Regions by conducting interviews, making observations, recording and transcribing actions of activities and events that takes place in the villages;
(iii) We request Mr. Mulung to organise and conduct meetings in the Yulawas/Molian villages and communities relating to his research study; and
(iv) We give access to the Yulawas/Molian village communities and other resources for the purpose of Mr. Mulung’s research work.

(c) In return for our gesture of goodwill and consent, whilst conducting his research we expect that Mr. Mulung will take every measures as far as possible to

(i) Ensure that he will work with our village leaders or appointed members of the community;
(ii) Keep us inform on his progress and daily programme of activities;
(v) Provide advice and assistance in areas of his profession and expertise when required; and
(vi) Inform us at the end of the study on the outcome of his study.

(d) We also anticipate that the project under which he is carrying out his study, (ACIAR/PNG agroforestry project) will facilitate new cash-earning opportunities as a benefit for the Yulawas/Molian communities; we are thankful for such assistance and in that regard we also give our support and participation in this research.

[1] Name: Mr. Rody Ivan (Village Planning Committee Chairman and Project Leader) < [PRINT NAME]
Village: Yulawas - Middle Fly District, Western Province
Signature: [Signature]
Witness: Mr. Steven Wembut (Chairman Middle Fly River Community Trust < [PRINT NAME]
Signature: [Signature]
Signed on this day ______ of May, 2008