School of Design and the Built Environment

Geography

The impact of Cocoa Pod Borer on the livelihood responses of farmers in East Sepik Province, Papua New Guinea

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number # RDHU-255-15.

Signature: .....

Date: 28th June 2023

Abstract

The increase in environmental and socio-economic hazards in developing countries raises questions about the vulnerability, adaptive capacities and resilience of communities. More importantly, there are questions about understanding vulnerability and adaptive capacities of different groups of people when confronted with sudden shocks or long-term stressors on livelihoods. Various studies conducted in developing countries have examined people's coping and adaptation strategies to different environmental hazards. In the Pacific, people's livelihood revolves around land-based resources, and land access is a key determinant of people's adaptive capacity. In this thesis I examine the experiences of smallholder cocoa farmers of East Sepik Province (ESP) in Papua New Guinea (PNG) and how they are responding to the financial shock caused by an introduced insect pest of Cocoa, the Cocoa Pod Borer (CPB) (*Conopomorpha cramerella*) which recently devastated their key livelihood income source – cocoa. Previous studies conducted on CPB focused on impacts and responses of cocoa farmers in general; in this study however, I go a step further to differentiate between migrants and landowners' coping and adaptation strategies in response to the impact of the shock.

Since the CPB intrusion in 2006, management of the pest by smallholder farmers has been very poor resulting in production losses of up to 80%. This pest outbreak has been much deliberated on by the government through its responsible agriculture institutions. However, efforts made so far to counter the impact of CPB on production and farmers' livelihoods have been inadequate and largely unsuccessful. Farmers' responses to CPB have varied. Studies show that while some farmers were able to overcome CPB, most farmers abandoned their cocoa holdings. Despite research to understand farmers' responses, most studies to date were limited to certain parts of East New Britain, East Sepik, Madang, New Ireland, and Chimbu Provinces and may not reflect the responses of farmers in other provinces affected by the outbreak. This study aimed to investigate how migrants and landowner cocoa farmers in ESP responded to the impact of CPB. It sought to explore factors that influenced their decision-making to restructure their livelihoods in the CPB environment.

In this study I employed a mixed method approach where in-depth interviews, focus group discussions, cocoa block surveys, case studies, participant observation and discussions with key informants were employed to generate data. The sampled population was from the landowner group of central Dagua in East Sepik Province of Papua New Guinea, and a

migrant community who settled in Dagua in the late 1940s under an informal agreement to access land.

Using the above methods, the study examined the impact of CPB and the financial shock on migrant and landowner smallholder cocoa farmers. It used the Sustainable Livelihood Framework (SLF) as a guide to investigate impacts on people's social, financial, human, physical and natural assets. It then investigated migrants and landowners' coping and adaptation strategies employed to minimize the impact of the financial shock.

In this study I demonstrate that when CPB struck there was a sharp decline in migrants' and landowners' incomes. The financial loss meant there was limited cash to maintain household food supplies, pay medical bills, school fees, and travel costs. There was also limited money available for mortuary expenses, bride prices and compensation payments, or to contribute to community fundraising activities or assist extended family members. This placed migrants under immediate pressure to abandon their cocoa blocks and pursue alternative livelihood activities. The landowners were under far less pressure, and therefore made more minor adaptations to their livelihoods. I show that the key determining factor distinguishing their coping and adaptation responses to the crisis was land access. Migrants adopted livelihood practices that required less need for land, while landowners utilized their land-based resources to support their livelihoods.

There was evidence that migrants and landowners' responses are context specific. Migrants have few land rights and are unable to access more land. They responded by intensifying the use of their current land holdings. This they did by intercropping, adopting and growing fast-maturing crop varieties, and growing crops like tobacco and betel nut which are of high value relative to the land area they occupy. Migrants also explored non-farm activities such as roadside markets to earn income. I also show that while responding to the financial shock, migrants also maintained good social relationships with landowners. This was to ensure they avoided confrontations with landowners which may result in them losing their ability to access land. For example, they ensured they contributed to the bride prices and mortuary expenses of landowner families. In addition, they made attempts to pay full school fees, medical bills and avoided disagreements with landowners over property use. Moreover, migrants supported each other during the crisis but were very specific on how they assisted each other, ensuring that they did not deplete their financial resources.

In contrast, I demonstrate in the thesis that because of access to land, landowners utilized land-based resources to earn cash as well as maintain household food supply. Key responses by landowners were agricultural extensification where they expanded their food gardens by farming fallowed sites, hunting and harvesting wild leafy vegetables including collecting firewood from the forest. The findings in this study show that landowners were not under immediate pressure to utilize potential resources they had to generate income.

Responses by the smallholder migrant and landowner farmers meant that they proactively responded to the crisis. However, each responded according to their adaptive capacity within their context. Migrants responded to two issues – the financial shock and their settlement issue. To reduce their vulnerability, they drew from resources available to them to generate income and maintain household food security. Landowners, in contrast, had several livelihood options to develop to earn cash or obtain food. The findings from this thesis illustrate that crises impact different groups of people differently based on the contexts and their adaptive capacities. It also provides a case study demonstrating the resilience of a migrant group under multiple stress conditions.

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Wuroh e ah, nina ne nima!

Oso ndera!

All Glory to God Almighty

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List of Abbreviations and Acronyms

ACIAR	Australian Centre for International Agricultural Research
ARoB	Autonomous Region of Bougainville
AUD	Australian Dollar
CARE	Cooperative for Assistance and Relief Everywhere
CARE CVCA	CARE Climate Vulnerability and Capacity Analysis
CBPNG	Cocoa Board of Papua New Guinea
CISP	Cocoa Industry Strategic Plan
CPB	Cocoa Pod Borer
CPBRCC	CPB Response Coordinating Committee
DAL	Department of Agriculture & Livestock
DFID	Department for International Development
DSP	Development Strategic Plan
EHP	Eastern Highlands Province
ENBP	East New Britain Province
ESP	East Sepik Province
FAO	Food and Agriculture Organization
ICCO	International Cocoa Organization
IDS	Institute of Development Studies
IPCC	Intergovernmental Panel on Climate Change
MASP	Mapping Agriculture Systems in Papua New Guinea
MTDP	Medium-Term Development Plan
NADP	National Agriculture Development Plan
NAQIA	National Agriculture Quarantine & Inspection Authority
NBPOL	New Britain Palm Oil Limited
NGOs	Non-Government Organizations
Oxfam	Oxford Committee for Famine Relief
PDAL	Provincial Department of Agriculture & Livestock
PGK	Papua New Guinea Kina
PICs	Pacific Island Countries

PMV	Public Motor Vehicle
PNG	Papua New Guinea
PNGCCIL	Papua New Guinea Cocoa Coconut Institute Limited
PNGDAL	Papua New Guinea Department of Agriculture & Livestock
PNGGA	Papua New Guinea Growers Association
WNBP	West New Britain Province
WSP	West Sepik Province
SES	Social Ecological Systems
SLA	Sustainable Livelihood Approach
SLF	Sustainable Livelihood Framework
SPSS	Statistical Package for the Social Sciences
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
UNRE	University of Natural Resources and Environment
UNSDS	United Nations Sustainable Goals
VSD	Vascular-Streak Dieback

Common, Botanical and Tok Pisin names

Common name	Scientific name	Tok Pisin name
Aibika	*Abelmoschus manihot*	*Aibika*
Amaranth	*Amaranthus tricolor*	*Aupa*
Banana	*Musa cvs*	*Banana*
Bean (common)	*Phaseolus vulgaris*	*Bin*
Bean (long)	*Vigna unguiculata sp.*	*Bin*
Betel nut	*Areca catechu*	*Buai*
Betel pepper	*Piper betle*	*Daka*
Black Palm	*Caryota rumphiana*	*Limbum*
Breadfruit	*Artocarpus altilis*	*Kapiak*
Cocoa	*Theobroma cacao*	*Kakau*
Coconut	*Cocos nucifera*	*Kokonas*
Coffee, Robusta	*Coffea canephora* var. *robusta*	*Kopi*
Galip nut	*Canarium indicum*	*Galip*
Ginger	*Zingiber officinale*	*Kawar*
Gliricidia	Gliricidia sepium	*Glirisidia*
Japan cheera	*Sauropus androgynous*	*Tri-deis kumu*
Kangkong	*Ipomoea aquatica*	*Kango*
Karakap	*Solanum americanum*	*Karakap*
Kumu mosong	*Ficus copiosa*	*Kumu mosong*
Leucaena	*Leucaena leucocephala (Lam.)*	*Landro*
Oil palm	*Elaeis guineensis*	*Wel pam*
Okari nut	*Terminalia kaernbachii*	*Okari*
Pawpaw (Papaya)	*Carica papaya*	*Popo*
Peanut	*Arachis hypogaea*	*Pinat*
Pineapple	*Ananas comosus*	*Painapol*
Pitpit	*Saccharum edule*	*Pitpit*
Pumpkin	*Cucurbita moschata*	*Pamken*
Pumpkin tops (leaves)	*Cucurbita moschata*	*Kuru pamken*
Sugar cane	*Saccharum officinarum*	*Suka*
Sweet potato	*Ipomoea batatas*	*Kaukau*
Taro	*Colocasia esculenta*	*Taro tru*
Taro, Chinese	*Xanthosoma sagittifolium*	*Singapo or taro kongkong*
Taun	*Pometia pinnata*	*Ton*
Tobacco	*Nicotiana tabacum*	*Brus*
Tulip	*Gnetum gnemon*	*Tulip*
Valangur	*Polyscias verticillata*	*Valangur*
Vanilla	*Vanilla planifolia*	*Vanila*
Vanilla	*Vanilla tahitensis*	*Vanila*
Watercress	*Rorippa nasturtiumaquaticum*	*Watakres*
Watery rose apple	*Syzygium aqueum*	*Laulau*
Yam, greater	*Dioscorea alata*	*Yam*
Yam, lesser	*Dioscorea esculenta*	*Yam*

CHAPTER 1

INTRODUCTION

Introduction

The lives of smallholder farming families in developing countries are often met with economic, social, environmental and political challenges (Curry *et al.*, 2012; Ellis, 2000; Wang *et al*., 2016). To support the sustainable livelihoods of farmers, it is important to understand farmers' vulnerabilities, and their resilience and adaptive capacity. Moreover, examining the key determinants of their adaptive capacities is crucial in understanding how they respond to livelihood calamities. This thesis contributes to this by examining the livelihood adaptation and coping strategies of smallholders in two cocoa-farming communities in the Dagua area of East Sepik Province (ESP) of Papua New Guinea (PNG), in response to a financial shock which progressed into a prolonged income-stress caused by the infestation of cocoa pod borer (CPB), *Conopomorpha cramerella* (Snellen).

Since PNG's first reported case of CPB in 2006 in East New Britain Province (ENBP), harvested cocoa yields have dramatically fallen across PNG, and the livelihoods of more than 150 000 smallholder farmers have been considerably impacted (Curry *et al*., 2011). For these smallholder farmers, cocoa incomes have played a key role in maintaining the livelihoods of farming households. In Dagua, cocoa has been an important source of income for the Daguans since its introduction to the area in the late 1940s. Cocoa has been their main income source since the 1980s. In this thesis I show that in Dagua, income losses due to CPB have been significant. The research also demonstrates that the immediate coping responses and adaptation strategies have been markedly different for two different social groups resident at Dagua. The first of these groups is the customary landowners in the area. The second is a community of long-term internal migrants originated from inland mountain areas, of West Yangoru in the ESP, and settled in Dagua after the Second World War, and who are living on the first group's customary land. These groups are culturally similar and have similar livelihoods. The main difference between the two groups is their access to land, and this, I argue, is the key factor determining their different coping and adaptive strategies.

Previous research in PNG, first in ENBP, and recently in Madang, East Sepik, Chimbu and New Ireland Provinces, has sought to understand how farmers are adapting to the CPB epidemic and to the introduction of new technologies to manage CPB (see Curry *et al*., 2011; Keane *et al*., 2021; Peter, 2021). This thesis builds on this earlier work by exploring in detail

the different impacts of CPB on migrant and landowner groups within a community, and the way that the different livelihood assets available to migrant and landowner groups, and their differing socio-economic contexts, have created different coping responses and adaptation strategies to CPB.

In the remainder of this chapter I will, first, present the research questions, objectives, the significance of the study, and the arguments of the thesis. Second, I will provide an overview of environmental threats to livelihoods in developing countries. Third, I will discuss the significance of the cocoa industry in PNG. Fourth, the arrival of CPB and the impact on people's livelihoods will be discussed. I then present the responses by the smallholder cocoa farmers. After this I will introduce the migrant smallholder farmers, as an important community group in this study. Lastly, I will outline the structure of the thesis.

Research question and objectives

The key research question is: how are migrant and landowner cocoa farming households within an agricultural-based community responding to livelihood income shortfalls induced by the agricultural pest - Cocoa Pod Borer? This question is answered through the guidance of three main objectives, which are the following:

1. To examine the differential impacts of the financial shock on livelihoods of migrants and landowning cocoa farmers,
2. To investigate different coping and adaptation strategies pursued by farmers in response to income losses due to CPB.
3. To identify key determinants that influence migrant and landowner farmers' decisions and responses to addressing the impact of CPB on household income security.

Through the thesis I explore:

1. Coping and adaptation strategies that landowning and migrant farmers adopt to respond to livelihood crises, and how these are shaped by the livelihood assets accessible to them. I particularly explore the significance of access to land and land-based resources in shaping livelihoods.
2. Differential access to land and land-based resources amongst cocoa farmers, and how these encourage divergent pathways of agricultural extensification and intensification, and the pursuit of agricultural and non-agricultural income earning strategies. I also examine how pressure on resources encourages livelihood innovation.

3. Relationships between landowners and the migrant community, and how these shape coping and adaptation strategies, and influence present and future vulnerability.

Significance of research

This study is significant for three main reasons. First, it provides new insights into rural farmers' responses to agricultural stress from the perspective of a developing Pacific Island country. Hence, it contributes to better understanding place-based responses to shocks and stress.

Secondly, the study contributes to a better understanding of migrants and landowner farmers' coping and adaptation responses to livelihood stressors. It explains why certain choices are made and the factors that shape these choices. It also contributes to understanding the coping and adaptation strategies of land-insecure farmers in PNG. As land pressures increase in PNG and as more farmers seek to earn income from land where they do not hold primary access or control rights, the thesis provides insights into the capacity of resource poor farmers to respond to pressures on their farming systems. This provides insights into how such farmers are likely to respond to other environmental disturbances, including from climate change.

Thirdly, studies on the impact of stressors and shocks on rural livelihoods in different geographical and socio-cultural contexts in PNG remain limited. Further studies are necessary to gain a deeper understanding of how socio-economic and cultural factors shape farmer responses to shocks and stressors. This study therefore contributes to understanding the factors that influence coping and adaptation under different socio-geographical settings. This is especially important in the context of the changing climate, and in a more trade-connected world, where pests and diseases are likely to increase. PNG farmers also face other types of shocks and stress, so understanding the socioeconomic factors that shape livelihood responses can help government, private sector and non-government organisations (NGOs) respond accordingly.

Environmental hazards and livelihoods in developing world

Environmental hazards threaten the livelihoods and well-being of communities in developing countries placing them in short or long-term vulnerable situations (Lahsen *et al*., 2010; Reed *et al.*, 2013). The livelihoods of marginalised rural communities are particularly vulnerable (Reed *et al*., 2013). Such hazards are also referred to as shocks, stresses, perturbations, disturbances, catastrophes, calamities (Dixon *et al.*, 2014; Jones *et al.*, 2010). They often pose

a risk of increased poverty (Baez & Santos, 2008; Chambers & Conway, 1992) thus negating efforts towards achieving the Sustainable Development Goals (UN DESA, 2018) to reduce poverty, inequalities and unhealthy living conditions (Nelson *et al*., 2016).

In developing countries, rural communities who depend on agriculture as the main source of income face the challenge of maintaining their livelihoods during periods of agricultural shocks and stress (Tongruksawattana *et al*., 2013). These communities' benefit from natural resources and obtain daily sustenance from ecosystem services. However, present variations in the environmental conditions have contributed to disturbances to natural ecosystems resulting in agriculture production losses and loss of incomes in these communities. The disturbances include droughts, floods, weather and temperature extremes, sea level rise, and the emergence and spread of pests and diseases (Gross, 2014; Hatfield & Prueger, 2015; Oo *et al*, 2018; Shiferaw *et al.*, 2014; Tanvir Rahman et al., 2015). In the face of changing climatic and environmental conditions, understanding people's adaptive capacities and their ability to cope and respond to their changing environment has become an area of wide interest (see, for example, Belay *et al*., 2017; Gough *et al*., 2010; Nielsen & Reenberg, 2010; Rosegrant *et al*., 2015; Scoones, 2009; Wang *et al*., 2016; Wilk *et al.*, 2013; Wood *et al.*, 2014). This is because people's resilience to shocks and stresses depend on the type of shock or stressor, its intensity, duration and the nature of the affected target, and the adaptive capacity of the agricultural system and farming households to withstand such events (Holling, 1973; Walker *et al*., 2004; Colburn & Seara, 2011; Gallopin, 2006; Mata-Lima *et al*., 2013; Folke, 2016). Communities often demonstrate adaptive or coping mechanisms which draw upon social and natural assets to minimise extreme impacts on their livelihoods (Adger, 2006; Chambers & Conway, 1992; Lin & Chang, 2013; McLaughlin, 2011; Nielsen & Reenberg, 2010; Scoones, 2009). Coping and adaptation strategies differ between people and communities but are important in response to situations of stress (Paavola, 2008). Numerous studies have examined the vulnerabilities and adaptive capacities of communities in developing countries to different impacts of climate change (see Hahn *et al.*, 2009; Osbahr *et al.*, 2008; Paavola, 2008; Shiferaw *et al*., 2014).

One important influence of climate change is the spread and distribution of agricultural pests and diseases under changing temperature and humidity conditions (Gross 2014). Studies have shown climate change to be a major cause in the reduction of crop yields worldwide, including due to pests and diseases (Cerda *et al*., 2017; Chakraborty & Newton, 2011; Luck *et al*., 2011). In PNG, the arrival and spread of CPB throughout the cocoa growing areas of the

country has had a major impact on livelihoods and has caused substantial loss of incomes for smallholder farmers (Curry *et al*., 2011). With increased threat of agricultural pests and diseases under climate change, knowledge of past responses to such shocks will contribute to better understanding of the likely responses of smallholder farmers to future shocks.

The cocoa industry and cocoa farming in PNG

The PNG government through its established institutions, namely, the Cocoa Board of PNG (CBPNG) and the PNG Cocoa Coconut Institute Limited (PNGCCIL) play crucial roles in ensuring economic benefit from cocoa is realised, through policy development, and through research and development practices (CBPNG, 2017; Omuru & Kingwell, 2000). The Cocoa Industry Strategic Plan (CISP) 2016-2025, the Medium-Term Development Plan, the Development Strategic Plan, the National Agriculture Development Plan and PNG Vision 2050 (CBPNG, 2017) serve as guide for institutions. The CBPNG in particular has embarked on initiatives to address the prevailing challenges in cocoa farming as well as increase production across the country. The Remote Area Cocoa Freight Subsidy project, District Cocoa Nursery project, Cocoa Quality and Market Promotion and Productive Partnership in Agriculture Project are amongst some of the initiatives that CBPNG undertook to address the government's vision for the cocoa industry (CBPNG, 2017). According to CBPNG (2017) other initiatives being considered include: clonal nurseries and budwood gardens, certification, formation of organised grower groups and cooperatives, partnership and networking, and the use of service providers. The recent work on enterprise-driven transformation of family cocoa production conducted in ESP, Madang, New Ireland and Chimbu, funded by the Australian Centre for International Agricultural Research (ACIAR) helped address some of these initiatives (Keane *et al*., 2021). The recent introduction of the Private Sector Service Provider (PSSP) initiated by the New Guinea Islands Produce (NGIP-Agmark) which takes a holistic approach to cocoa farming from production to awareness and training has also proven successful in changing farmers' approach to cocoa farming amidst CPB conditions. This concept has been adopted by the National Department of Agriculture and Livestock (NDAL) and the CBPNG to help improve operations of farmer groups and cooperatives (Peter, 2021: 96). The ACIAR project initiative and the PSSP concepts seem promising in enhancing people's adaptive capacities to respond to impact of CPB.

Cocoa (*Theobroma cacao*) is native to South America. Its adoption as a cash crop led to its extensive distribution through parts of Africa, Asia and Oceania (ICCO, 2014). In PNG, cocoa was introduced as a plantation crop by German settlers in ENB around 1900. After the Second

World War, the push to have cocoa exported to other countries apart from the small Australian market became an interest of the colonial administration (MacWilliam, 2013:45). This further opened up the export market for PNG, but it soon became clear that the plantation sector alone was not able to meet demand and the opportunity to encourage smallholder production was the way forward (Allen *et al.*, 2009:315). By the late 1970s smallholder production overtook the plantation sector, and by 1990, plantation production had significantly dropped. Smallholders also realized that they too could earn cash from cocoa – a similar scenario to coffee. Today, 95% of cocoa production in PNG is from smallholder growers while the remaining 5% is from the plantation sector (PNGCCIL, 2017: 30).

At the time of this study, smallholders were growing cocoa in 14 of PNG's 22 provinces. Most expansion of smallholder production occurred in the provinces of ENB, Oro, Morobe and the Autonomous Region of Bougainville (ARoB) and East Sepik (Lummani, 2006; Allen *et al*., 2009:317). Recently, cocoa was introduced into Simbu in the highlands of PNG. There are around 150 000 smallholder cocoa growers in PNG and this number is increasing (Curry *et al*., 2011). Smallholders are defined by the industry as those that farm less than 3 hectares of cocoa. PNG smallholders typically practice a low input-low output production system, do mixed cropping, and rely mostly on family labour (Curry *et al*., 2007; Louw & Jordaan, 2016; Lowder *et al*., 2016) (see Table 1.1). Smallholder cocoa farmers also actively engaged in other livelihood activities, and this affects productivity. Low smallholder productivity, high levels of pest infestations and a 'non-business' approach to cocoa farming by farmers are considered by the industry as the main on-going challenges for farmers. In addition, lack of leadership, research and development, and extension activity by the government agencies have also contributed to low cocoa productivity.

Table 1.1 Common characteristics of smallholder cocoa farmers

Attribute	Description
Block size	• Farm less than 3 hectares. Under CPB conditions 1 hectare is recommended by PNGCCIL.
Production system	• Practise low input-low output production system. • Majority sell as wet bean. • Productivity is low.
Block description	• Cocoa is commonly intercropped with vegetables, perennial tree crops or plants with cultural significance.
Labour	• Utilise family labour. • Occasional use of hired labour. • Returns to labour is usually low.
Agricultural tools and technology	• Simple hand tools including machete (bush knife), grass knife, wheelbarrow, pruning saws, secateurs and so forth. • Minimal use of chemicals (herbicides and weedicides). • Small proportion own cocoa driers. • Mobile phones assist farmers communicate about extension visits, cocoa prices, and organising work.
External support and information	• Support mainly obtained from PNGCCIL, DPI and CBPNG and Agmark.
Main factors affecting productivity of smallholders	• Labour shortages. • Low levels of block maintenance. • Land shortages. • Low cocoa prices. • Inadequate skills, training and support. • Poor access to credit facilities. • Cocoa not seen as business.

Source: Aipi 2012; Curry *et al*. 2007; Curry *et al.* 2011; Lummani, 2006; Omuru *et al*. 2001

Smallholders' productivity is determined not only by commodity prices but also by other independent factors, both economic and non-economic. Aipi (2012) argued that almost 78 percent of variations in export volumes could be attributed to a range of independent factors and only 22 percent were influenced by world cocoa prices. These independent factors are largely embedded in the socio-cultural contexts of the people. For example, farmers cultivate cocoa for different goals. While some farm to maximise incomes, some do so for social reasons such as earning a reputation in the community (Aipi, 2012). In East Sepik Province (ESP), cocoa is mostly cultivated in small quantities by smallholders. The majority of these smallholders farm on clan-owned land. Smallholder cocoa production has dominated production in ESP over the last twenty years (CBPNG, 2014). Production from the plantation sector continued to decline while smallholder production gained momentum until the spread of CPB which saw a rapid decline in production from 2009. The intrusion of the pest made it challenging to meet the industry's annual targets.

The arrival of CPB in PNG

CPB (*Conopormopha cramerella*) is a nocturnal insect pest of cocoa. Adult moths reside on the underside of branches during the day and mate at night. CPB breeds continuously, and with a generation time of about one month the damage to pods is prevalent throughout the year. The egg and larvae stage occur on and in the cocoa pod. This occurs for almost a month before the larvae form a cocoon and pupate either on the pod or on the ground. Attack on the pod occurs in the pod's 5 to 6-month development stage. The pest destroys the pod when the larvae burrow through the mesocarp, into the pod and feed on the mucilage wrapping the newly developed beans. This takes approximately two to three weeks. During that time, the soft tissues in the pod harden. In some cases, the whole pod is affected forcing pre-mature ripening (Day, 1985; Lim, 1992).

CPB was identified in the early 1900s as a native pest in the regions of South East Asia and the Western Pacific (Day, 1985). It contributed to more than 50% yield losses in these regions before control measures were established (Day, 1989; Lim, 1992). Efforts to develop resistance mechanisms have had limited success (Bloomfield & Lass, 1992) with smallholder farmers within the region encouraged to use Integrated Pest & Disease Management (IPDM) practices to minimise the impact of the pest on production (Curry *et al*., 2011:38; Konam *et al*., 2008; Peter *et al*., 2017; Wood *et al*., 1992).

In PNG, CPB was first identified in ENBP in 2006, and by 2011 it had been found in all the major cocoa producing provinces (see Table 1.2). In ENBP reduction in yields was very significant (see Figure 1.1). The epidemic gradually spread to other provinces (Table 1.2) and resulted in similar reduction in yields. Production data from other provinces indicate that the spread of the epidemic was gradual across the country. For example, while production for ENBP fell significantly after 2008, ESP and the AROB maintained some level of production for some time until the impact became apparent. This was because production at that time was expanding, which offset the losses.

In ESP, the impact of CPB on smallholder production was gradual since its first reported case in 2008, probably due to the wide spatial distribution of cocoa production in the province. After 2008 many other provinces reported its presence (Table 1.2). From 2011, there was a steady decline in production until efforts were carried out by the PNGCCIL to address the situation.

Table 1.2: CPB detections in PNG.

Location	Province	Month/Year
NARI Research Station Kerevat	East New Britain	March 2006
Poro Settlement/Aitape	Sandaun	June 2006
Boroi/Bogia	Madang	April 2008
Karkar Island	Madang	April 2011
Maprik/Drekikier	East Sepik	2008
Hoskins	West New Britain	July 2009
Bougainville	AROB	October 2009
Namatanai	New Ireland	November 2009
Baluan Island	Manus	April 2010
Siassi Island	Morobe	May/June 2011

Source: CCIL, 2016: 36-37

Despite cocoa's significant contribution to national agricultural revenue (Allen *et al.*, 2009; Yen *et al.*, 2010), the industry has been battling with a number of pest and disease problems. Even though the country did manage to increase its production nationally from an average of 42 000 tonnes in 2002 to 56 000 tonnes in 2008, reaching the government's export target of 100 000 tonnes by 2016 was not achieved (see Figure 1.1) (Allen *et al.*, 2009; PNGCCIL, 2017). A slight increase however was seen in Madang and Morobe where cocoa was increasing, and cocoa expansion in ARoB and ESP offset the losses occurring in ENB. Production in ARoB and ESP did decline from their peaks in those provinces but settled at higher rates in national production than in the early 2000s. Major contributors to the decline in ENB were the poor block maintenance practices and lack of adoption of improved technologies (Curry *et al*., 2011; Keane *et al*., 2021; Peter et al., 2017). The incursion of CPB presented an unprecedented challenge for the industry and the livelihoods of the smallholder farmers (Curry *et al*., 2007; Yen *et al.*, 2010).

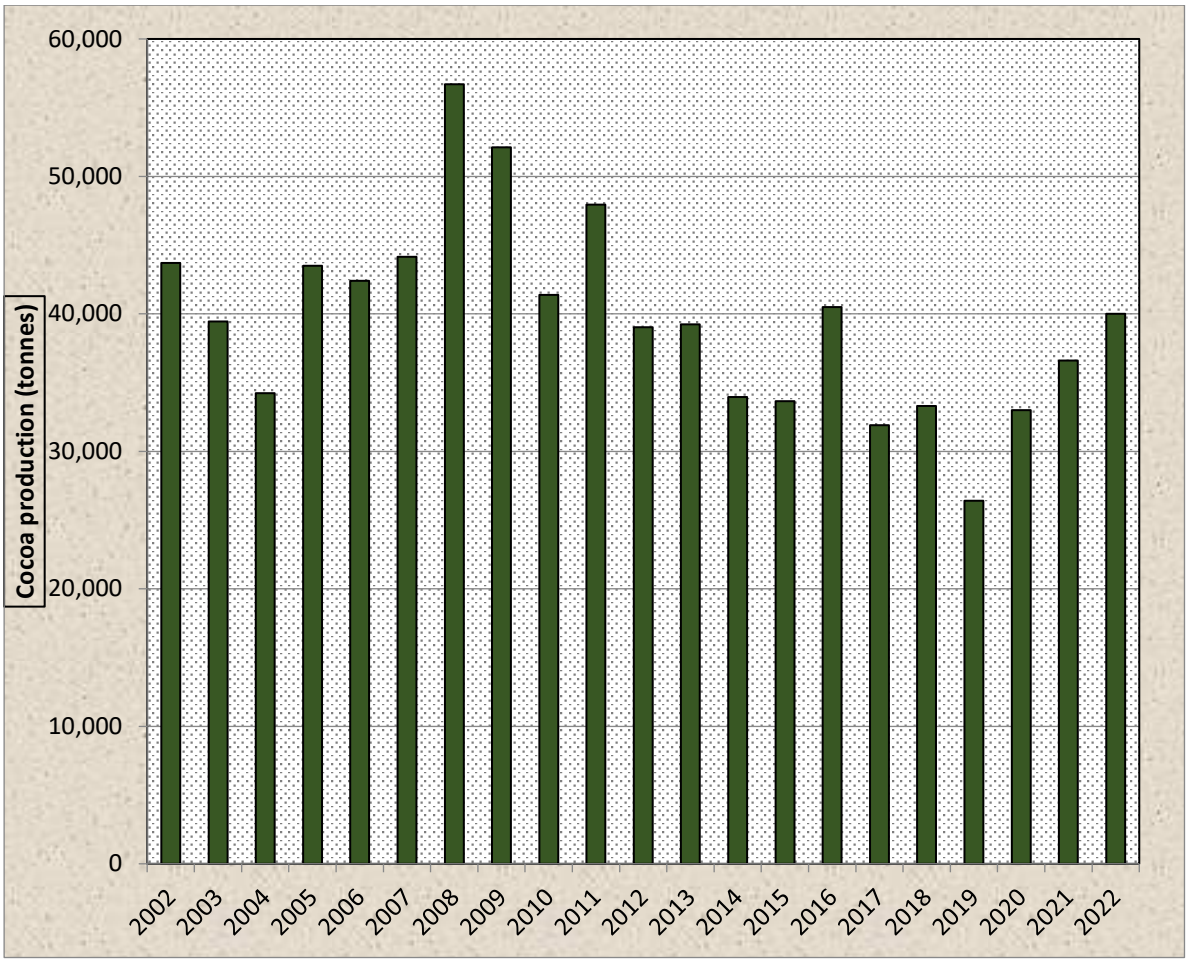

Figure 1.1: PNG cocoa production, 2002-2022. Source: PNGCCIL 2017, Bank of PNG. 2024

Impact of CPB on livelihoods

The impact of CPB has been detrimental to the livelihoods of smallholder cocoa growers. Although other cocoa pests and diseases exist, CPB has been the prime threat to the industry (Rosmana *et al*., 2010; Peter *et al*., 2017), and importantly to the lives of smallholder farmers who depend on incomes earned from cocoa (Curry *et al.*, 2007; Peter *et al*, 2017). MacWilliam (2013:216-219) warned that such circumstances were bound to happen when people depended too much on one livelihood activity or a single commodity, ignoring the risk of possible economic shocks and stresses. A similar case in Indonesia saw smallholder's incomes fall dramatically when their average production of 1500-2000 kg per hectare was reduced to 500 kg per hectare during the outbreak of CPB (Ruf & Yoddang, 2004). This not only posed threats to farmers' livelihoods but farmers decisions to continue investing in cocoa production.

In PNG, cocoa holdings had become attractive livelihood assets for farming communities, out-competing other crops and non-farm incomes. It contributed much to the social well-

being of farmers. Incomes from cocoa have helped fund school fees, health expenses, fundraising activities, social activities, home expenses, transport costs, food purchases and meeting cultural obligations (Curry *et al*., 2007, 2011; Peter *et al*., 2017; Peter, 2021: 79). Since the incursion of CPB, people's economic and social livelihoods have been disrupted. Based on Omuru *et al*. (2001), a projection of losses to household incomes in ENBP was calculated by Curry *et al.* (2009) (Table 1.3).

Table 1.3: Estimated yield and income losses to CPB

Proportion of yield loss (%)	Reduction in yield (kg/ha) from 620 kg/ha	Reduction in income (kina/ha)	Estimated income loss per household (Kina)
25	155	777	2,042
50	310	1,553	4,085
75	465	2,330	6,127

Source: Curry *et al*., 2009:14

According to Curry *et al*. (2012), such losses would have a severe impact on families, especially those with limited potential to recover such losses with other available income sources. For many farmers, reduced incomes also threatened aspects of people's lives such as social gatherings, payment of school fees and medical bills, and meeting travel, wedding and mortuary expenses. This scenario, as seen in ENBP, forced smallholders to adopt alternative strategies to generate income, usually by drawing on assets accessible to them, and within their capacities (Curry *et al*., 2007; 2011).

Responses to CPB in South East Asia and the Western Pacific Region

In South East Asia and the Western Pacific region, the intrusion of CPB saw concerted efforts from government organizations and private institutions to educate farmers on how to manage the pest. Earlier control strategies included chemical, biological and cultural methods. Specific techniques included: *rampasan,* which is the removal of all of pods more than 6-7 cm in length for six weeks to break the CPB cycle, sleeve and bagging of pods; use of pheromones for trapping moths; use of exotic and augmented parasitoids, host plant resistance, and use natural predators such as ants to feed on pupae (Lim, 1992). Each method had advantages and disadvantages. For example, painting of pods with dry engine oil was an effective way of reducing CPB on the pods, however, it was laborious and had considerable effect on the environment and human health. Cultural methods such as frequent harvesting and field sanitation worked well enabling the CPB reproductive cycle to be broken at the field

level. This is the current recommended approach (Curry *et al*., 2011; Lim, 1992; Peter *et al*., 2017; Wood *et al*., 1992).

Not all farmers initially adopted the new technologies in South East Asia and the Western Pacific. Adoption of the technologies was gradual following intense training programs centred on full farmer participation (Lim, 1992; Hafid & McKenzie, 2012). Reports from Indonesia and Malaysia indicated that farmer responses to the CPB outbreak varied. While some farmers rapidly adopted introduced technologies, other farmers struggled to cope with the high labour demands needed to control CPB (Lim, 1992; Ruf & Yoddang, 2004). Also, due to inadequate government policies and regulations, even those who adopted the technologies were often cheated by businesses selling chemicals (Neilson, 2007). Farmers who were not able to adopt the technologies, diversified agricultural production by planting fruit trees, cultivating vegetables or raising livestock to generate income to compensate for the loss of cocoa income. Ruf & Yoddang (2004) noted that some farmers in Indonesia replaced cocoa with oil palm because incentives from oil palm were better. The continuous attack by pests and diseases was another reason farmers in Indonesia have decided to replace cocoa. In Malaysia, however, severe losses were avoided by developing awareness programs, management training and the distribution of improved breeding stocks resulting in farmers having greater capacity to adapt to CPB. Malaysia eventually responded by pulling out most of their plantation cocoa and replacing it with oil palm.

Responses to CPB in PNG

The responses to the epidemic can be seen from two perspectives, the smallholder farmers and the government responses. Smallholder farmers' responses display the decisions they made during the initial stress period. This includes their decisions towards investing time and effort into cocoa production as well as their decisions to cope and adapt utilising other opportunities available to them. The government response was to maintain the industry because cocoa contributed to the national economy and the incomes of many smallholder households in PNG. Hence, it functioned through its established institutions to combat the threat to the industry.

Smallholders' Responses

According to Curry *et al*. (2011:52; see also Peter, 2021: 79-82), in ENBP the initial response by the majority of farmers was to fully or semi-abandon their cocoa blocks, and to seek

alternative livelihood options to raise their incomes. To lessen the impact of the shock, farmers reduced their household expenditures. Farmers also expanded food gardens by adopting mixed farming where food crops were integrated with livestock rearing, a practice not common prior to the CPB incursion. The produce was either sold or used to maintain household food supply. Relying on social and kinship networks also proved beneficial for people. For example, remittances increased during the disaster period. Another useful initiative by farmers was to seek access to improved planting materials and to attend training organized by PNGCCIL. Farmer groups and cooperatives were also formed to help respond to the livelihood crisis (Curry *et al*., 2011; Curry *et al*., 2009; Peter, 2021: 79-82). There were also instances of farmers earning their income by harvesting the cocoa holdings of relatives in areas free of CPB. These responses indicate that rural farmers are not passive, rather are active decision-makers, agents and actors of change, and can diversify their livelihoods out of necessity when affected by extreme external conditions (Ellis, 2000; Whitehead, 2002).

While most farmers largely abandoned their cocoa, a small proportion of farmers attempted to manage their cocoa blocks under CPB conditions by adopting the high labour input strategies required to control the pest. These include weeding, proper shade management, centralized pod breaking and burial, use of fungicides and insecticides with target spraying and block sanitation. While these methods may seem adoptable in terms of labour demands and costs, they can be overwhelming for farmers who for a long time have been accustomed to the low input 'foraging' management system of cocoa production (Curry *et al*., 2009; Curry *et al*., 2011; Daniel *et al.*, 2011b; Lim, 1992). For example, Curry *et al*. 2011 suggest that a possible explanation for farmers' low adoption rate of CPB control methods was the increased labour demands and associated costs required for high input production.

Government Responses

The PNG government responded to the epidemic through its established institutions. Soon after the outbreak in ENBP, a CPB Response Coordinating Committee (CPBRCC) was set up by the government to oversee the epidemic. The committee was made up of members from different industry stakeholders including Papua New Guinea Cocoa Coconut Institute Limited (PNGCCIL), National Agriculture Research Institute (NARI), National Agriculture Quarantine & Inspection Authority (NAQIA), Provincial Division of Agriculture & Livestock (PDAL), National Department of Agriculture & Livestock (NDAL), University of National Resources & Environment (UNRE) and the PNG Growers Association (PNGGA). The CPBRCC identified target areas which included farmers' mobilisation, training, awareness

and support; stakeholder support and partnership initiatives; and appropriate legislation. At the farmer level, the CPBRCC initiated a response plan that involved intensive block sanitation, pod disposal, spraying and harvest routines. The initial goal was to eradicate the pest completely, however, due to the rapid emergence of the pest in other provinces, eradication proved impractical and the goal shifted to the application of best management practices, improving of breeding materials and providing extension services.

Following the report from CPBRCC, a socioeconomic impact study of the epidemic was conducted in ENBP engaging various stakeholders in the industry (Curry *et al*., 2007). The study was conducted by PNGCCIL and international partners with funding from the Australian Centre for International Agricultural Research (ACIAR). The final report and recommendations were published in 2011 (Curry *et al*., 2011).

At present, the CBPNG and PNGCCIL are promoting Integrated Pest & Disease Management (IPDM) practices to minimise CPB impact on blocks. The adoption of the PSSP initiative in taking the holistic approach to cocoa farming is also a positive move by farmers in enhancing cocoa production and tackling the challenge of CPB (Peter *et al*., 2017). Farmers have been encouraged to adopt improved block management practices by maintaining high sanitation levels including weeding, pruning, shade control and pod breaking and burial. Importantly, a weekly and complete harvesting of all mature and diseased pods was highly recommended to break the CPB reproductive cycle (Curry *et al*., 2007; 2011), a practice farmers in Malaysia and Indonesia struggled with initially when the epidemic threatened their farms (Rosmana *et al*., 2010; Saxbøl, 2014). While these practices were thought to be effective, most farmers in PNG have not been able to implement them fully because of the cost of inputs and the relatively high labour demands required for field management (Curry *et al*., 2007; Curry *et al*., 2009) resulting in continued production declines (Figure 1.3) (Yen *et al*., 2010). Moreover, government training programs were very limited and did not reach the large majority of farmers.

Studies focused on smallholder growers of commodity crops and their coping and adaptation strategies to shocks and stressors have also increased over years. While coping strategies are short term measures that people utilise to reduce the impact of shocks and stress; adaptations are long-term strategies, planned and acted upon in response to varying degrees of such disturbances (Smit & Wandel, 2006). In this study I pay particular attention to smallholder cocoa growers and their responses to income stress. Several studies have been conducted on

understanding the production practices and broader livelihoods of smallholder cocoa farmers (see Curry *et al*., 2007; Fleming & Omuru, 2001; Kerua & Glyde 2016; Koczberski & Curry 2007; Lummani, 2006; Omuru & Fleming, 2001) and exploring their responses to CPB (Curry *et al*., 2015; Curry *et al*., 2012; Peter, 2021). In this thesis I will add to these studies by exploring coping and adaptive responses to CPB in different locations and under different socioeconomic, cultural and environmental attributes. In particular, I examine the impact of CPB and the responses of a group of migrant farmers farming of customary land that is not their own. These growers face several challenges maintaining their livelihoods under stressful conditions especially when farming under insecure land tenure arrangements. By building understanding of the impacts of CPB on different groups of farmers and their different responses, this research will support the development of policies and improved strategies to enhance people's livelihoods and to support their participation in the modern market economy.

Introducing the Migrant Smallholder Cocoa Growers in Dagua

The migrant smallholder cocoa growers at Dagua are from the West Yangoru area of East Sepik Province, inland of Dagua. The Sepik region was the most significant source area for internal migrants during the colonial period (Curtain, 1980). From the 1880s, internal colonial migrations occurred where men migrated to other areas in PNG to work on plantations for short-term periods (Curtain, 1980; May, 1977). After the Second World War, these migrations became much more popular, and by 1970s people were taking up long-term residences in their new locations. While some migrants worked on plantations, there were also many other movements of people in the period, within ESP to other local destinations within the province, to participate in emerging industries (Curtain, 1980). The West Yangoru people, also referred to by Margaret Mead (1938) and the local Daguans as the Mountain Arapesh people, migrated to Dagua under the leadership of the late Sir Peter Simogun to participate in the local agricultural projects that were established in Dagua. The migrants were not squatters, and so differ from settlers living in cities or town peripheries (see, for example, Jones 2012). While some West Yangoru migrants journeyed on to West New Britain Province (WNBP) to work on oil palm plantations and smallholdings, others remained in Dagua. These migrants settled in what is now called Urip village under informal agreements between Simogun and the landowners. At the time of this study, participants from the migrant group were the second, third and fourth generation of the first settlers. This study focuses on these migrants as well as their hosts – the landowners of Dagua. The two groups are described further in Chapter 4.

Structure of the thesis

In Chapter 2 and 3 I review the literature. Chapter 2 is devoted to discussing the theoretical framework, and introduces the key concepts including livelihoods, vulnerability, resilience, adaptation, and adaptive capacity. In the chapter I highlight the use of these concepts in other developing countries as well as in the context of PNG and the Pacific Island Countries (PICs). Transitions in the subsistence farming in PNG and the Pacific and describes people's coping and adaptation strategies to livelihood calamities are discussed in Chapter 3. Also in Chapter 3 I describe the vulnerability of different communities in the Pacific and PNG, and people's responses to livelihood shocks and stress making.

In Chapter 4 I describe the methodological approach employed in this study and provide an overview of the study site. I also present the philosophical assumptions and the related frameworks and concepts that contribute to constructing participants' interpretations, beliefs and attitudes in response to the CPB incursion.

The findings of the study are presented in Chapters 5 to 8. In Chapter 5 I discuss cocoa as the main income source for farmers in Dagua. I also present farmers' household demographics, cocoa block ownership and examine cocoa as the main source of livelihood. The findings on the different impact of CPB on migrants and landowner communities, comparisons with similar studies conducted among cocoa farmers in ENBP, and land-short migrant farmers in other parts of PNG are presented in Chapter 6.

In Chapter 7 I discuss the differences in the responses of migrants and landowners to CPB in terms of farm management practices and their capacity to cope with CPB at the block level. Also in the chapter, I present farmers' perspectives on the difficulties of controlling CPB. The comparisons between the livelihood coping and adaptive strategies of migrants and landowners and the discussions on the alternative income and livelihood activities that farmers have diversified into to reduce the impact of CPB on household income and wellbeing are discussed in Chapter 8.

In Chapter 9 I present the conclusions of the thesis, recommendations for future research, and suggest possible policy implications.

CHAPTER 2

THEORETICAL FRAMEWORK: LIVELIHOOD, RESILIENCE AND ADAPTIVE CAPACITY

Introduction

In this chapter, the theoretical framework for the thesis is presented. I use the Sustainable Livelihood Framework (SLF) as the broad framework to discuss people's responses to livelihood shocks and stress. Because people's responses are significantly determined by the context of their lives, the thesis incorporates the concepts of livelihoods, vulnerability, resilience, adaptive capacity and adaptation to better understand migrants' and landowners' responses to financial shock and stress experienced from the impact of the Cocoa Pod Borer (CPB) (*Conopomorpha cramerella*). An actor-oriented approach is also enlisted because migrants and landowner farmers are key decision-makers determining the course of their actions. Their socioeconomic, cultural, political, lifestyle contexts and their emotions, feelings and habits shape their decision-making. These concepts have been used widely in examining impacts of shocks and stress on natural and socioeconomic systems (e.g., Smit *et al*., 1999; Paavola, 2008).

In the chapter, I first present an overview of environmental stress and associated impacts on livelihoods. Second, I discuss the Sustainable Livelihood Framework. Third, I discuss the concepts of vulnerability, resilience, adaptive capacity, and the actor-oriented approach. The chapter aims to outline theoretical perspectives relevant to understanding migrants and landowners' responses to the impact of the financial shock caused by CPB.

Overview of environmental shocks and stress on livelihoods

Livelihood shocks and stressors impact agricultural communities worldwide. Shocks and stressors are either natural, for example climate variability, earthquakes, drought, floods, agricultural pests and diseases, poor soil fertility, and lack of access to agricultural inputs and technologies (Tanvir Rahman *et al*., 2015; Coulibaly *et al*., 2015; Baez & Santos (2008); Ashraf & Routray, 2013; Curry *et al.*, 2011; Chakraborty & Newton, 2011). These shocks and stressors often impact negatively on people's livelihoods limiting their access to resources. For example, variability in climatic attributes such as rainfall and temperature place communities dependent on short rainfall season at risk of vulnerability (Coulibaly *et al*.,

2015). These environmental disturbances present considerable challenges to rural communities in developing countries, making livelihoods difficult to sustain (Downing, 1993; Adams and Hurd, 1999; Easterling *et al.,* 2007; Kang *et al.,* 2009; IPCC, 2012; Gross 2014; Coulibaly *et al*., 2015; Korres *et al.*, 2017; Araya *et al.,* 2017).

The need to understand livelihood risks and threats became more prominent towards the end of the 20th century when the concept of 'sustainable development' became a global concern prompting research interests into livelihood issues of farming communities mostly in developing countries where infrastructure and service support are often lacking (Su *et al*., 2018). Population increase, with increasing demand for resources, means understanding people's livelihoods and livelihood decisions is necessary for the development of appropriate development policies for the rural poor (Carney *et al*., 1999; Chambers & Conway, 1992; Scoones & Wolmer, 2003; Chapagain & Raizada, 2017). To understand livelihood risks, it is necessary to understand the concept of livelihoods and how livelihoods are constructed.

Livelihoods

Livelihood describes how people organize and utilize resources they have access to, to make their living. Chambers & Conway (1992: 6) described it as:

> the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the long and short term.

The definition above implies that the livelihood system should be one that is sustainable and resilient during periods of stress and vulnerability. It should also have the adaptive capacity to provide avenues to build on opportunities that become available and usable by people. Livelihoods are conceived of as a system where means and ends are met through capabilities, equity and sustainability (Chambers & Conway, 1992).

Figure 2.1 points out active interactions between the assets, the capabilities and the outputs attained that sustain people's living. A notable feature of this system is that the assets, the livelihood capabilities, and people's living are interconnected, and that if one is acted upon, a chain-reaction occurs, and the entire system is impacted upon. And so, in livelihood studies, it

is vital to recognize the connections between parameters, and how these can be impacted upon by shocks and stress forcing people to make decisions.

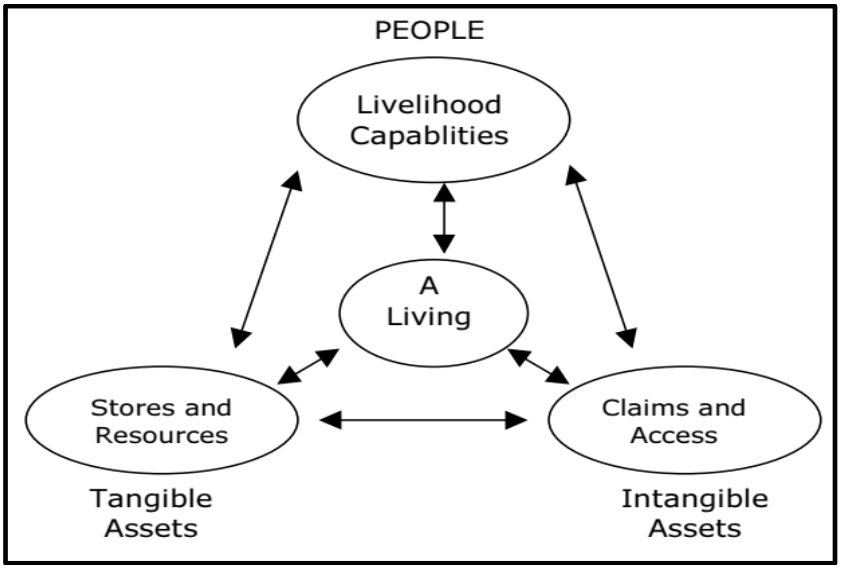

Figure 2.1: Components and flows in a livelihood.
Source: Chambers & Conway (1992, p. 7)

Determinants of livelihood

Determinants of a livelihood system provide some contexts on how people respond to shocks and stress. Chambers & Conway (1992) explained that livelihoods can be either predetermined or developed through education and migration. They describe a predetermined livelihood as when people are born into a family, class or community where roles and responsibilities are established. Education contributes to livelihoods when, for example, people receive training for a particular skill or profession. Adopting new livelihood activities in new destinations is an example of how migration contributes to people's livelihoods (see, for example, Curry & Koczberski, 1998).

In the next section, I discuss the Sustainable Livelihood Framework (SLF) as the key framework in this study (See Figure 2.2). I describe the role and the main components of the system by which the five main capitals – *human*, *physical*, *natural*, *social*, and *financial capitals* – and the policies, institutions and processes fall under. The advantage of using SLF is that it provides a holistic perspective of the entire livelihood system.

Sustainable Livelihood Framework

The Sustainable Livelihood Framework (SLF) was developed from ideas and concepts that evolved in the 1980s when the World Bank and United Nations felt the need to address

sustainable development mainly in developing countries. The impacts of rapid globalisation on the environment made it necessary for policies to be established to address development in a more sustainable manner, targeting poverty (Solesbury, 2003). A major step in this endeavour was made through the Brundtland Report published by the United Nations in 1987. The report emphasized sustainable development capturing poverty, food security issues, human development, population and environmental degradation amongst others, having developing countries as focus. Later, in 1992, Chambers and Conway through the Institute of Development Studies (IDS), published *Sustainable Rural Livelihoods* (Chambers & Conway, 1992), and by the late 1990s and early 2000s the Department for International Development (DFID) accepted and promoted the SLF (De Haan, 2012). Its acceptance in the field of development saw other organisations such as Cooperative for Assistance and Relief Everywhere (CARE), Oxford Committee for Famine Relief (Oxfam) and United Nations Development Programme (UNDP) utilizing it in their development work, adding small variations where needed (Carney *et al*., 1999). Despite its wide acceptance, the SLF has criticisms. A key point highlighted by the critiques is that human subjects or the households are important component of the livelihood and are neglected in the SLF (Petersen & Pedersen, 2010). I have, therefore, sought to include the actor-oriented approach because of the nature of the study which involves farmers as key decision-makers in the livelihood crisis.

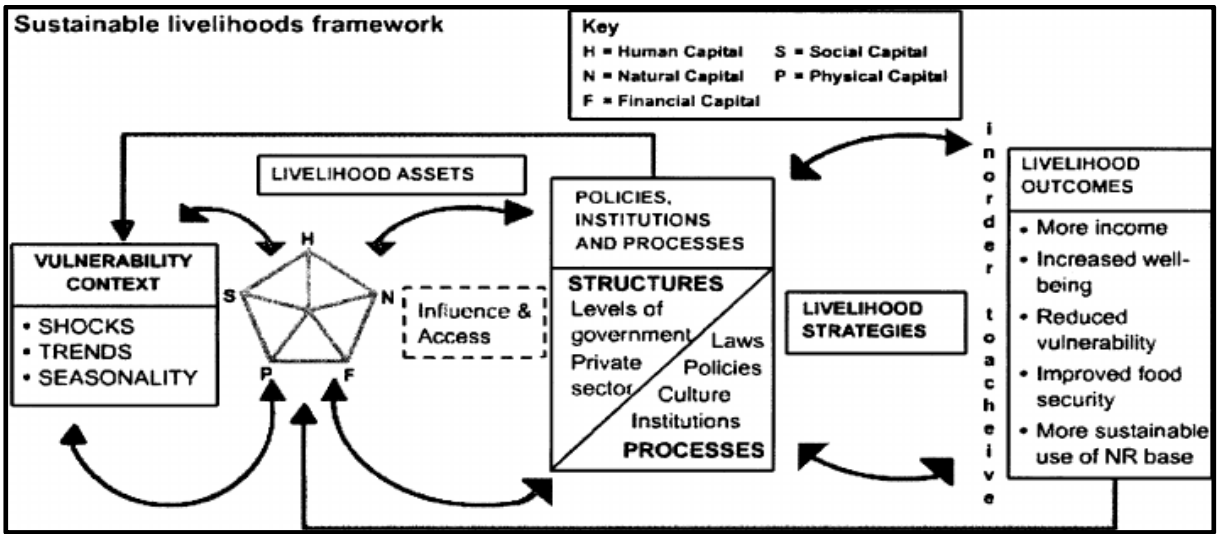

Figure 2.2: A process-oriented sustainable livelihoods approach Source: Knutsson & Ostwald, 2006.

The SLF was developed to illustrate people's access and interactions with livelihood assets (Reed *et al.*, 2013). The framework displays the vulnerability contexts, the five capitals (*human, physical, financial, natural and social*) and the institutions and processes between

them (Scoones, 1998) (see Figure 2.2). Capitals are resources that form the core of the livelihood of an individual, household, social group or community (Chambers & Conway, 1992). These are the resource stocks from which livelihood services are obtained (Kollmair & Gamper, 2002). Often the term capital is used interchangeably with assets, or as phrased by Bebbington (1999), 'capital' assets. These assets are what people have access to and can either be tangible or non-tangible. Bebbington (1999: 2022) explains that the assets are not only 'tangible' resources but 'are assets that give [people] the *capability* to be and to act'. These assets, with the processes and interactions occurring between them, contribute to how people determine their livelihoods. An overview of the capitals is described in Table 2.1.

Table 2.1: Description of livelihood capitals

Capitals/Assets	Description
Human	The human resources that are essential in sustaining livelihoods such as knowledge, skills, experience, health, nutrition, capacity to cope and adapt to situations, labour, capacity to work and so forth (Scoones, 1998; DFID, 2000).
Physical	The physical resources that people use or access such as infrastructure (buildings, roads, communication infrastructures) and production technologies and other machineries (Morse & McNamara, 2013; Liu & Liu, 2016).
Natural	The resources accessible from nature that are of benefit to livelihood sustenance. For example, land, crops, plant resources, livestock, water, rivers, beaches, trees, and forest products. Natural capital also includes environmental services such as, seasons, the hydrological cycle and natural events that support human livelihoods (Scoones, 1998; DFID, 2000).
Economic /Financial	The economic resources that people utilize to maintain their livelihoods such as available stocks (e.g., cash) or regular inflow of money (e.g., salaries) (Scoones, 1998; Kollmair & Gamper, 2002).
Social	Family, social relations, networks, groups, and associations that people draw upon or interact with to enhance their livelihoods (Scoones, 1998; DFID, 2000).

The different capitals are closely interconnected. Having access to one capital can assist people to access other types of capital. For example, financial capital can provide opportunities to access social or human capital (Wei *et al.*, 2016). Curry & Koczberski (1998) illustrated this in a case study of young migrant labourers from Wosera working in oil palm plantations in West New Britain Province. These men used cash earned to enhance connectivity with relatives back in their home villages, thus, enhancing social capital. Land,

which is a natural capital, can be used to cultivate marketable crops or rented out to access financial capital that again enhances people's ability to have access to other assets (Wei *et al*., 2016; Inu, 2015).

The SLF also highlight *policies*, *institutions,* and *processes*, which are crucial in placing people in a position where they are able to meet their livelihood goals or maintain their livelihoods in conditions of vulnerability. For example, limited access to credit from commercial banks results in many farmers not being able to expand their farm enterprises. Policies, institutions and processes, however, can be complex because determinants of livelihoods occur at different scales from the individual to global. They may also be private or public (Wilson, 2012). Furthermore, within these scales there are cross-level, cross-scale, multi-level and multi-scale interactions that shape whether or not people are able to access livelihood resources (Cash *et al*., 2006). The SLF framework allows for analysis of other streams of interest such as gender, governance or farming systems (Carney, 1998). This makes it a useful analytical tool for understanding migrants and landowners' livelihoods, because they have different resources and assets available to them.

Vulnerability

The concept of vulnerability originated from the natural and the social science fields but is now used in many other fields (Smit & Wandel, 2006). In social-ecological system, the concept is used together with interconnected concepts of adaptive capacity and resilience (Lei *et al*., 2014). Different versions of the definition of vulnerability exist in the literature (see, for example, Chambers, 1989; Adger, 2006; Füssel, 2007; Shiferaw *et al*., 2014; Singh *et al*., 2014). This study adopts the definition by S. R. Singh *et al*., (2014: 71), which describes vulnerability as *"an internal risk factor of the subject or system that is exposed to a hazard and corresponds to its intrinsic predisposition to be affected or to be susceptible to damage"*. This description best suits this study because it focuses on a system's internal capabilities and how each of these internal structures would react to shocks and stress.

People's vulnerabilities can be classified in a similar way to the five livelihood capitals. The common ones are physical, economic, social, environmental, or attitudinal. Vulnerability can also occur at different scales.

Table 2.2: Types of vulnerabilities

Vulnerability Type	Description
Physical	The state of physical assets that people have access to. This may include buildings, infrastructure and agriculture, which form the basis of livelihood.
Economic	The nature of the economic assets and the economic systems. Examples of these would include production factors in agriculture (land, labour and capital), income sources, costs and inputs, economic potentials and use of natural resources.
Social	Weak family structures, lack of leadership, unequal participation, weak community organization, discrimination (racial, ethnic, linguistic, religious). Culture, tradition, religion, local norms and values, economic standard and political accountability.
Environmental	Unwise use of natural resources, land degradation, pollution of air and water. This can push the environment into a vulnerable position prone to disasters and stress.
Attitudinal/motivational	Determined by personal or group beliefs and values systems. Negative attitude towards change, lack initiative, dependent on external support, lack of variety in livelihood sources, lack of entrepreneurship, disunity, victims of conflicts, hopelessness, obvious pessimism.

Sources: Adger (1998), Twigg (2001) and Füssel (2007).

Vulnerability can be discussed taking into consideration two parameters – exposure, and sensitivity. Exposure is the extent or the degree by which a system experiences stress from one or more external factors such as from environmental, economic or political factors. This is where an interaction is observed between the stimulus and a component of the whole system. The sensitivity of the component affected is displayed depending on the exposure and how much the system can cope. Sensitivity is the degree by which the system is affected as in what is affected, how much is being affected, where the impact is, whether the systems is being affected partially, wholly or transformed (Smit & Wandel, 2006; Gallopin, 2006; Adger 2006). A case study of people living at the Mekong River illustrates this. According to Nguyen & James (2013), although wealthy and poor people lived at the delta and were exposed to food incidences, it was the poor that were more vulnerable than the rich. This highlights the fact that people can have a similar exposure experience, however, those most vulnerable are more sensitively exposed to the disaster.

Vulnerability can be multidimensional, dynamic, scale-dependent, site specific, and situation specific (Cardona *et al*., 2006; Adger, 1998). From a multidimensional perspective, vulnerability involves an internal complexity of systems that cannot be easily measured. It includes the interplay between several factors such as demographics (e.g., ethnicity, education, social differentiation, and population factors), technology (e.g., information,

machinery, devices), the status of the local and national economy (e.g., poverty), environmental changes (e.g., use of natural resources, land degradation, impact of climatic attributes), and political factors (e.g., planning, policy changes, political stability) (Cardona *et al*., 2006). Addressing of one factor of vulnerability is frequently challenging given the interplay between different factors. Hence, the multidimensional aspect of people's vulnerability influences the way livelihood assets are used or become available to people (Füssel 2007; Proag, 2014).

Vulnerability can also be viewed as a dynamic process. The exposure, sensitivity and adaptive capacity of a system, in response to a stimulus may not be the same every time, at every place, for all communities, or in relation to different forms of disturbance (Smit & Wandel, 2006). The parameters of vulnerability, such as exposure, sensitivity and adaptive capacity vary over time, from place to place and people to people, and so, very dynamic (Smit & Wandel, 2006). Moreover, multiple disasters or calamities may act on people at one time. These make people double exposed and place risk on their adaptive capacities at risk (Belliveau *et al*., 2006). Because of these dynamics, assessing of vulnerability may be challenging if other factors are not considered.

Also, vulnerability is scale-dependent. It can occur at individual, household, community, and region or system levels. The vulnerability of individuals can be different to the vulnerability of their community. Moreover, the use of assets to reduce vulnerability at each of these scales differs (Cardona *et al*., 2006; Cutter *et al*., 2008; Murphy *et al*., 2015). Vulnerability is also site-specific. Variations between locations occur depending on environmental factors, social factors, economic factors and political factors. Differences occur between systems depending on exposure, the intensity of impact and how the affected system absorbs and recuperates from the adversity (Cardona *et al*., 2006).

Finally, people or a system is vulnerable when it is devoid of resilience and adaptive capacities (Folke, 2006). Individuals or households that lack adaptive capacities would poorly adapt to secure their livelihoods during shocks and stress.

Resilience

The term resilience was derived from Latin verbs *resilio* and *resilire* which mean to rebound or spring back (McAslan, 2010). The concept of resilience was introduced into the analysis of social-ecological systems by Holling, to help explain how individuals, households and communities respond to threats to their livelihoods (Adger, 2000; Mitchell & Harris, 2012;

Carpenter *et al*., 2001). In this research, I adopt the definition by Walker *et al*. (2004: 1) who defined resilience as 'the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks …'.

Walker *et al*. (2004) described ecosystem resilience as having three components: general resilience, specified resilience and transformability. These components are also useful in describing resilience in social systems. Folke *et al*. (2010) defined general resilience as the resilience that occurs in the system as a whole as a result of any disturbances that the system is exposed to. This type of resilience is not specific to a particular component of the system rather it impacts on the entire system and all parts of the system responds to it. Walker *et al*. (2004) elaborates further stating a holistic response from the system is displayed to buffer the impact of the calamity.

The concept of specified resilience is best described by Carpenter *et al*. (2001: 765-781) as a shift 'of what, to what?' In this case the adaptive capacity is focussed on one particular aspect of the system and not the whole. Addressing specific resilience, however, may not be easy. Cifdaloz *et al*. (2010) argue that while specified resilience addresses specific system components and perturbations within a system, other impediments could inhibit possible adaptations: for example, presence of multiple stressors, which may be challenging to address or responses to one particular part of the system could concurrently affect other parts of the system causing further stress within the system (Folke *et al*., 2010; Kais & Islam, 2016).

Transformability is the ability to reorganize into a different system when the former system is unable to produce outcomes as desired (Folke *et al*., 2010). In discussing human perspectives in relation to transformability, Walker *et al*. (2004) point out three determinants: (1) willingness to change, (2) options available for change and, (3) whether there exists the capacity to shift to a new system. Transformability happens when the elements in the existing system are unable to sustain the system in conditions of stress or perturbations; as such, a shift to a new system emerges. Sometimes transforming into a new system is deliberate where the actors choose what to do, other times it is forced upon the actors. Folke *et al*. (2010) added that transformations also include a shift in how the social dimensions work. For example, people observe changes differently. This affects how they relate to it, how they relate to others and how they reorganize themselves and their assets to adjust to the changes. As highlighted by Walker *et al*. (2004), a key initial step in transformability in social dimensions is the ability

for the human participants to realize the conditions they are in and to decide whether or not an alternative way of living is worth pursuing.

A significant aspect of resilience is social resilience. Social resilience is the ability of all social institutions to respond to disturbances resulting from natural or human-made phenomena. Social institutions include individuals, families, communities, organizations and other formal and informal entities that are embedded and function in societies. Social resilience involves social capitals and seeks to understand the dynamics of resilience within that sphere (Keck & Sakdapolrak, 2013; Kais & Islam, 2016).

Different versions of the concept have been given by various scholars and groups (e.g., Adger, 2000; Obrist *et al*., 2010; Kais & Islam, 2016). This study utilizes the definition provided by Keck & Sakdapolrak (2013: 5), who argue that social resilience be seen as comprised of three dimensions:

> 1. *Coping capacities* – the ability of social actors to cope with and overcome all kinds of adversities; 2. *Adaptive capacities* – their ability to learn from past experiences and adjust themselves to future challenges in their everyday lives; 3. – *Transformative capacities* their ability to craft sets of institutions that foster individual welfare and sustainable societal robustness towards future crises.

The above definition describes the ability and capacities of human groups and communities (Adger, 2000; Kais & Islam, 2016) to respond to stress (Obrist *et al*., 2010). Or it can refer to human systems' capacity to react in stressful conditions (United Nations International Strategy for Disaster Reduction [UNISDR], 2018). Understanding social resilience can be complex because resilience itself is dynamic and requires an interdisciplinary approach to examine. Factors such as ecology, economics, politics and other social dimensions are crucial in understanding how individuals or community resilience work (Adger, 2010). Below I describe important components of social resilience at three levels – community, household and individual.

Community resilience is the ability of communities to manage, recuperate or adjust to social or environmental stress and perturbations (Kelly *et al*., 2015). Communities can have diverse characteristics based on attributes such as wealth, social status or labour activities. Moreover, individuals in the communities may be members of many other interest groups such as economic status, gender, religion and recreation, thus, making communities very dynamic (Twigg, 2009). In social resilience, social capital or assets are crucial because these are where

interactions, collective actions, relationships, values, reciprocity, trust, and social norms are embedded (McAslan, 2010). These are important attributes that shape people's response to shocks or stressful events (Twigg, 2001). However, interactions between these elements make resilience at the community level potentially complex because of different outcomes that may occur concurrently (Cutter *et al*., 2008).

According to Patel and colleagues, there are at least nine common fundamental elements that set the foundation of a resilient community (Patel *et al*., 2017) (Figure 2.3). However, Wilson (2012) points out that resilience at the community level can be challenging because communities are made up of individuals, households or groups of people with their connections within and outside of the community. With these connections their resilience may differ and difficult to assess. This brings about resilience based on scales. Scale interactions may affect the ability of communities to recover from stressors and shocks. Wilson (2012) illustrates this multi-scaler dimension of resilience (Figure 2.4).

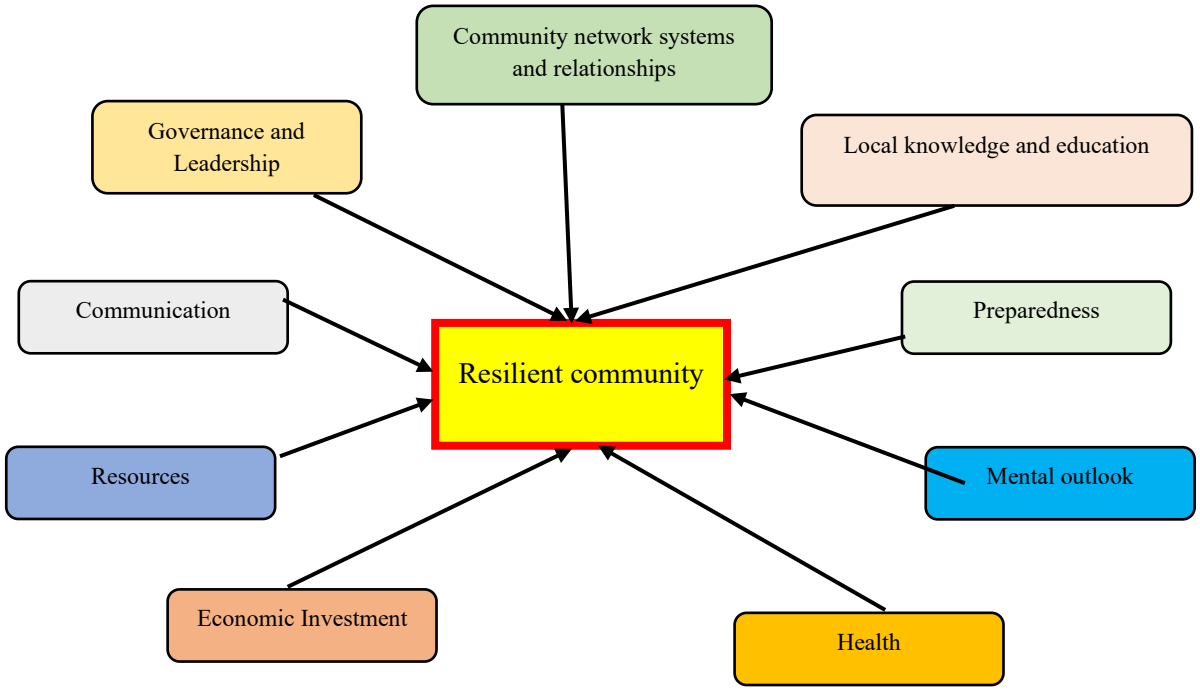

Figure 2.3: Elements of a resilient community.
Source: Patel *et al*. (2017)

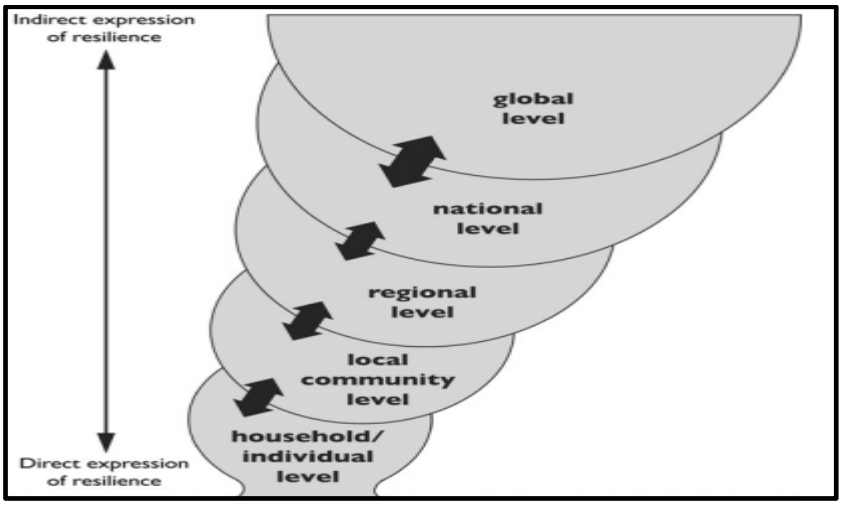

Figure 2.4: The spatial scales of resilience.
Source: Wilson, (2012, p. 1219).

Wilson (2012) points out that a community can be studied taking the downscale or upscale direction. According to Wilson, downscaling refers to the heterogeneous nature of communities were individuals, households, structures and institutions have their own resilience pathways. Upscaling on their other hand refers to hierarchical systems and structures that impact on decisions made at individual or household levels. These higher levels have greater influence on how communities and individuals live (Wilson, 2012). For example, interacting with governance issues, policies, laws and essential services form some interfaces individuals and communities engaged with taking the upscaling approach (Wilson, 2012). Assessing resilience in these scales can be challenging. It is a massive task considering that communities are vibrant dynamic systems (McManus *et al*., 2012).

Below the community level are the households, families and individuals, who interact in ways that are often difficult to measure (Wilson, 2012). Interactions between individuals, groups, families, households, and with the environment are complex (Jones *et al*., 2011). This has implications on the state of adaptive capacities and the kind of responses to shocks and stress faced. However, most studies conducted on resilience and adaptations in social-ecological systems research have taken households as the unit of analysis (Ellis, 1998; Krantz, 2001; Alinovi *et al*., 2010; Jones *et al*., 2011).

In developing countries, responses to calamities are best assessed at the household level because most strategies are implemented at this level (Alinovi *et al*., 2010). According to Alinovi *et al*. (2010:345) 'Households are components of food systems and can themselves be conceived as (sub) systems'. This definition, they note, 'is consistent with Spedding (1988)'s definition of a system as "a group of interacting components, operating together for a

common purpose, capable of reacting as a whole to external stimuli: it is affected directly by its own outputs and has a specified boundary based on the inclusion of all significant feedback" (Alinovi *et al*., 2010: 345). Hence, households can have one or more related or unrelated people living together. Furthermore, households can be made up of one person or more than one person living in the same dwelling and are able to meet their daily needs. A household's resilience to calamities is shaped by factors including household size, age, gender, incomes, access to food, social safety nets, social security, access to government services and other physical, human and social adaptive capacities (Jones *et al*., 2018).

Understanding of individual resilience is thought to have begun in the field of psychiatry in the attempt to study how children coped with stress (McAslan, 2010:13). Since then, the study of individual resilience progressed and became popular in the social sciences to understand how individuals responded to manmade and natural disasters. Individual resilience is being defined similarly as the concept of social resilience but is based on individuals rather than groups at multiple scales. It is therefore defined as the ability of an individual to bounce back when undergoing shocks and stressors. Jones & Tanner (2015) point out that most of the literature discusses the concept of resilience from an objective, 'top down' approach and have not adequately addressed subjective experiences of people and how they make decisions that affect their own lives. Rose (2007) agrees that individuals do possess the ability to bounce back from stress and shocks that they are faced with. Experiences from individuals therefore would be useful in attempting to understand resilience from a 'subjective' perspective. This emphasizes the point on being focused on specific parameters when discussing resilience at different levels within a society. Individual resilience therefore becomes an important consideration when we discuss resilience in its multi-scalar dimension (Jones & Tanner, 2015). Individual resilience is also strengthened through social networks. In the context of Melanesian countries such as Papua New Guinea, relational or communal connections are important in resilience to shocks and stress. People seek assistance from relatives, friends, neighbours, religious groups or those from the same tribal background (Koczberski *et al.,* 2018). This is largely different to Western communities where individual resilience is more significant.

Adaptation

There are various definitions of the adaptation, (for example, from IPCC, United Nations Framework Convention on Climate Change [UNFCCC], United Nations Development Program [UNDP] or the Australian Government's Department of the Environment and Energy), this study uses the definition from Smit & Wandel (2006: 282) who state that adaptation is:

> *... a process, action or outcome in a system (household, community, group, sector, region, country) in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity*.

In agriculture-based livelihoods, adaptation is important because interactions with external stimuli often impact farm outputs (Smit & Skinner, 2002). Environment or social catastrophes pose threats to farmers' livelihoods, and farmers therefore have to devise strategies to adapt (Paavola, 2008).

Identifying the type of adaptation practices pursued by people is important. Due to the complexity in examining adaptation, several studies have suggested parameters that can be used when thinking about adaptation (Table. 2.3). These attributes demonstrate people's actions according to the contexts of the disasters.

Table 2.3: Some differentiating attributes of adaptation

Attributes of adaptation	**Description**
Timing relative to stimulus	*Anticipatory, concurrent, reactive*
Intent	*Autonomous or spontaneous, planned*
Spatial/Institutional Scope	*Local, regional, national or (local and widespread)*
Temporal Scope	*Short term, long term*
Form	*Technological, behavioural, financial, institutional, informational*
Degree of necessary change	*Incremental, transformational*
Function/effects	*Retreat, accommodate, protect, prevent, tolerate, spread, change, restore*

Sources: Smit *et al*. (1999), Smit & Skinner (2002), Huq *et al*. (2004), Smit and Wandel (2006), Kates *et al*. (2012) and Biagini *et al*. (2014).

Adaptation as a process involves people making adjustments over time in response to disturbances (Smit *et al*., 1999). Examining adaptations in different contexts can be difficult. However, Smit *et al*. (1999) present four questions that provide a framework for how

adaptations can be investigated. The questions are 'adaptation to what? Who or what adapts? How does adaptation occur?' and 'How good is the adaptation?' (See Figure 2.5).

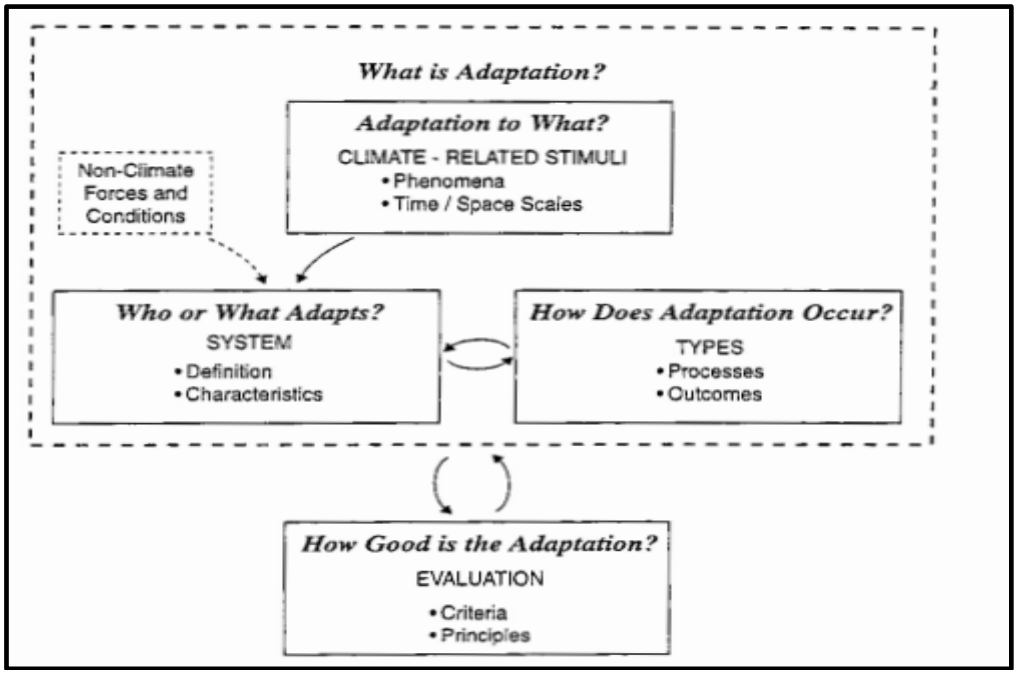

Figure 2.5: An adaptation framework. Source: Smit *et al*. (1999: 204)

According to Smit *et al*. (1999) it is important to identify what is causing the adaptation response, that is 'adaptation to what?' While Smit *et al*. (1999.) emphasise broader adaptations to climate change they also point out the need to identify specific shocks or stressors that occur as a result of variations in climatic attributes. As Coulibaly *et al*. (2015) pointed out; stress induced by one stressor often triggers another and leaves societies in a continuous state of vulnerability and poverty. Coulibaly *et al*. (2015) pointed out numerous stressors affecting Malawi farmers such as land degradation, drought, poor market facilities and the chronic level of poverty. These impacted on adaptation practices at different scales. Identifying specific stressors therefore requires careful assessments because often multiple stressors or disturbances occur concurrently (Quinn *et al*., 2011). According to Quinn *et al*. (2011), adaptation responses to crises must consider all dimensions: the social, economic and political contexts that societies are in to better understand why people adapt the way they do.

The second question is 'who or what adapts?' This is the unit or system exposed to a stress or shocks which exhibits adaptation to the disturbance. These exposed units could be people at various scales from the individual to a larger scale, or natural and man-made systems and structures (Smit *et al*., 1999). For example, in Vietnam, Phuong *et al*. (2017) pointed out that it was the farmers 'who' were responsible for making decisions on adopting improved crop

varieties, altering season calendars and venturing into alternative livelihoods (what). It is therefore important to identify who or what these participants are when investigating adaptation practices.

Third, 'how does adaptation occur?' Adaptation can be a complex process because many actors may be involved. It is, however, useful to think of adaptation in terms of its form and process (Smit *et al*., 2000). Several scholars attempted to establish the parameters to describe how adaptation occurs. In doing so, typologies of adaptations have been suggested by several authors, which includes parameters such as timing relative to stimulus, intent, temporal scope, form, degree of necessary change, function or effects and spatial or institutional scope Carter *et al*. (1994), Wilbanks & Kates (1999), Smit *et al*. (2000), Smit & Skinner (2002), Huq *et al*. (2004), Smit & Wandel (2006) and Biagini *et al*. (2014).

The final question is 'how good is the adaptation?' An adaptation exercise is considered appropriate if the costs are affordable, it shows equity, is sustainable and able to be implemented within the capacity of the people (Smit & Pilifosova, 2003). However, it is also noted that certain adaptation practices may be relevant for only a certain period of time and may change many years down the line. This would call for further strategies to adapt. As Smit & Pilifosova (2003) highlighted, changing demographics or serious climate-induced phenomenon may lead to shifts in previous adaptation practices. Pritchard & Thielemans (2014) also gave examples of adaptations that seemed good at the beginning but eventually placed people in very vulnerable situations. In their example, the Bihar community in India built embankments to control river flow during floods. However, this eventually marginalised members of the community, particularly women, who were not able to access other resources such as roads or dry firewood for cooking (Pritchard & Thielemans, 2014:332). Pritchard & Thielemans referred to this as maladaptation practices. Smit & Pilifosova (2003) emphasized that it was important that adaptations be planned out carefully considering all necessary details to avoid succumbing to further risks and uncertainty. Furthermore, adaptation strategies implemented by the people are often within the limits of how much stress they could cope with. People would always prefer adaptations strategies that would equate to or better the loss incurred from former stress (Smit & Pilifosova, 2003).

Coping versus adaptation strategies

Coping and adaptation strategies are similar concepts used in examining people's responses to shocks and stress (Smit & Wandel, 2006; Kihila, 2018). Though these concepts are often used

interchangeably (e.g., Ding *et al*., 2008; Ashraf & Routray, 2013), differentiating between them helps in understanding the rationale for people responding in certain ways. Coping strategies are referred to as the short-term measures people employ to "just survive" stress (for example, selling-off a household item to meet the financial need at that time). In Table 2.4, coping strategies are more reactive responses to perturbations and often do not last. The primary goal of coping is to ensure the system continues functioning to a certain extent to lessen the impact of the shocks or stressors. These strategies are often short-term and immediate, where people resort to readily available resources to meet their needs.

Adaptation strategies are continuous, long-term, planned and sustainable initiatives that people embark on in response to stress (Smit & Wandel, 2006; Murphy *et al*., 2015). For example, diversification of livelihood activities is a longer-term strategy as is expanding to non-farm activities (Opiyo *et al*., 2015). Murphy *et al*. (2015) further elaborated that adaptation strategies seek to carefully reorganise the system's status quo so as to reap long term benefits in a sustainable manner. To explain the differences between coping and adaptation strategies, CARE International clarify further some differences in the attributes of coping and adaptation strategies (Table. 2.4).

Table 2.4: Differences between coping and adaptation strategies

Coping	*Adaptation*
-Short term and immediate	-Practices and results are sustained
-Oriented towards survival	-Oriented towards longer-term livelihood security
-Not continuous	-A continuous process
-Motivated by crisis; reactive	-Involves planning
-Often degrades the resource base	-Uses resources efficiently and sustainably
-Prompted by a lack of alternatives	-Focused on finding alternatives
	-Combines old and new strategies and knowledge
	-Focused on finding alternatives

Source: CARE (2009: 7)

Adaptive Capacity

Before discussing adaptation, it is fitting that adaptive capacity is understood. This is because adaptive capacities of people are displayed through their adaptation practices (Smit & Wandel, 2006). The Intergovernmental Panel on Climate Change (IPCC) (2001: 6), in relation to climate change, defined adaptive capacity as

> *the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.*

There are several other related concepts: “adaptability, coping ability, management capacity, stability, robustness, flexibility and resilience” (Smit & Wandel, 2006: 286-287). A description that suits this study is given by Jakku & Lynam (2010: 3) who argue that “Adaptive capacity comprises the *properties* of a system that enable it to *modify itself* in order to *maintain* or *achieve a desired state* in the face of perceived or actual stress”. These include knowledge, resources, technology, regulations, policies, management, and technology. Adaptive capacities can be planned and organized to equip individuals, social groups or communities to respond positively to shocks or stress they are encountered with.

Determinants of farmers’ adaptive capacities

People’s ability to adapt to situations depends on their adaptive capacities, and these adaptive capacities are influenced by a range of determinants. An important determinant of adaptive capacity is access to resources. Limited access to resources such as access to land, government services, market stores, road networks, communication and technological inputs can affect farmers’ adaptive capacities and types of inventions, (Belliveau *et al*., 2006; Egyir *et al*., 2015).

Social relations, family, networks and politics are important social determinants that enhance adaptive capacity (Smit & Wandel, 2006). For example, Koczberski *et al*. (2009) describe the struggles of migrants in the West New Britain Province of Papua New Guinea, pointing out that prevailing social connection between settlers and landowners, helped settlers secure additional land for cash cropping.

Financial resources such as savings, availability and access to credit schemes, market prices, government trade policies and costs of goods and services also affect farmers’ ability to adapt to stress (Smit & Wandel, 2006; Belliveau *et al*., 2006). Farmers who have access to financial resources are better positioned to adapt to shocks and stress than subsistence farmers who rely mostly on natural resources for living (Coulibaly *et al*., 2015; Shirima *et al*., 2016). For example, according to Asfaw *et al*. (2016), wealthier households in Malawi were better able to purchase modern technologies to sustain their farms than less wealthy households. These farmers also have more secure land tenure.

Human factors also affect the capacity to adapt (Smit & Wandel, 2006). General determinants include age, gender, class, educational status, household size, land ownership, farming experience and knowledge (Aneani *et al*., 2012; Kasirye, 2013; Nielsen & Reenberg, 2010; Shirima *et al*., 2016), access to technical training, personal income and personal health (Jones

et al., 2010). The later section of this chapter discusses people as active participants in making decisions on how to respond to events that affect them. Factors stated above play crucial role in shaping their responses.

In sum, adaptive capacities are contextualized depending on various factors discussed above. Access to natural and economic resources, awareness and training, technological capacities, infrastructure, social capital and institutions are crucial in enhancing people's adaptive capacities. Adaptive capacities can also vary for different demographics within a population; for example, wealthy farmers may have access to financial resources to mitigate the impact of economic shocks than their poor counterparts.

Actor- Oriented Approach

The actor-oriented approach best suits livelihood studies because it engages people as the core actors in livelihood decision-making (Sakdapolrak, 2014). Its use in this thesis serves two purposes. First, it addresses concerns raised by critics of SLF who believe individuals and households should be given more agency when considering livelihoods (Petersen & Pedersen, 2010; Morse & McNamara, 2013). It does this by placing emphasis on capturing first-hand information from farmers who were affected by the pest attack on their livelihood crop.

Second, to understand the factors that determined people's decision-making. The actor-oriented approach focuses on the human actor as possessing agency and responsible for their courses of action (Long, 2015; Murphy *et al*., 2015). Long (1990) argues that it is useful to consider the human actor in the whole process of adapting to calamities as external events do impact on individuals, households, social relations and organisations, subsequently causing people to respond in certain ways. Numerous studies have been conducted using the concepts from the actor-oriented approach to understand people decision-making process (see for example, how livelihoods were maintained throughout the political upheavals in upland Vietnam, livelihood research and development tools, understanding of livelihoods in Bolivia, corruption and livelihoods in Senegal, and livelihood transformations in Peru (Turner, 2012; Bury, 2008; Biggs & Matsaert, 1999; Schaer *et al*., 2018). The actor-oriented approach therefore points out that individuals are socially active participants and react to natural or social events through thought processing and strategic decision-making (Long, 2015).

There are several advantages of this approach for use in livelihood studies, and especially in connection with the Sustainable Livelihood Framework (SLF). First, the approach focuses on the unit exposed to external events, a factor that is not clear in the SLF (Morse & McNamara,

2013). In this way the unit of analysis can be examined from within and how it responds to external stimuli. Second, it can be used with another approach, the *context-oriented approaches* to help explain how people relate to external events and how they devise response strategies under such situations within their contexts which then fits with the broader SLF components (Murphy *et al*., 2015). In this way the exposed subjects are examined in their own specific human, physical, natural, financial and social contexts. Moreover, the actor-oriented approaches also provide a platform to examine socially embedded factors and connections important in people's decision- making (Turner, 2012).

Third, the actor-oriented approach is useful because it specifies challenges faced by people which then can be examined in detail. For example, in understanding present vulnerability, people's coping and adaptation strategies should be considered in relation to their historical contexts. This gives a clear understanding of what capacities people possess (Cardona *et al*., 2006). Furthermore, it points to opportunities that are within the capacity of the actors to act upon. A common critique of the actor-orientated approaches has been that it is too narrow and does not capture the broader issues (Murphy *et al*., 2015). However, shocks and stressors impact on individuals, households, social groups or communities differently, and as such, examining specific units of analysis is vital to understanding responses to disasters.

Two dimensions in the actor-oriented approaches are the *rational approaches*, and the *relational approaches*. The rational approach focuses on how people make choices based on the challenges and opportunities present. This approach has been argued to be more rigid towards economic choices and too restrictive, thus neglecting other factors that affect people's choices such as the emotional state of decision-makers, beliefs, values, identity and other sociocultural factors (Levin & Migrom, 2014). According to Pelling (2010), people's personal, sociocultural and environmental context play important roles in the decisions they make. This brings up the next approach still within the actor-oriented approaches – the relational approaches. Relational-oriented approaches refer to actors' vulnerabilities based on relationships and interactions between different actors and units (Murphy *et al*., 2015). McLaughlin (2011) argues the lack of adaptive capacities within the social sphere is one key issue that puts people in vulnerable situations. Taking a more accommodating approach to the rational approaches discussed above, the relational approach takes on a more constructivist or subjective form where people's responses to an epidemic can be examined taking into account their socio-cultural contexts. This approach is useful in this thesis because, as Curry (1999)

demonstrated, social embeddedness in rural PNG communities has profound influence on people's economic and livelihood activities.

Conclusion

The study of livelihood shocks and stressors affecting livelihoods has become increasingly important since the later part of the 20th century. This has prompted discussion on how best to understand people's vulnerabilities and responses to such events. Because livelihood dimensions can be complex - involving interplay between several actors and processes, a framework of concepts and theories are essential in describing people's experiences.

The literature supports the use of Sustainable Livelihoods Framework and the interrelated concepts of vulnerability, resilience, adaptive capacity, and adaptation to understanding impacts of shocks and stress on rural poor. The value of adopting an actor-oriented approach is also emphasised in the literature. This chapter has provided an overview of these concepts. In the chapter I argue that the concepts provide and appropriate framework for the discussion of migrants and landowners' responses to the financial shock caused by the agricultural pest, Cocoa Pod Borer (CPB). The next chapter explores adaptation and resilience of agricultural systems in PNG and the broader Pacific region.

CHAPTER 3

RESILIENCE AND ADAPTATION IN PNG AND THE PACIFIC

Introduction

In this chapter I discuss resilience and adaptation in the Pacific and Papua New Guinea (PNG). This provides context to people's responses discussed in the subsequent chapters. In this chapter I argue that people are resilient, proactive, and able to devise coping and adaptation strategies to reduce the impact of livelihood shocks and stress. In the previous chapter we have seen that people's responses to livelihood disturbances depend on their adaptive capacities which are dynamic and contextualized. I argue that people draw from a mix of assets available to them at a particular time to reduce the impact of livelihood shocks and stress they experience. In the PNG and Pacific, land and socio-cultural factors play significant roles in people's resilience and adaptations. The chapter first discusses general livelihoods transitions in subsistence farming systems in PNG and the Pacific, second it discusses farmers' coping and adaptation strategies to livelihood shocks and stress, third, it discusses livelihood vulnerability of migrants in the Pacific, and finally gendered dimensions of livelihood adaptation strategies. This chapter discusses how they respond to shocks and stress affecting their livelihood in the communities they now settle.

Livelihoods Transitions in subsistence farming systems in PNG and the Pacific

Most communities in the Pacific are rural, with people developing their livelihood activities on what the natural environment can provide. Agriculture and fishing continue to be the main livelihood activity for Pacific Islanders (Rosegrant *et al*., 2015; Georgeou *et al.*, 2022). For thousands of years people have depended on land-based resources for food crop gardening, raising livestock and building homes. Together with this, social cohesion and interactions between people and communities ensure values, norms and beliefs are sustained through generations. These form the fabric of people's daily lives.

Subsistence agriculture is the main livelihood activity in Pacific Island countries, supporting lives of more than 80% of the Pacific population (Georgeou *et al*., 2022). It is a way of life that is embedded within the social, economic and environmental space of the people. It does not only entail the farming routines, rather, it is the lived experience of the people that shape their daily interactions (Hau'ofa, 2017; McGregor *et al*., 2009). Even though countries like Fiji have more semi-commercialized farming systems, other Melanesian neighbours still have

a large portion of their population relying on subsistence farming for daily sustenance and income generation. Vanuatu, for example, has over 80 percent of its population engaged in subsistence farming. Likewise, PNG with 83% (Bourke & Harwood, 2009) and Solomon Islands 80% (Georgeou *et al*., 2022), while in Fiji 36% still rely on subsistence farming (Singh-Peterson & Iranacolaivalu, 2018).

Subsistence farming is often seen as being characteristic of being poor, vulnerable, food-insecure, primitive, traditional, financially insecure, small-scale or remote (Bourke & Allen, 2009a: 7; Singh-Petersen & Iranacolaivalu, 2018). While this may be true, as described in limitations in dietary needs in Solomon Islands (Andersen *et al*., 2013), a counter argument can be seen in Thompson (1986:235) who argues that it is the outcome from the system that matters the most, and that capitalist perspectives should not cloud the way subsistence farming is seen.

In the Pacific communities, subsistence farming in rural communities is flexible and a wide range of crops and animals are raised. This characteristic of subsistence farming makes it possible for communities to continue to supply food during periods of shocks and stress. Understanding the characteristics of subsistence farming helps in clarifying the strengths of this system in adaptation. It also points out certain disadvantages within this system of farming that could be exposed to shocks and stress. Table 3.1 summarised the strengths and weaknesses associated with subsistence farming.

Mixed cropping practices in subsistence farming helps build resilience towards specific shocks and stress. For example, in West New Britain Province, settlers cultivate a wide range of crops on their farm to raise additional cash to supplement earnings from Oil Palm. Sweet potato, corn, bean, Chinese taro, banana, tobacco and yam are some crops often planted together (Bue, 2013:116). This practice helps sustain household food supply and generate cash. Cultivating peanut and corn is also a regular practice and has been useful in maintaining soil fertility. In other Pacific Island countries, such as Vanuatu, Fiji, Solomon Islands, Tonga and Samoa, mix farming is particularly significant in maintaining food and income supply for rural communities during periods of stress (Georgeou *et al*., 2022; Lebot & Siméoni, 2015).

Since the development of agriculture in PNG, a range of economic, social and environmental effects has led to significant changes in subsistence farming. In PNG, changes in the subsistence farming system occurred well before western influence (Bourke, 2001). For example, use of island beds to cultivate crops according to water requirements evolved more

than 7000 years ago, and the construction of drains in swamp gardens occurred 4500 to 5000 years ago (Bourke, 2009:14).

Table 3.1: The strengths and weaknesses of subsistence farming and their influence on livelihood sustainability.

Advantages	Disadvantages
Does not require inputs such as start-up capital or titles (McGregor *et al*., 2009). Maintains livelihoods during periods of shocks and stress (McGregor *et al.*, 2009; Lebot, & Siméoni, 2015). Can sustain populations in weak economies (McGregor *et al*., 2009). Maintains agro-biodiversity of crops (McGregor *et al*., 2009). High crop diversity means that disease outbreaks affecting a particular crop generally do not undermine food availability (McGregor *et al*., 2009). Allows for agroforestry practices which in turn help buffer impacts of environmental stress (Bourke, 1997; McGregor *et al*., 2009). Variety of crops with different botanical features may help maintain soil fertility (Bourke, 1997).	Yield is often small, and so may be vulnerable to increasing population pressure (Reddy, 2007). Households who own poor soils would experience poor harvests resulting in food and income insecurity issues (Lebot, & Siméoni, 2015) Households owning small portions of land can be marginalized in terms of food and income when production is affected (Lebot, & Siméoni, 2015) Continuous farming to meet household needs results in reduced fallow periods thus reducing soil nutrient availability (Lebot & Siméoni, 2015). Crops may not withstand extreme weather conditions (Jansen *et al.*, 2006). External disturbances interrupting planting cycles can reduce food and income security for farmers (Jansen *et al*., 2006). For settlers or migrant farmers who lack land access, the pressure to expand farming to meet household needs can be a persistent stress (Koczberski *et al*., 2018).

A major wave of agricultural change occurred when the Austronesians moved into the Pacific more than 3500 years ago, bringing with them new crops and animals (Bourke, 2009:14). The movement of European explorers, colonists, missionaries and traders across continents contributed immensely to the distribution of crops and animals around the world. Plants introduced included cash crops, fodder plants, shade crops, decorative plants and weeds (Bourke, 2009: 18-19). In PNG, European influence emerged from 1400s to the late 1800s. While they brought with them plants and animals, more than 170 crops were already used for food prior to that time (Bourke, 2009:15). In the Pacific, a major transformation in farming

practices occurred after World War II when new crops became popular and new ways of farming were introduced into communities. The influence of the cash economy encouraged many into trying out new farming ideas (Hau'ofa, 2017; Bourke & Harwood, 2009). In support, Allen (1985) also argues that traditional shifting cultivators possess a wealth of knowledge and experience in cultivation practices which allow people to adapt to change and have equipped people with the capacity to reorganize themselves during periods of stress.

Since the early colonial period, communities in the Pacific have readily engaged with the modern market economy. Cocoa, coffee, copra, coconut oil, tea, ginger, rubber, sugarcane, vanilla, sandalwood oil, and spices are amongst some of the common food and cash crops Pacific countries export (Allen *et al*., 2009: 292-379; Leslie, 2013). The introduction of these crops into the Pacific contributed to each country's economy and benefited people. In PNG, for example, cash crops were introduced around 1800s (Bourke, 2009:19). These included tobacco, cotton, rubber, cocoa, sisal and coffee. After the Second World War, major transformations occurred in the way people farmed. Coffee, cocoa and coconut became important cash crops adopted by people (Bourke, 2009:21). Most rural farmers in the Pacific own the land under customary tenure, and so, the farmers themselves decide what crop to cultivate, often switching between crops depending on how attractive the financial returns are. Since cash crops can provide substantial returns, farmers are willing to allocate lands that would otherwise be used for subsistence farming to cash cropping. For example, in Vanuatu, productive land for subsistence agriculture is taken over by cocoa farms, and people are no longer able to expand on their subsistence production (Allen, 2001). This raises social and cultural concerns because a large part of the livelihoods of Pacific Islanders is centred on land access. And so, adopting new technologies that are not compatible with the existing sociocultural structures may yield fewer benefits in the long run (Curry *et al*., 2021).

Population growth has also gradually changed the way subsistence farming is practiced. Ningal *et al*. (2008) reported strong correlation between population increase and land use change between 1975 and 2000 in the Morobe Province of PNG. An example of land use change at subsistence level can be seen from the way farmers practice gardening. Inu (2015) found the increasing population, people's aspiration for cash and land shortages in the Bena area of EHP, led to smaller portions of land being devoted to subsistence farming. Furthermore, Inu noted that unlike traditional subsistence farming where the food crops planted were mostly annual or biennial, coffee was perennial, hence remained on the land for

many years restricting land access for subsistence farming. As McGregor & McGregor (1999) stated, such changes in the subsistence farming can lead to vulnerability in the long run.

People have also adapted their farming practices in response to environmental conditions. For example, communities in Vanuatu that are frequently affected by tropical cyclones have adapted their farming practices by planting fast growing crops after the cyclone. This provides a source of food while waiting for other crops to mature (Le Dé *et al*., 2018). While this serves as a coping strategy it also affects the way subsistence farming is practiced because crops such as lettuce or cabbage which are planted after the storm are introduced crops. These introduced crops are cultivated differently to the usual crops that traditionally produced. Also, the new crops have enabled farmers to diversify their coping strategies. Some of the drivers of change in subsistence farming operate at scales above individual or household levels, in areas over which farmers have little or no control.

The Pacific is experiencing substantial changes in subsistence farming. Some aspects of the changes lead people to conditions of vulnerability. An important aspect of the transition from subsistence farming to increased participation in the cash economy is how to influences farmer's abilities to adapt to changing circumstances.

Understanding farmers' coping and adaptation strategies to livelihood shocks and stress

Shocks and stress on people's livelihoods are common across the Pacific. Some of these are induced by natural factors such as cyclones, earthquakes, drought, frost, floods or sudden onset of pests and diseases affecting crops, animals, livestock and humans. Others are economic factors such as a fall in commodity prices, and others are caused by social and political factors such as conflicts, increasing population pressure on existing resources, inappropriate policies, and poor decisions on resource allocation, migration and unemployment (see, for example, Bourke *et al*., 2016; Curry *et al*., 2011, Dey *et al.,* 2016). These calamities often result in people being displaced, without shelter, food, water or cash to access basic services. People are forced to cope with these disasters and to develop strategies to adapt.

Across the Pacific Islands, people have shown high resilience and the ability to cope with, and adapt to, a wide range of livelihood disturbances and stressors (Reenberg *et al*., 2008; Charan *et al*., 2018). In recent times these have become even more significant, given a changing climate, substantial economic change and rapid population growth. All these have shaped people's responses. People's coping and adaptation strategies include diversifying livelihood

strategies, agricultural intensification, agricultural extensification, changing attitude to farm management practices, investing in training and skills development, changing household expenditure patterns, changing diet, changes in gendered roles, support from social networks, utilizing indigenous knowledge systems, and migration. These are discussed in turn.

Diversifying livelihood strategies

Diversifying livelihood activities is important in sustaining life through periods of shocks and stress. The changing socio-economic landscape of the Pacific has meant households now require regular access to cash to meet household needs, school fees, health expenses, mortuary expenses, fundraising and cultural obligations. Across the Pacific, it is common for households to be engaged in several income-earning activities – *land based or non-land-based*. In Fiji, Tonga, Kiribati and Nauru, in response to the impact of climate change, people scaled-up on the production of crops such as *aibika* (spinach), sugarcane, cabbage, tomatoes, taro, cassava, sweet potato, and yam to generate cash (Georgeou *et al*., 2022). In Vanuatu, Leslie (2013) reported that people living in the peri-urban villages were struggling to secure their livelihoods and so engaged in mostly non-farm livelihood strategies to maintain their incomes and wellbeing (Leslie, 2013). Curry *et al*. (2015) argue that policies and plans should be developed to support and encourage farmers to diversify. In PNG, a study of oil palm smallholders in Hoskins and Popondetta in PNG by Koczberski *et al*. (2001) found that apart from oil palm, smallholders were also earning money from other farm and non-farm activities such as cultivating and selling food crops and export crops (cocoa, coffee, copra, and vanilla), operating PMV services, kerosene sales, running trade store, off-block employment, raising poultry, fishing or gambling. They also revealed that socio-cultural relationships between individuals, households and communities contribute significantly to people's livelihoods in terms of social security. These characteristics make it possible for people to develop a portfolio of livelihood activities that help them cope with shocks and stress (Fletcher *et al*., 2013). Curry *et al*. (2017) observed a similar practice in ENB where smallholder cocoa farmers were engaged in a diverse array of other income-generating activities. Curry and colleagues reported that smallholders were engaged in activities such as, coffee farming, kerosene sales, livestock raising, other cash crops, remittances, sewing, running trade store, wage employment and baking. These additional economic activities became beneficial during the cocoa pest outbreak that affected their incomes from cocoa. According to Roscher *et al.* (2022), planning for livelihood diversification is important for the region in the long run, if communities are to sustain themselves. Roscher *et al*. (2022) state that people's responses to

shocks and stress has become an area of focus in the last two decades in communities around the world. People are aware of situations that threaten their livelihoods and respond by engaging in alternative or supplementary income-generating activities that help them manage possible risks (Koczberski & Curry, 2005; Koczberski *et al*., 2001).

Agricultural intensification

Agriculture intensification is when production output is increased without increasing the area of land under cultivation (Bourke & Allen, 2009c: 230). Intensification is a common response to population and land use pressures across Pacific (Koczberski *et al*., 2001; Bue, 2013; Inu, 2015; Georgeou *et al*., 2022). Across the Pacific, improved crop husbandry practices have been employed by people. Sweet potato *(Ipomoea batatas)* has been widely adopted recently in Polynesia and Micronesia due to its ability to tolerate soil types on the islands (Georgeou *et al*., 2022). In PNG, evidence of farmers improving on crop husbandry practices persists. Bourke (2001, 222) describes six techniques: adopting productive staple crops, adopting promising cultivars, reducing fallow periods, extending cropping period, utilizing soil fertility techniques and improving agronomy practices. These responses are similar elsewhere in the Pacific. For example, in Vanuatu, farmers utilized crop rotation techniques on the same piece of land to maintain food supply, while in the Solomon Islands, readjusting fallow and cropping periods have become evident (Jansen *et al*., 2006). In PNG, Bue (2013:96) highlighted the increased rate of intensified subsistence farming amongst Oil Palm block holders in Land Settlement Schemes in PNG. These farmers are oil palm growers who are also engaged in subsistence farming on their blocks. To supplement inadequate incomes from oil palm, they adopted strategies such as improving crop management practices, intercropped immature oil palm with food crops, and adopted crops with special characteristics such as being high yield and early-maturing (Bue, 2013:113-122).

Agricultural extensification

Agriculture extensification is the act of bringing more land under cultivation and typically involves relatively low external production inputs such as fertilizers or pesticides. Expanding area of land under cultivation is a strategy used by smallholder farmers to increase food production or generate income. In PNG, Bue (2013:187) reported smallholder settlers in Hoskins farming hilly lands within their vicinity to produce food for their families, and to sell. These hilly areas were never cultivated before. Also in WNB, Koczberski *et al*. (2018) provide an example of this where under pressure to access land for food gardening, oil palm smallholder farmers resorted to strategies such as utilizing unused land around their homes,

edges of the block or steep slopes and gullies, and negotiating access to customary land or state-owned land leased to corporate institutions. In the Eastern Highlands, farmers in Asaro rented or purchased unused customary land to expand cultivation of food crops (Inu, 2015:89-91). In both of these cases, the farmers were migrant settlers who had no exclusive rights to land. And so, when faced with land pressure coped by cultivating unused land or purchasing customary land to expand production. In many Pacific communities, however, it is becoming increasingly difficult to bring new land under cultivation. One way smallholder farmers in parts of PNG use to get around this is to commodification of land, which has provided another alternative for those with limited access to land and wish to purchase or rent portions of customary land (Inu, 2015: 89-91; Koczberski *et al*., 2009). Farmers with limited access to land can also explore the strategy of renting the land, and practice expanding is part of the Eastern Highlands Province (Inu, 2015:91).

Changing attitude to farm management practices

Farmers make crucial decisions to lessen impact of shocks and stress on their livelihoods. Some decisions involve trade-offs ensuring farmers' efforts and invested in activities that provide higher returns. For example, Curry *et al*. (2011) described cocoa farmers in East New Britain initially abandoning their cocoa blocks because the devastation by the CPB pest had been so overwhelming and made it too challenging for them to manage the blocks. Farmers reported that they spent less time on block maintenance activities such as pruning, harvesting, weeding, and block sanitation. However, according to Curry and colleagues, not all farmers abandoned their blocks, instead some chose to partially abandon the block, but with limited commitment to block maintenance. Recent observations, however, show that an increasing number of the cocoa farmers are now realizing that the cocoa pest would not go away. These farmers have now decided to maintain their blocks, attend trainings, and practice the recommended block management practices outlined by Papua New Guinea Cocoa Coconut Institute Limited (PNGCCIL) (Peter *et al*., 2017). Rehabilitation of abandoned farms, such as the cocoa blocks in East Sepik, New Ireland and Madang are also evidence of farmers' willingness to adopt better management practices (Keane *et al*., 2021: 44-45). These shifts in decision-making, shows farmers' flexibility to adapt to shocks and stress affecting their livelihoods.

Investing in training and skills development

Farmers across the Pacific Islands realize the need to learn and adopt new skills to manage their livelihoods. This has become crucial because of the ongoing livelihood disturbances caused by changes in climatic conditions and frequency of events such as flood, cyclone, drought, frost, rising sea-levels and incidences of agricultural pests and diseases. Formal education, informal education, technical support, workshops, training, field days, and face to face learning can be vital to developing skills which contribute to livelihood maintenance (Johnston, 2015:204-106; Georgeou *et al*., 2022). In Fiji, workshops on skills development on water use and management in response to the impact of climate change on vulnerable communities have been highly regarded by participants, and in most cases, implementation of new ideas have been successful (Dumaru *et al*., 2011). Work by Peter *et al*. (2017) on how farmers responded to CPB show that farmers attended workshops to learn skills that would enable them to manage their cocoa blocks and to effectively implement management strategies required for the new resistant cocoa clone varieties that were distributed to farmers. The work on developing cocoa production activities countering the impact of CPB in East Sepik, New Ireland, Madang and Chimbu also show increased farmer participation in trainings and workshops indicating farmers realizing the need to invest in training and skills development (Keane *et al*., 2021:31-36).

Across the Pacific Islands farmers are also willing to adopt improved appropriate technologies. For example, in Fiji and Tonga and other smaller island states across the Pacific, the introduction and use of mobile phones have improved people's communication and knowledge about oncoming disasters and so help them prepare before the disaster or to check families and friends after the event (Johnston, 2015:126). Newly introduced food such as sweet potato was distributed to communities after a disaster: this was readily accepted by the inhabitants (Johnston, 2015:129). In PNG, cocoa farmers in East Sepik, New Ireland, Madang and Chimbu readily adopted appropriate technologies such as solar driers, budding knives, and plastic film, which is a substitute for budding tape. Farmers also accepted innovative ideas that were introduced by the trainers; for example, the formation of village extension training and satellite groups (Keane *et al*., 2021:45-50). Farmers therefore show that they are willing to adopt promising technologies that would help sustain their livelihoods.

Changing household expenditure patterns and changing diets

Changing household expenditure patterns is crucial in managing household expenses. In PNG, Curry *et al*. (2012: 166) reported that during the CPB outbreak in East New Britain

Province, all smallholders reduced the frequency of travel, 61% stopped supporting families and relatives in meeting social and cultural obligations, and 87% of people reduced expenses on health when CPB first struck. In education, families reported difficulty in meeting full school fees and resorted to other strategies such as paying in instalments. Modifying expenditure patterns was a useful coping strategy that helped alleviate financial stress people were experiencing.

An important coping strategy during livelihood crisis is reducing consumption or switching to other available and affordable sources of food. Natural disasters such as frost, drought, flood or cyclone force people to switch to other alternative food sources for sustenance. Population pressure, limited access to land for subsistence farming, and economic challenges also result in people changing their diets (Georgeou *et al*., 2022; Jansen *et al*., 2066, 3). In Vanuatu, prices of domestically grown food were expensive for poor urban dwellers. In response to this most switched to consuming rice and flour. In PNG, Curry *et al.* (2011) provides an example where during the infestation of cocoa by CPB, 48% of families studied rarely purchased store foods, but produced and relied on garden foods, which were affordable and available. A more severe situation was when frost struck the upper highlands of PNG in 1997 and 1998. Allen & Bourke (2001) note that people resorted to emergency foods such as wild yams, pueraria, ferns and banana corm and stem, to sustain them during a drought period that had led to frosts which wiped out the sweet potato crop.

Support from social networks

Utilizing social assets has been part of coping and adaptation strategies for the people of the Pacific over the years (Reenberg *et al*., 2008). It is through family, tribe, clan or social groups that people define their identities. Over the years, families and relatives mutually supported each other through activities such as contributions towards payment of school fees, medical expenses, mortuary expenses, wedding, compensation payments, establishing small businesses, church fundraising activities, or household and personal needs. Kinship relationships, and indigenous economic values and practices determine people's adaptive capacity, resilience and their decision-making (Curry *et al*., 2015; Curry, 2005).

Social relationships are a means to access resources during difficult times. In a study of migrant oil palm smallholders in WNB; when under immense pressure to access land, people drew assistance from relatives, friends, church members, and those sharing the same ethnicity to have short and long-term access to land (Koczberski *et al*., 2018). In ENB Province, Curry

et al. (2011:52) reported that during the CPB crisis, families from blocks affected by the pest experienced drastic financial losses. These families were allowed to harvest cocoa from relatives whose blocks were not infected by the pest. Another example of people obtaining support from families is during natural disasters. For example, when people's food crops failed during the 1997/1998 and 2015/2016 El Niño events many people survived by migrating to stay with relatives and people with whom they have longstanding customary relations and being sent food and money by relatives (Allen and Bourke 2001).

Utilizing indigenous knowledge systems

Pacific Islanders over the years have used existing spiritual beliefs, traditional governance practices and leadership, family and community networks, traditional agriculture and food security strategies to help cope with livelihood calamities and adapt to change (Fletcher *et al*., 2013). The use of indigenous knowledge in climate adaptation programs has been given considerable attention by scientists, practitioners, educationists and policy makers (Hart, 2010; Hiwasaki *et al*., 2014; Kangalawe *et al*., 2011; Kuruppu & Willie, 2015; Maila & Loubser, 2003). According to Kelman *et al*. (2012:13 in Johnston, 2015:114), indigenous knowledge or traditional knowledge is defined as a:

> body of information passed down through generations in a given locality and acquired through the accumulation of experiences, relationships with the surrounding environment, and traditional community rituals, practices and institutions.

This knowledge has sustained people through generations and has been useful in mitigating the impact of shocks and stress. For example, in Malaita in the Solomon Islands, taro viruses were managed using indigenous knowledge. This knowledge, however, is not being maintained well by younger farmers (Jansen *et al*., 2006:54). An example from PNG that exhibits a combination of experience, experimental learning and adaptation is the indigenous sweet potato composted mound system in Enga Province. According to Taraken & Ratsch (2009), the mounds, which are 0.5-1.5m high and 2-4m in diameter, are covering a heap of mulch, which over time becomes compost. The mulching materials used comprise a mix of grass, weeds or thinned crop materials. This agriculture practice has proven sustainable over time for several reasons: first, the mulch serves as a slow nutrient release source thus helping to maintain soil fertility over time. This allows for continues growth, tuber formation and multiple successive harvests. Second, the heat during decomposition helps in regulating the mound temperature during frosts and cold weather, resisting crop failure and thus maintaining

food supply for the household. Third, the mounds also allow cold air drainage at original ground level away from the sweet potatoes. Moreover, the mound size allows for multiple planting points thus allowing larger yields. This farming technique demonstrates people's resilience and adaptation that they have developed through experimental learning.

Indigenous belief systems and Christianity have been useful part of people's coping and adaptive practices across the Pacific Islands. Luetz & Nunn (2020) argue that scientific interventions introduced to island communities ignore traditional knowledge and spirituality, and this has led to lack of adoption of useful scientific interventions. They argue that the need for sustainable adaptation is inevitable and has become more challenging in recent years. Their argument stems from the fact that a majority of the Pacific Island communities have been Christianized and people have adopted Christian norms, beliefs and values into their way of life. These have helped during times of calamities. For example, Johnston (2015:107-111) reported that in Fiji and Tonga, church came to people's assistance during post-cyclone periods providing food, water and shelter when government assistance took a long time to reach people. Johnston elaborated that people's prayers gave them peace of mind during livelihood turbulences giving them inner strength to go through the livelihood crisis. Nunn (2017) argued that people's spiritual beliefs may sound irrational; however, ignoring these would be counteractive to adaptation measures introduced in communities.

Migration

Migration is a common adaptation and diversification strategy in the Pacific in response to a range of economic, social, cultural and political reasons (Christensen & Mertz, 2010; Curry & Koczberski, 1998; Reenberg *et al*., 2008; Steven, 2016). Migration may vary for different groups of people depending on their situations they are responding to. For example, in Kiribati, Nauru and Tuvalu, climate change has considerable impacts on low lying atoll islands across the Pacific forcing people to relocate their houses or migrate to New Zealand or Australia (Curtain & Dorman, 2019). In Tonga, on the island of Uiha, people are migrating to towns in search of better education and employment opportunities (Johnston, 2015:202). In the Solomon Island, internal migration from the bush to the coast to access government services is common (Jansen *et al*., 2006). Similar reasons were given for regional migration in Fiji where rural Fijians are moving into urban centres (Singh-Peterson & Iranacolaivalu, 2018). In PNG, a growing body of research has been focused on migrants and their livelihoods in PNG (for example, Bue, 2013; Curry & Koczberski, 1998; Curry & Koczberski, 1999; Koczberski *et al*., 2012; Mendano, 2012; Ryan, 2015). Internal migration,

in particular, is increasing, and has been described as an adaption and diversification strategy (Steven, 2016). Migrants are frequently from disadvantaged, rural areas of the country who have emigrated to other parts of the country. Some moved because of the push to participate in the capitalist economy while many in recent years emigrated in search of better livelihood opportunities in urban areas (Curry & Koczberski, 1998). An example is provided by Curry & Koczberski (1998), who described migrants from East Sepik Province who left their original homes where development was very limited and moved to West New Britain Province in the hope of securing land and engaging in oil palm work. Although some pursued short-term migration, and later returned to the East Sepik, for most it became a long-term adaptation strategy to access better health services, education for their children and earn financial money to improve their standard of living.

The livelihood vulnerability of migrants in the Pacific

Migration is an important livelihood adaptation strategy, however, migrants leaving their original home because of natural disasters or seeking opportunities in towns and cities, or in better off rural areas, often face uncertainties and challenges in their destination sites. These migrants face challenges with population growth and limited access to land, in locations they now reside, mainly because of their status as outsiders with limited rights to access land. This places them in a state of livelihood vulnerability. In the Solomon Islands, a generation of 'land poor' citizens has emerged. This is a generation who do not have primary land rights because of their status as children of migrants. In Vanuatu, migrants who move to Port Vila lack access to quality infrastructure and social support systems (Leslie, 2013). In PNG, Koczberski *et al*. (2012) highlight conditions of vulnerability amongst smallholders of oil palm in WNBP. Table 3.2 highlights some of these conditions. The nature of stress on migrants is more critical given their status as 'outsiders' requiring them to make crucial livelihood decisions. Bue (2013), Curry & Koczberski (1999), Koczberski *et al*., (2001), Mendano (2012), Koczberski *et al*., (2012) provide empirical evidence of migrants' livelihood challenges, and I utilize their research findings to discuss the contexts of vulnerability and adaptations amongst smallholder migrant farmers. According to their studies the key challenge was the increasing population which put considerable pressure on resource use and allocation particularly land. In response to this people sought alternative means to sustain their livelihoods.

The challenges faced by smallholder migrant farmers, as in the case of oil palm growers are numerous and interlinked. One constraint can trigger other situations that can marginalize people. For example, a migrant household would be disadvantaged when it comes to land

access: at the same time, they may also be experiencing an increase in the number of household members which would result in an increase in food and cash demands. Financial insecurity would lead to not participating in social obligations and meeting other personal and household needs, thus rendering them vulnerable to livelihood risks. The authors above however highlighted that farmers are resilient and actively develop strategies to reduce the impact of stress on the livelihoods.

Gendered dimensions of adaptation strategies

When livelihoods are threatened from economic, social or environmental impacts such as drought, frost or agricultural pest epidemics, males and females have shown a variation in the strategies they employ to support their livelihoods. Across the Pacific, males generally take on the more physical tasks such as chopping trees, clearing bush for gardening, digging drains and pruning while women take on more labour-intensive tasks of maintaining food gardens such as weeding (Georgeou *et al*., 2022; Johnston, 2015:101-106). Evidence of gender roles in agriculture production in PNG, is displayed throughout the country's evolving agricultural landscape (see for example, Sharp *et al*., 2022; Allen *et al*., 2009: 431-436). Curry *et al*. (2009) and Peter *et al*. (2017), reported women scaling-up on the sale of garden produce soon after cocoa income fell from Cocoa Pod Borer pest attack on cocoa. The main reason for women preferring production and sales of garden produce, however, is that they have much more control over income raised from the sales of garden produce. Women have also increased time spent on food gardening. Inu (2015:108-109) reported that during the coffee off-season in parts of Bena in Eastern Highlands of PNG, women gardening time increased from 6% to 11% of total labour time. This was a strategy used to earn additional income from the sales of the vegetables sold at the local markets. Men commonly have more control over income earned from cash crops. For example, In East Sepik, New Ireland, Madang and Chimbu provinces, Keane *et al*. (2021:28) reported that women participation in cocoa development work increased more compared to men. This signifies women's willingness to participate in activities that would help generate food or cash for their households. Examples above show the evolving role of gender in coping and adapting to livelihood challenges.

Table 3.2: Common livelihood challenges experienced by migrant farmers

Land use	Income	Social
Insecure land access. Land disputes between families or between block holders and landowners. Unaffordable rates of block prices. Soil fertility decline on blocks. Limited land for gardening as more is given to oil palm Due to population pressure, limited area of land is now allocated to food gardening. Inadequate supply of food for consumption and marketing hence reduced fallow periods. Less extension visits from oil palm institutions.	Inadequate incomes when oil palm earnings are low. Makes it difficult to satisfy household needs. Inadequate incomes when not engaged in off-farm activities. Women not receiving fair share of income from oil palm harvests to cater for personal and family needs. Insufficient incomes leading to lack of participation in social obligations.	Increase in family population on one block can increase tensions over income distributions and land use. Increasing population results in more separate production units, thus reducing labour exchange between households. Disagreements on income sharing between family members can cause a system failure. Land disputes with relatives led to reduction on labour inputs thus affecting harvests and incomes.

Source: Bue (2013); Curry & Koczberski (1999), Mendano (2012), Koczberski *et al*. (2012), Koczberski (2007), Koczberski *et al.* (2001).

Conclusion

In this chapter I described resilience and adaptive strategies employed by inhabitants of the Pacific during periods of livelihood crisis. The coping and adaptive capacities of people, however, are context specific depending on the type of calamity they are exposed to, and resources accessible at the time of disaster. For Pacific Islanders, geographical constraints coupled with rapid transformation in the social, economic and environmental spheres have brought about positive changes, as well as challenges that have placed people in vulnerable positions. Pacific island communities have, however, accepted transformations that have had positive impacts on their livelihoods. The introduction of the capitalist economy has made it possible for people to enjoy the benefits of better living. However, these changes have also brought considerable challenges. The main livelihood resource for the people is land. Land has been a major factor is people's adaptive capacity and has a significant influence on how people respond to livelihood shocks and stress. This chapter reveals that people are resilient when faced with livelihood calamities. Farmers in particular show that they are able to adjust

their farming techniques to ensure their basic needs are met. Women have played significant roles in ensuring successful coping and adaptation strategies for their families.

I also discussed in this chapter the context of migrant farmers as a marginalized group. The dream of earning a better living through migrating and engaging in the modern economy also encounter shocks and stress that place them in positions of making crucial livelihood decisions to maintain their wellbeing. Their coping and adaptive strategies, however, show that they are resilient and able to devise strategies to survive the calamities they face. Farmers have agency and are not passive. They are able to draw on assets available to them and make decisions on how these resources should be utilized. This provides the basis for discussions in Chapters 6, 7 and 8. In the next chapter I discuss the methodology employed in this study to elicit information on how smallholder cocoa farmers of migrant and landowner group responded to the impact of CPB on their livelihoods.

CHAPTER 4

STUDY SITE AND METHODOLOGY

Introduction

In this chapter the methodological framework used in this study is presented. I outline why the case study approach, utilizing mixed-methods data collection techniques, was considered the most appropriate methodology for this research. This stems from the idea that relying solely on quantitative or qualitative approach in research can limit a more holistic enquiry of the subject matter in this study. The chapter is in two parts. The first part presents the theoretical and conceptual framework for the study. It begins with the philosophical assumption and the constructivist/interpretivist paradigm as guide to this study. It then discusses characteristics of case study approaches, and the different variants of case studies and their advantages and disadvantages. In the second part of the chapter I provide a description of the study site and methods used in the study. I conclude the chapter with a discussion on the researcher's personal field experience in the use of participant observation. Finally, ethical considerations are presented.

Philosophical assumptions

The methodology for this study is developed from the premise of constructivism and interpretivist paradigm where people's experiences in life are subjectively interpreted (Warrick, 2001). This paradigm has been widely used in the social sciences to interpret and to better understand people and their construction of reality (Yin, 2009; Rowley, 2002; Mackenzie & Knipe, 2006; Goldkuhl, 2012). While individuals define experiences for themselves, the social environment impacts peoples' perceptions and interpretations.

To develop a well-rounded enquiry in this study, three key elements must be satisfied. These are, first, the philosophical assumptions as to how the researcher understands the existence and formation of knowledge; second, the appropriate strategies available in seeking answers to questions raised; and finally, the methods by which data are collected, analysed and presented (Creswell, 2003). The selection of appropriate research methods to study human responses to a range of environmental variables is of paramount significance (Adger, 2006; Colburn & Seara, 2011).

The aim of this study is to understand people's responses to CPB through decision-making and actions displayed in vulnerable situations. Taking the constructivist and interpretivist

positions therefore is supported with the understanding that vulnerability, resilience and adaptation are multifaceted and can operate at different scales including individual or societal, or site specific or general (Adger, 2006; Cutter *et al*., 2008; Kafle, 2010).

Research as Case Study

A case study approach was used to examine people's livelihoods, explore the impact of CPB on their livelihoods, and explain their livelihood responses. Case studies are useful for studying a particular phenomenon in its context (Yin, 1994) (see Table 4.1). Case studies can be intrinsic, instrumental and collective (Stake, 2005) or exploratory, explanatory and descriptive (Yin, 1994; Grandy, 2010) and are used depending on the context of the study. In sociology and agriculture, many studies have used the case study approach to investigate various agricultural phenomena (for example, McCusker and Carr, 2006; Shameem *et al*., 2014). Yin (1994) also points out that the use of case studies is suitable for studying contemporary issues where the researcher has no control over what is happening and seeks to understand the dynamics and the reasons for a phenomenon.

Table 4.1: Characteristics of case studies

Common characteristics of case studies
• Used when the question of "how" and "why" are asked to understand a phenomenon • Used to study phenomenon in real-life contexts • Can use qualitative, quantitative or mixed methods approaches • Nature of case under study determines methodology employed • The case of interest is usually embedded in a bounded environment • Useful for studies that require clinical, ethnographic, participant-observation or in field to understand case.

Sources: Yin (1994); Stake (2005).

Although case studies are useful, they can produce unreliable results leading to improper interpretations if not conducted well. Some of these problems are highlighted in Table 4.2.

Table 4.2: Advantages and disadvantages of case studies

Advantages	Disadvantages
• The case of interest takes precedence over the population size. For example, a case of interest could involve just one participant. • A large-scale phenomenon is difficult to study. Case studies there provide the avenue of researching the phenomenon at a manageable scale. • It allows the researcher to explore the phenomenon from different perspectives. • It explores the case holistically to generate a better understanding of the issue. • It is flexible and may also reduce the stringent sampling rules applied in other research methods. • Researcher develops new skills in wider range of research methods.	• May lack rigour if not conducted well. • Cases in sociological studies are often interlinked and difficult to study separately. • Large amount of field notes taken requires more time to organize and analyse. • Incorrect interpretation from researcher may happen. • Observer bias may occur. • Triangulation can be time consuming. • Expensive when conducting multiple methods simultaneously. • Expertise is needed when multiple methods are used.

Sources: Yin (1994); Stake (2005), Gerring (2004); Baxter and Jack (2008)

Constructivist/interpretivist paradigm

The use of a case study approach provided me with the opportunity of utilizing methods that required a prolonged time living with migrant and landowner communities - the two groups who were the focus of this study. This was important because the realities for the migrant group differ from the landowners: people lived and interacted in dynamic ways within their space. It was therefore possible to observe, interact, and to identify with farmers' thoughts, emotions, attitudes, and how they interpreted and constructed meaning to the livelihood stress they were experiencing.

The constructivist/interpretivist paradigms in research are based on the premise that reality is not discovered but is created (Andrews, 2012). According to Kim (2001), constructivists attempt to understand and form the nature of reality by thoroughly investigating the context and the culture by which a subject under study occurs. Social constructivists claim that reality is constructed from the subjects' interrelated activities with their environment (Gray, 2014). Individuals, however, respond to the environmental stimuli in varied ways, hence, according

to constructivists', understanding of individual perspectives is vital in framing reality (Kim, 2001).

For this study, farmers were studied within the framework of their socio-economic contexts and from their perspective of reality. It is from farmers' day-today experiences that they interpret and construct meanings and attitudes to environmental challenges, such as epidemics. This study aimed to understand how individuals constructed their realities when impacted by CPB.

The Mixed Methods Approach

According to Creswell (2003), mixed methods is a procedure whereby certain qualitative and quantitative methods are used simultaneously to answer specific research questions. This approach gives a broad understanding of the scope of the issue (Creswell & Clerk, 2007; Azorin & Cameron, 2010; Torrance, 2012), assists triangulation of the research results and reduces biases and improves validity (Teddlie & Tashakkori, 2011; Panda & Gupta, 2013). The multidimensional aspect of this study also required that sufficient data be collected from measurable and non-measurable units of analysis to make useful interpretations of the CPB impacts. For example, it was important to capture farmers' reflections of their feelings of the financial losses they experienced during the CPB incursion through qualitative methods as well as assess drops in yield figures and household income through quantitative data. Hence, both approaches contribute to understanding the intensity and extent of the CPB epidemic on people's livelihoods and consequently their livelihood decisions.

Qualitative and quantitative research approaches

Use of quantitative and qualitative data is also useful in triangulation making the findings more credible. For example, key informants were asked how they viewed the impact of CPB on people's incomes and farm management practices. Their responses were confirmed from in-depth interviews when individual cocoa farmers were asked to recall cocoa production figures from their blocks before and after the incursion of CPB. Furthermore, cocoa block assessments revealed farmers' efforts in maintaining production. These helped validate the responses provided by the farmers.

Table 4.3: Quantitative and qualitative research compared in a mixed methods approach

	Qualitative Research	**Quantitative Research**
Reality	Multiple realities exist. Subjective	Single reality. Laws exist.
Conceptual	-Emerging methods -Open-ended questions -Interview data, observation data, document data, and audio-visual data -Text and image analysis -Researcher is engaged with the research.	-Predetermined -Performance data, attitude data, observational data, and census data -Statistical analysis -Research is aimed at satisfying an objective or a set of objectives -Researcher is detached from the research.
Methodological	-Narratives -Phenomenology -Ethnography -Grounded theory -Case Studies	-Experimental designs -Structured questionnaires -Official statistics -Hypothesis testing -Social surveys -Instrument based questions
*Research (*objective approach)	Explore, discover and construct	Describe, explain and predict
Data	-Descriptive (words, images, objects)	-Numerical (Numbers, statistics)
Data analysis	-Descriptive analysis, content analysis, grounded theory, thematic analysis.	-Statistical analysis, correlations, regressions,
Strengths	-Phenomenon is understood when the researcher and subject are in the same context. -Enhances the ability of uncovering undetermined processes, events or traits. -Allows all point of views to be presented. -New insights and trends can be unveiled from research pool for data (obtained from the various data collection methods). -Phenomenon can be thoroughly examined.	-Use of established theories and concepts help validate the findings. -Data can be easily analysed and less time consuming Reliability and validity are emphasized in design of study, hence confidence in the findings. -A specific variable of interest can be studied in isolation. -Researcher has no influence on the results
Weaknesses	-Researcher's presence may influence responses -Large data of different types can delay analysis and presentation of findings. -Maintaining rigour can be problematic. -Researcher's limited experience can affect reliability and interpretation of findings.	-Findings from studies conducted in controlled environments can be challenging to obtain in real life situations. -Deeper understanding of the phenomenon is not often explored. -Findings are often too abstract for lay person. -Human aspects of a phenomenon are often left out.

Source: Creswell (2003), Mackenzie & Knipe (2006), McLeod (2017).

Another reason for using the mixed method approach in this study was to contribute to literature on the socio-economic perspectives of the impact of CPB on farmers' livelihoods and adaptive responses in PNG by building on the work by Curry *et al*. (2007; 2011) which

has largely shaped this study. Although other studies have been conducted on CPB, most have had a strong technical focus, targeting biological and chemical control, cloning, hybridization and block management. This study, however, aims to better understand farmers' adaptive behaviour by focusing on their livelihood responses and decision-making processes in the context of CPB. Hence the use of both qualitative and quantitative methods. Quantitative methods made it possible to obtain data and present findings on household cocoa production figures, farmers' cocoa income earnings, block management responses and livelihood choices. Qualitative data, on the other hand, made it possible to collect in-depth data on people's thoughts and feelings on the impacts of CPB on households, businesses, government services; as well as community descriptions, and why people made specific livelihood decisions in response to the financial stress they experienced.

Etic and emic in research

Two important perspectives discussed by Morris *et al.* (1999) is what the researcher possesses and brings into the research, termed as *etic* and what the researcher draws from the information collected from participants views, termed *emic*. An etic perspective is when the researcher goes into the field with his or her own defined values and notions of reality or worldviews, thus commencing studies with specific perspectives or hypotheses. An emic approach is when the study aims to draw out information from participants and understand their behaviour by considering the influence of the social, economic and cultural context in which the behaviour takes place. From this information theories or generalizations can be deduced.

As a Papua New Guinean having spent my childhood and early years of my life in rural Tulu Village, in Manus Province, Sissano and Ramo villages in West Sepik Province, I possess a good understanding of rural livelihoods. In addition, as an agriculture lecturer at the University of Goroka, I have lived and researched in rural Eastern Highlands, Western Highlands, Chimbu, Madang and Morobe Provinces. This exposed me to the livelihoods of rural households in the lowlands and highlands of PNG. Thirdly, I am fluent in Tok Pisin, which is the common vernacular spoken by migrants and landowners.

Research plan

The research plan (Figure 4.1) provides an overview of the study from start to finish. It also indicates the location for particular phases of the study.

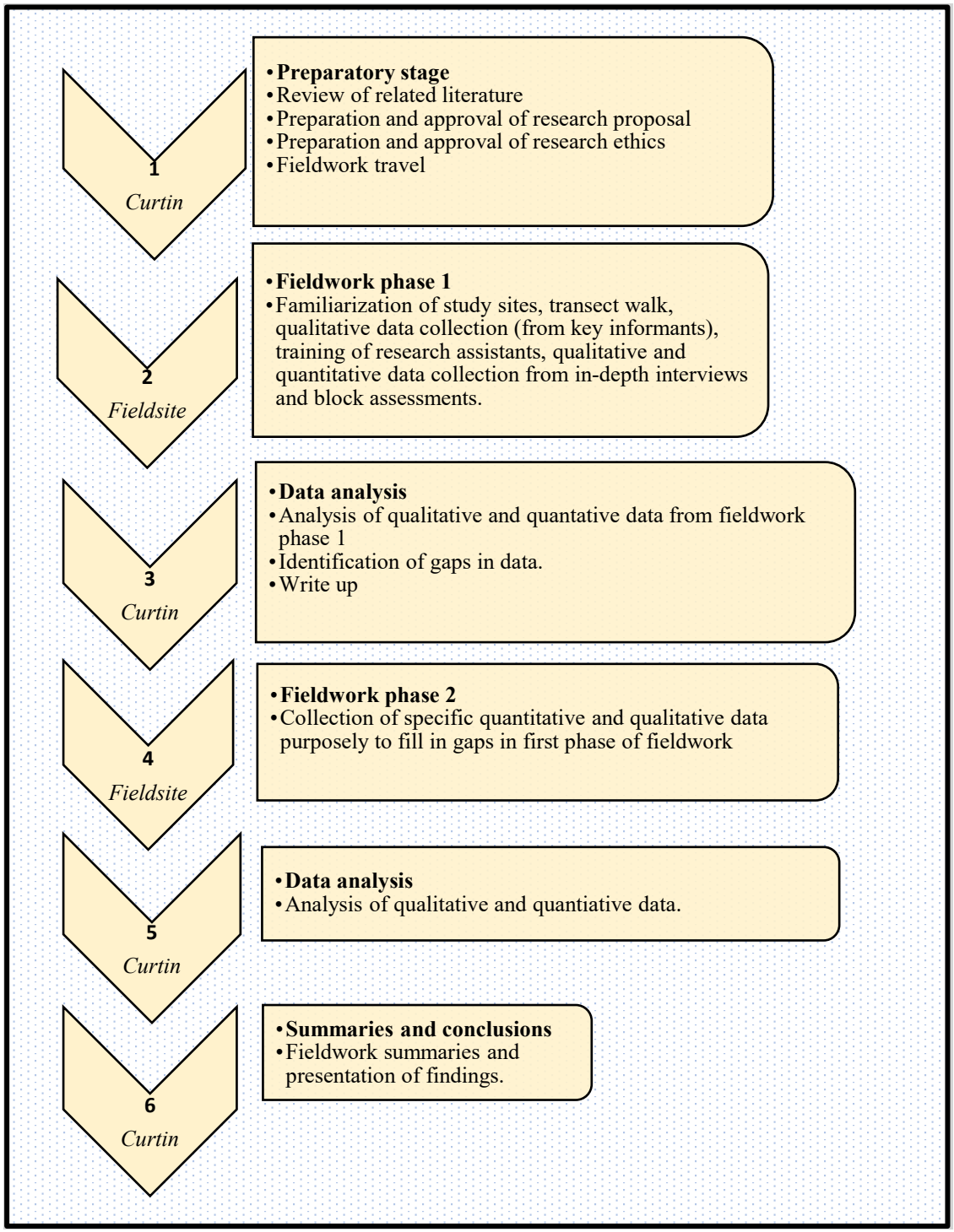

Figure 4.1: Overview of the research plan.

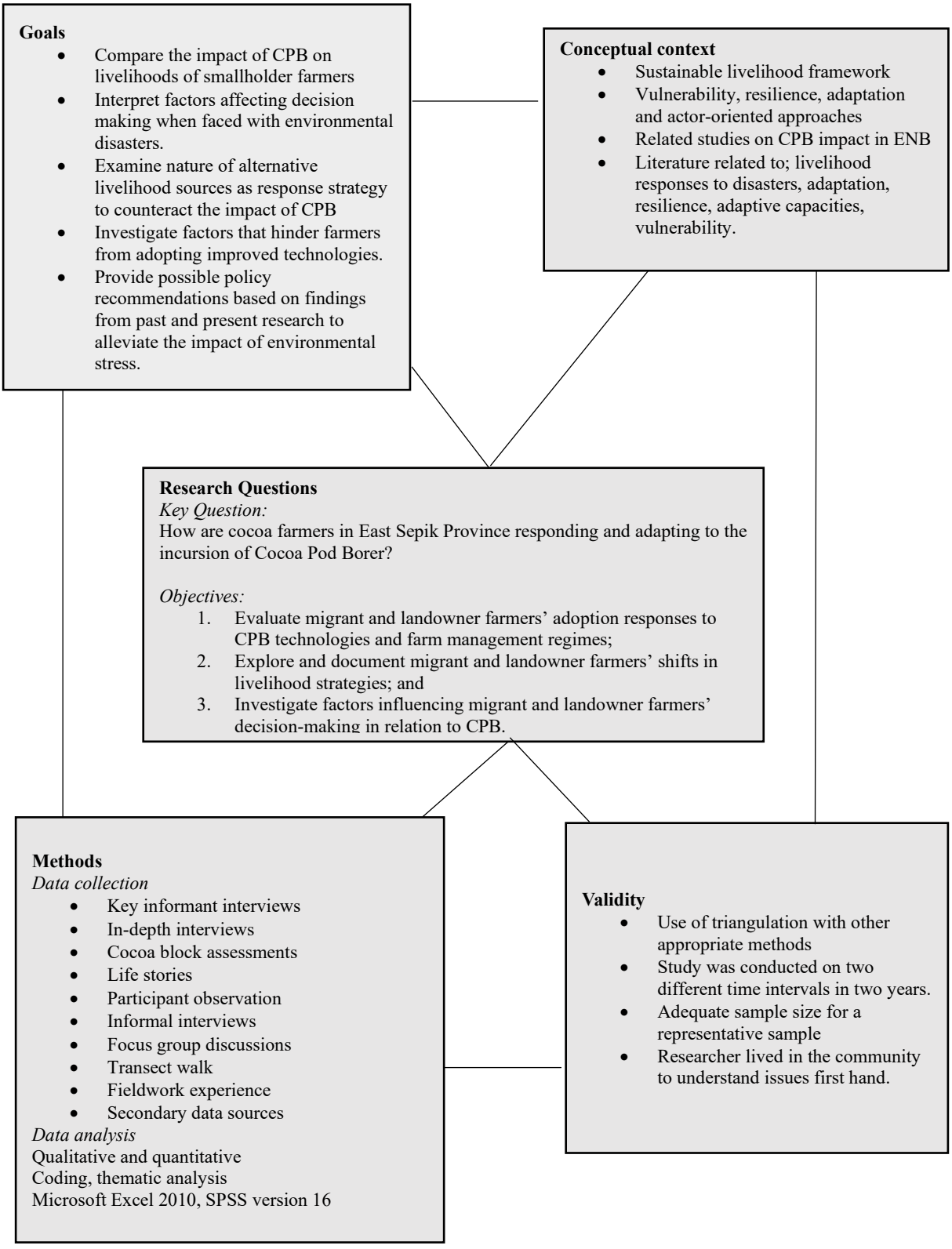

Figure 4.2: Overview of thesis. Adapted from Maxwell (2005).

Study site and description

Location of study

This study was conducted in the central Dagua community located on the coast approximately forty-five kilometres west of Wewak; the provincial capital of ESP. Dagua can be reached by road or sea. I conducted fieldwork in the village during two periods: from January to May in 2016 and January to April in 2017.

The general landscape of Dagua is flat with small hills at the back of Makopin village. The fieldsite encompassed three villages, across three wards: Urip, a migrant community, and two customary landowner communities – Makopin and Sibugen-Maguer. Both the landowner and migrant groups speak the Arapesh language. Settlement is dispersed, although all communities can be easily accessed by road. According to the 2011 national census, the population of Urip was 235 with 55 households, and the total population of Makopin and Sibugen-Maguer was 911 with 190 households. Most people live in traditional bush-material houses with few living in semi-permanent and permanent homes. The communities derive their primary livelihoods from land-based resources. Cocoa, coconut, coffee, vanilla and betel nut are common cash crops. The livelihoods in the three communities are described further in Chapter 5. The Dagua community was purposively selected because the majority of the households were engaged in cocoa production. Also given the population is made up of landowners and migrants, it presented an opportunity to understand the different impacts of CPB on migrants and landowners, and their differing responses to the financial shock caused by the pest.

A fieldsite in East Sepik Province was chosen because, despite the presence of CPB, in 2011 cocoa production in the province overtook ENB, which had prior to then been the leading province in cocoa production (Cocoa Board of PNG, 2014). Research work on farmers' responses to CPB has focused on East New Britain (ENB) farmers (see, for example, Curry *et al.*, 2011), whereas little was understood of the experiences of farmers and their responses to CPB in other cocoa-producing provinces, including East Sepik. In the 2000 Census, 39,334 households (or 60.3% of households) in East Sepik Province reported earning income from cocoa (NRI 2010:113). It is important to understand the experience of cocoa farmers in ESP due to there being considerable cultural and environmental differences between ENB and ESP which may shape how farmers have been impacted by CPB.

Figure 4.3: Map of PNG showing cocoa producing provinces at the time of this study from 2015-2018.

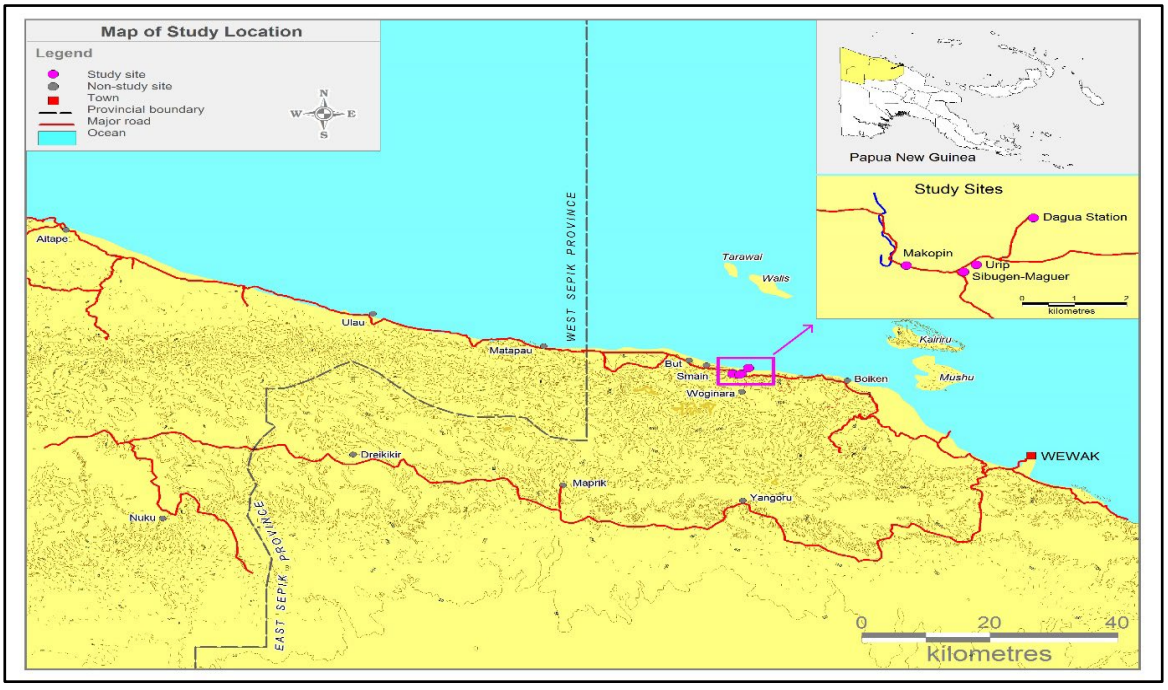

Figure 4.4: Map of West and East Sepik Provinces indicating the study sites.

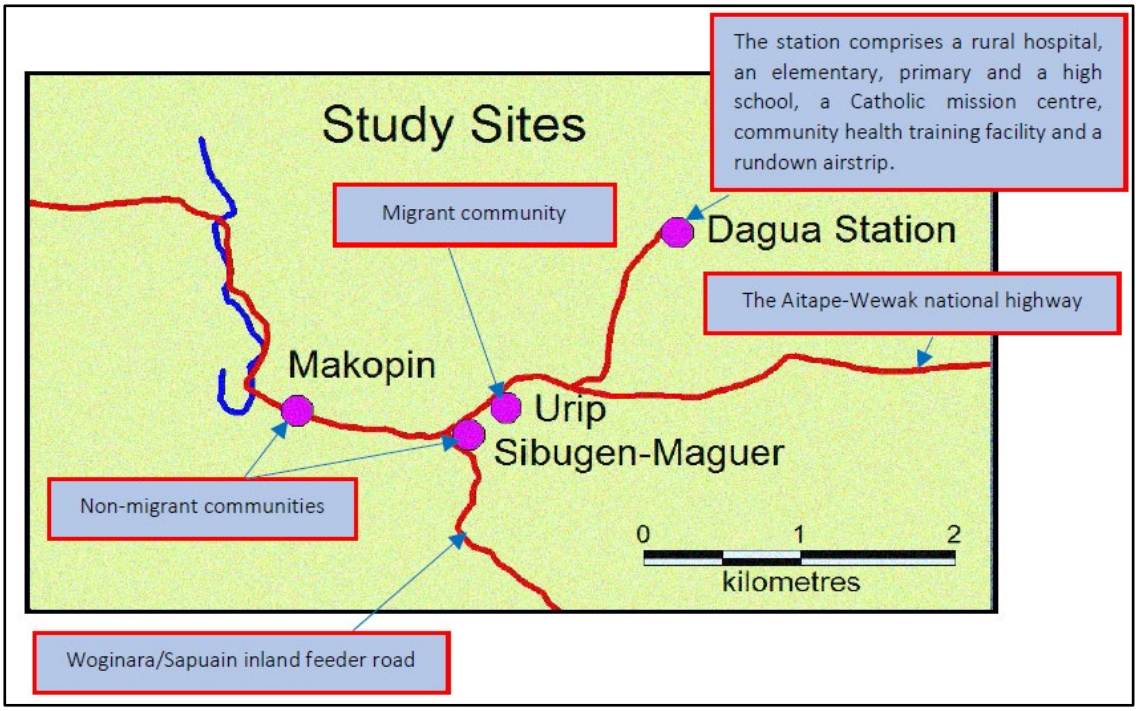

Figure 4.5: Location of study sites at Dagua

Overview of landowner and migrant communities

The landowner group resides in Sibugen-Maguer and Makopin villages. The different clan groups own large portions of land in the Central Dagua area that stretches from the coast inland to the hills. The Urip people, migrants from the West Yangoru area (also referred to as the 'Mountain Arapesh-speaking people'), settled in the Dagua area in the late 1940s with the approval of the landowners. It was agreed the landowner would allocate portions of their land to the migrants to settle and farm (see Chapter 5). The migrants were amongst a larger cohort of people from ESP who migrated as labourers to other provinces in response to the emergence of a capitalist economy, with many of these migrants working on plantations in coastal and island provinces (May, 1977; Allen & Bourke, 2009: 51; Numbasa & Koczberski, 2012; Curry & Koczberski, 1998). Over time, intermarriage between migrants and landowner families has created bonds between the two groups.

As part of their settlement agreement in Dagua, migrants were obliged to participate in the agricultural and livelihood transformation that was occurring at that time. That included cultivating new crops such as peanuts, rice, cocoa, coffee and coconut for copra production. It also brought these people closer to government services. Both migrants and landowners adopted cocoa as their main income generating source. The difference in resource access between the two groups has, however, meant that CPB has impacted each group in different ways, and has generated different responses.

Gaining access to the fieldsite

Two issues made it crucial that I make connections before entering the communities. First, I had to align myself with a government department or an organization. People view this as important because they have had prior experiences, which have shaped their opinions on the legitimacy of individuals or organizations that visit their communities. Second, the community was new to me, and so, I had to form professional and social connections with people to assist me in the research. To achieve these, PNGCCIL, DAL, ward councillors, my host families and church provided assistance.

The first point of contact was PNGCCIL and the provincial DAL office in Wewak. These two organisations were important because they dealt with cocoa and other agricultural commodities in ESP. The initial meetings followed prior conversations I had with the two organisations when planning my fieldwork in Australia. The PNGCCIL officer provided an overview of the community including community issues and the general livelihoods of people. The officer also assured me of PNGCCIL's support for my fieldwork.

Within the community itself, I first approached the ward councillors. The councillors were important in my study because they were the head of the communities and should be made aware of my presence in their communities. The councillors were initially suspicious, having had poor prior experiences with government organisations over the years. After explaining to them that I was a student and doing the fieldwork as part of my PhD research, the three councillors accepted me in their communities and assured me of their support throughout my fieldwork.

During my fieldwork it was arranged for me to stay with host families. My host families were very supportive. The first host family collected me from the airport and escorted me to their home in Dagua. They introduced me to the ward councillors of the migrant and landowners communities, met key traditional and business leaders, and the elders of the communities. The host family also helped oriented me to the community setting especially the surveying the landowner and migrants' locations and environment. These made my fieldwork easier because I had familiarized myself with the environment and people. After the fieldwork, the family farewelled me at the airport. In my follow-up visit to Dagua, the second host family did the same. Because of my lengthy stay with them, I was able to obtain useful information about the people and the communities.

The Seventh Day Adventist church provided another important entry point into the community. Although the church membership was small, it comprised members from both the migrant and landowner communities. Through the church network, I was able to visit homes casually, discuss people's views on social issues faced in the community. I was able to form close associations with migrants and landowners and understand their issues more deeply.

Data collection

In this study I combined a range of qualitative and quantitative research methods. Methods used were transect walk, in-depth interview questionnaire survey, key informant interviews, life stories, focus group discussions, informal conversations, cocoa block assessments, and participant observations. Each method is discussed in more detail below.

Transect walk

Early in my fieldwork I conducted a transect walk with the aim of understanding the general layout of the community. I aimed to describe home sites, natural resources, roads, local government service sites, and general landscape features (Appendix 5). The walk ran from east to west, beginning in the landowners' community of Makopin, the highest point in the community, through the migrant community, and down to Dagua station near the coastline. Due to the distance and time, the walk was carried out over two days. Two local guides assisted me during the walk by providing information on interesting features of the communities.

In-depth questionnaire survey

A total of 232 detailed questionnaires were conducted with farming households, 185 households from the landowning groups and 47 households from the migrant groups. The initial aim was to do a questionnaire survey with every household from the migrant and landowner group. However, as interviews progressed, a saturation point was reached where new households interviewed gave similar responses to other households already interviewed, and additional households were no longer contributing new information. Nevertheless, the sample for this study represents a high proportion of the population with, in the 2011 census, 190 households recorded in the landowner communities of Makopin and Sibugen-Maguer, and 55 households recorded at Urip, the migrant community.

The questionnaire was undertaken at the household level. Of the 185 households surveyed from the landowner community, the primary respondent for 160 of the households was male, and for 25 households the primary respondent was female. Within the migrant community, for

37 of the 47 households surveyed the primary respondent was male, and for 10 households the primary respondent was female (see Table 4.3). Because land in the area is held by patrilineal clan groups, and because cocoa is considered men's domain and men take the lead on cocoa farm management decisions, most surveys were carried out with the male head of household. In most cases where women were interviewed, they were either widows or their husbands were away for an extended or indefinite period in Kimbe, Wewak or other neighbouring villages. Three of the women had husbands serving their sentences in prison. The under-representation of women amongst respondents was observed, and in response a series of women-only focus groups were held (discussed below).

Due to safety concerns and being mindful of existing conflicts between members of the communities, the sample of cocoa farmers is more heavily weighted to those cocoa farmers who resided within the villages' boundary. Fewer farmers were recruited from those who lived in small hamlets away from the community vicinity. The questionnaire (Appendix 1) was administered with both migrant and landowner farmers. Ten enumerators mostly grade ten and twelve leavers, with one university student who was in the village at that time, assisted in the fieldwork. The enumerators were trained on how to collect data.

Farmers were approached in advance for an interview and upon their consent a suitable time was scheduled for the interview (Appendices 10, 11, 12 and 13). Interviewees were asked to have one or two relatives to witness the interview. For women, a male relative was always present. A local research assistant was also present. Each interview lasted for approximately 30 to 40 minutes. The interviews were conducted in *Tok Pisin*, PNG's *lingua franca*, a language understood by the researcher and the participants.

In the process of carrying out interviews, I became aware that there were limits to asking sensitive questions. For example, when asked about landownership, migrants had no problem admitting that the land they cultivated belonged to the landowners. Landowners, in contrast, would not easily admit who owned the land they were farming or residing on. This is because although they were landowners there were tensions within each clan as to who had more say on allocation of land to clan members, and how land was used. Also, while some questions regarding coping and adaptation strategies were easy to ask, there are moral considerations that have to be taken into account when asking questions on people's personal decisions on the types of strategies they use.

The questionnaire comprised eight sections which aimed to obtain information on: block history; cocoa harvests; block management information and assistance; CPB management strategies; time and labour input; primary income sources for men and women; livelihood activity and change; and CPB impacts on family and community (Appendix 1). Questioning focussed on how livelihoods and cocoa production practices changed following the incursion of CPB.

Table 4.4: Participant demographics

Independent Variable	Migrants (N=47)		Landowners (N=185)	
Gender	*Male (n=37)*	*Female (n=10)*	*Male (n=160)*	*Female (n=25)*
Marital Status	25 (67.6)	8 (80.0)	85 (53.1)	16 (64.0)
Married	11 (29.7)	0 (0.0)	70 (43.8)	4 (16.0)
Single	1 (2.7)	2 (20.0)	2 (1.3)	5 (20.0)
Widow	0 (0.0)	0 (0.0)	3 (1.9)	0 (0.0)
Divorced				
Education Level				
None	0 (0.0)	2 (20.0)	2 (1.3)	2 (8.0)
Primary	19 (51.4)	4 (40.0)	72 (45.0)	18 (72.0)
High school	8 (21.6)	2 (20.0)	22 (13.8)	2 (8.0)
Secondary School	3 (8.1)	1 (10.0)	4 (2.5)	1 (4.0)
College/University	0 (0.0)	0 (0.0)	1 (0.1)	0 (0.0)
NA	7 (18.9)	1 (10.0)	11(6.9)	2 (8.0)
Household size per farmer				
<5	2 (5.4)	5 (50.0)	37 (23.1)	9 (36.0)
5-10	25 (67.6)	4 (40.0)	108 (67.5)	15 (60.0)
>10	3 (8.1)	1 (10.0)	15 (9.4)	0 (0.0)
NA	7 (18.9)	0 (0.0)	0 (0.0)	1 (4.0)
Religious affiliation				
None	0 (0.0)	0 (0.0)	8 (5.0)	0 (0.0)
Catholic	9 (24.3)	3 (30.0)	82 (51.3)	14 (56.0)
Pentecostal	15 (40.5)	5 (50.0)	42 (26.3)	6 (24.0)
SDA	13 (35.1)	2 (20.0)	17 (10.6)	2 (8.0)
New Apostolic	0 (0.0)	0 (0.0)	8 (5.0)	2 (8.0)
Other	0 (0.0)	0 (0.0)	3 (1.9)	1 (4.0)

*Other: Jehovah Witness, Evangelical church, Israel Ministries

Key informant interviews

Key informants were selected to be interviewed based on their status and leadership roles in the community, and within the cocoa industry. These include five officers from PNGCCIL/PDAL, three ward councillors, drivers and owners of PMVs, four cocoa dryer owners, two wet bean buyers, three trade store owners, the community magistrate, the

hospital chairman, three head teachers at schools, three church leaders, and five community elders. Details of these key informants are described below. These are individuals who are perceived as leaders and who were considered most knowledgeable about particular aspects of the community. Prior to interviewing them, I introduced myself and explained the purpose of the research. After they understood I requested their consent to participate in the research. I then proceeded with the questions. Their responses were recording using a digital voice recorder. Their responses were later transcribed.

PNGCCIL/DAL officers

Interviews with five PNGCCIL and DAL officers were done in Wewak. The officers were asked about production figures and when CPB was first reported in the communities. The officers were also asked about the level of adoption of CPB management practices amongst farmers. This contributed insights into why farmers were adopting, not adopting, or were slow to adopt the recommended technologies. The interviews also identified some of the challenges they faced with their agricultural extension work (Appendix 1).

Ward councillors

Three councillors were interviewed. Before the interviews I explained to them the purpose of the research, why Dagua was selected and potential benefits to communities and cocoa farmers in general (Appendix 1). Each interview was followed by a walk through the village where I was shown people's livelihood activities and existing community projects.

PMV owners

One Hino truck and two fifteen-seater buses served the communities. Interviews were conducted with the drivers and the owner of the truck to gain insights into the flows and connections between Dagua and Wewak town. The interviews were conducted during my trips to town. I made sure I took the front seat so I could interview the drivers and the truck owner on the way to town and back. This approach was helpful in this research because the vehicle would stop at many different spots along the highway picking up passengers and cargo, making it possible to ask related questions to the type of cargo transported to and from Wewak, regular passengers on the PMVs, number of passengers, hire of the vehicle, and impact of CPB on the PMV business (Appendix 1).

Cocoa dryer owners

The migrants and landowners owned many cocoa dryers, however, only four dryers from the landowner group were operational at the time of this study. The owner of each operational dryer was interviewed. The research sought information on how the dryer was operating

before and after the CPB incursion. Specific questions also included, number of bags processed before and after CPB, details of dryer hire, transportation, government support and future plans of the dryer (Appendix 1).

Local wet bean buyers

The three wet bean buyers interviewed were from the landowner group. These buyers have very good relationships with farmers. The migrant group did not have a buyer at the time of the study. One of the buyers was a woman who provided interesting information on how she organised her business, which was usually a male dominated activity. General information from each buyer was collected including how long they had been in the business, their buying points and who assisted them with labour. Specific questions relating to CPB were also asked. These included how much buyers were paying for a kilogram of wet-bean before and after the intrusion of CPB, and CPB's impact on labour costs of operations, supply of beans, and buying of beans by exporters in Wewak (Appendix 1).

Trade store owners

Three trade store owners were interviewed: two from the migrant group and one from the landowner group. Each store owner willingly provided the history of the business which included business ownership, purpose of its establishment, and time in operation. They also provided information on daily operations, types of goods sold, turn-over rate and daily takings. Particular attention was paid to understanding how the trade stores operations had changed after the CPB incursion (Appendix 1).

Community magistrate

The magistrate, who was in his early 50s, was well-respected by both communities and very knowledgeable about local community issues. In addition to formal interviews with the magistrate at his home, much of the information obtained was through informal conversations with him at his home and during village visits. We discussed in detail the law and order situation of the communities and how this had been changed by the CPB incursion (Appendix 1).

Hospital chairman

The chairman of Dagua rural hospital provided a brief overview of the hospital operations and staffing. He was asked the average number of patients per day receiving services at the hospital, and about common illnesses treated at the hospital. This was important because patients are charged for health services, and the cost varied depending on the type of service received. For example, treatment for mild headache was charged less than a woman in labour.

He was asked how the hospital services and people's ability to pay for such services were impacted by CPB (Appendix 1).

Head teachers of elementary, primary and high school

Interviews were conducted with the head teachers of the elementary, primary and high school. Payment of school fees, project fees, and for school uniforms provided useful information on people's financial ability to meet these costs before and after the incursion of CPB. Community participation in school-organized activities such as building classrooms, staff houses, or general cleaning were also important indicators of the willingness of people to commit time to school activities. These could have been affected given time people needed to attend to other activities to maintain their livelihoods. Head teachers were also asked if their school had participated in any CPB awareness programs in the community (Appendix 1).

Community church leaders

One church elder from each the Catholic Church, Church of Christ, and Seventh Day Adventist church were interviewed. Church membership exceeded fifty for all of these denominations. Church is an important institution in the communities, and religion has a significant influence on people's beliefs, values and behaviour. Cash amounts that members contribute through tithes, offerings and church fundraising activities indicate people ability/willingness to contribute financially to the church. The impact of CPB could have changed this. In PNG, church organizations assist in awareness programs on various issues. Church leaders at Dagua were asked if they assisted in delivering awareness programs regarding CPB (Appendix 1).

Village cultural leaders

Five village leaders –three from the landowners group and two from the migrant, were asked to reflect on any changes to cultural values, beliefs, norms and traditions before and after CPB. The organization of the meeting resembled a focus group discussion, where I moderated the session. The leaders provided information on the history of the communities, notable historical events, perspectives on past and present agriculture activities. Moreover, they were asked how CPB affected people's daily activities and whether CPB had an impact on traditional ceremonies such as bride price payments and compensation payments. Finally, they were asked if an event of similar magnitude to the CPB epidemic had occurred in the past and how people had responded to it. This was important so as to draw comparisons with how people are presently responding to CPB (Appendix 1).

Life stories

During fieldwork, I had the opportunity to interact informally with many individuals from migrant and landowner groups and I sought to hear people's life stories. They were from different age groups with the eldest over sixty years old and youngest twenty. In their stories, migrants often discussed the struggles they faced as outsiders living in Dagua. Often, they began their stories with their place of origin, followed by discussing whose land they lived on. Landowners' stories revolved more around traditional history, landownership, and their daily livelihood activities. The migrants' and the landowners' stories added depth to my understanding of each community and their sense of belonging.

Focus group discussions

Three focus groups were established, one for the migrant village and one for each of the two landowner villages. Purposive sampling was conducted to select women who had access to a cocoa block. Each focus group had 6-8 participants, although other women often sat on the periphery to listen. Women were selected for the focus group discussions as women's voices were underrepresented in the questionnaire survey. Women are often reluctant to give their views when their husband is present, and so the women-only focus groups enabled women to freely discuss livelihood matters (Appendix 4).

The women were approached and consent obtained from them to participate in the discussion a week in advance. This gave them time to schedule their week, and discuss their participation with their husbands, which is important to avoid misunderstandings and mistrust. The three focus group meetings were conducted separately on different days. The meeting was less formal to encourage the women to speak freely. Each group discussion was conducted in the front yard of the respective ward councillor's home. The councillor periodically checked on the meeting to ensure the discussions progressed well.

Six key questions formed the discussion. Each question was posed one at a time, and additional probing questions were asked when necessary. The women were asked to compare their livelihood situations before and after the CPB invasion. These included how they assisted their husbands and the number of hours they invested in cocoa work, income earned from cocoa, and how cash income was shared within the family (Appendix 4).

Informal conversations

Casual talks with people during the fieldwork were rewarding as these generated interesting points not always captured in my survey instruments. According to Swain & Spire (2020)

informal conversions can enrich the data by providing context and authenticity. Living in the village for nine months, gave me the opportunity to talk to people at roadside markets, in their gardens, at church, during PMV rides to and from town, during the opening of a government health facility, during my involvement with community work, and at people's homes when I visited. The talks were often about livelihoods, village history, culture, social events, business opportunities and community challenges.

Cocoa block assessments

During the fieldwork period, an ACIAR-funded project on cocoa undertook cocoa block assessments in Dagua (Keane *et al*., 2021). In their project, twenty-seven farmers from Dagua had their cocoa blocks assessed. Ten of the blocks were from the migrant group, and seventeen blocks from the landowner group. The data were kindly made available to me, which was used to complement data I collected on cocoa blocks in the three villages. Some of the cocoa blocks assessed by the ACIAR-funded project belonged to farmers who had participated in my questionnaire surveys and interviews. In total my study had cocoa block assessments for 185 landowners and 47 migrant farmers. Specific characteristics of cocoa trees were assessed. These included number of trees, tree height, tree flowering, number of healthy pods, pods attacked by CPB, and presence of other pests and diseases. Management practices in the blocks assessed included pruning, shading, weeding, use of herbicides, fertilizers, removal of diseased pods and pod disposal (Appendix 3). This information was important to ascertain farmers' labour input in maintaining their blocks during the CPB period.

Participant observation

Participant observation is commonly used in qualitative studies, ethnography, sociology and anthropology mainly to study people in their natural setting (Iacono *et al.*, 2009). This is a useful technique as it provides the opportunity for the researcher to collect qualitative data of important practices and behaviours that could help explain research findings. According to Fink (2000), the quality of research can be enhanced when the researcher is involved mentally and physically with the participants in the research setting. I had the opportunity to live with two different families: one for a six-month period and another for five months (Table 4.4) (Plate 4.1). This provided me an understanding of how households vary in their livelihood decisions, activities and culture. For example, the first family was focused on business activities such as raising chickens and purchasing and fermenting of cocoa wet-beans. Daily routine activities revolved around these enterprises. The second family's activities revolved

more around food gardening, attending to their cocoa block and taking care of school-aged children. Observations were recorded on a daily basis.

While I sought to understand the lives of my hosts, my presence did impact their daily activities. For example, my host families gave up several of their planned activities such as, family visits to neighbouring villages because they did not want me left alone at home. They also had to readjust the way they did certain activities. For example, they stopped cooking pig meat because, as a Seventh Day Adventist, eating pork is against my religious belief, and they respected that. They were also concerned with my welfare and security throughout the fieldwork, and routinely questioned who I was talking to and where I had been. This can be stressful for the host families. I therefore had to notify them in advance, what my plans for the day and week were.

Residing in the community for an extended period also helped me understand community issues better. For example, how people were accessing government services such as agriculture extension services, health, education, village courts or financial services. It also helped me understand the context of leadership struggles within migrant and landowner groups where ward committees and councillors had to facilitate development amidst rising law and order issues. I also had the opportunity to understand how cultural issues can impact on people's farming activities. For example, the belief in *sanguma* (witchcraft) forced people to not attend to their distant cocoa blocks early in the day, and to leave these blocks well before dusk for fear of becoming a victim of *sanguma*.

Part of my observations included observing how migrants related to landowners. At most times migrant and landowner relations seemed harmonious; however, there were situations that revealed the differences between the two groups. For example, on the Friday evening, three days after my arrival at Dagua, a drunk migrant who had a machete in his hand was heard shouting abuse on the main road and telling landowners to forget about land issues and let everyone live together in peace. This indicated to me that there were on-going issues that I needed to understand. Upon asking my host family the next morning, I was informed that migrants are often stressed about land issues and would often vent their frustrations when drunk. From that experience, I reconsidered how I should conduct my fieldwork in a neutral manner without prompting situations that may cause tensions between the two communities.

Living in Dagua

I initially planned to have this study conducted at Maprik because of a number of other livelihood activities that were thriving there, such as vanilla, alluvial gold, peanut, and other fresh garden produce. However, I was not able to identify a host family to live with for my five-month fieldwork. A colleague from Dagua suggested I conduct my fieldwork in his village because the majority of the Daguans farmed cocoa and all had problems with the Cocoa Pod Borer. I agreed. My colleague approached his family to seek their approval to host me during my fieldwork. The family agreed, prepared a room for me, and had the elder brother appointed to escort me when I conducted farmer visits. The elder sister volunteered to prepare my meals during my stay. I travelled to Wewak, caught up with the family and travelled in a PMV to the village.

In the first phase of the fieldwork I lived with the family at Sibugen-Maguer village. The father was a kiap in the late 1970s. The mother abandoned the family more than twenty years ago. The father was able to provide background details of the landowner and migrant communities. The family owned a chicken shed, a mini-cocoa dryer and cocoa blocks. They were also buying wet bean. I participated in these activities occasionally. I paid rent to the family in addition to the fortnightly purchase of rice, flour, oil, tinned meat, tinned fish, noodles, salt, sugar, coffee, tea and fresh garden foods. I had to travel to Wewak to purchase these. Drinking water was obtained from a nearby tank and dug-out wells provided water for bathing and laundry. Solar lights were used for lighting, and we cooked meals in a standalone kitchen separate from the main house. Being with the family, I was able to understand the livelihoods of people, through family discussions, observations and actively participating in some family duties.

There were challenges I experienced. For example, I had no constant power supply to charge my computer and phone, thus, affecting communication with supervisors, family members, research assistants, and government officers and my research participants. The prolonged dry season during 2015-2016 forced me to use water wells further from the village. This raised security concerns and caused my host family stress thinking of my welfare.

In the second phase of my fieldwork, to gain a wider experience of life in Dagua, I lived with another family on the western side of the village. The father was the community magistrate who worked for the village court. He was also a carpenter and had been involved in building houses or doing maintenance work in the community. The mother took care of house chores

and attended to their garden. Since the father was employed, he contributed financially to the care of some children from his and his wife's sides of the family. I again paid rent and made similar contributions to the family as I had to my first host family.

Both families escorted me to visit farmers. Also they advised on certain farmers whom I should not visit because of existing conflicts between these families and my host family. Visiting these families would be interpreted as me being manipulated by my host family to spy on them. The families assisted by escorting me to locations of government and mission services such as the church, hospital and schools. In all of these activities I kept fieldnotes of my observations. The key characteristics of my two host families are shown in Table 4.5.

Table 4.5: Host family descriptions

	First host family (2016)	Second host family (2017)
Place of residence	Sibugen-Maguer	Makopin
Number of family members	4	12
Number of adults	4	5
Number of people with steady employment	0	1
Cocoa blocks	Yes (6)	Yes (5)
Food gardens	Yes (1)	Yes (2)
Additional sources of income	Yes (Chicken, cocoa farming, cocoa buying)	Yes (Food gardening, cocoa farming, carpentry)
Land tenure	Landowner	Landowner
Family relationships and social networks	Very good	Very good
Religious denomination	Catholic	Catholic

The differences between the host families provided insight into how relationships, decision making, problem solving, and use of resources are negotiated within the family and with others in the community. It added to my understanding of how realities can be interpreted differently between households and household members. Even though I am familiar with PNG's way of living with extended family members, experiencing it under a different cultural lens was a rewarding experience.

Plate 4.1: My second host family during my fieldwork at Makopin village.

Being hosted by two families, both from the landowner community, did, however, spark a rumour amongst migrants that I was there only for the benefit of landowners. I had to explain to them that I was there for both communities. I eventually developed trust amongst the migrant community when I engaged an equal number of research assistants from both groups and interacted with them through their ward councillors, elders, and other community members. After doing so, many opened up and were willing to share with me their CPB experiences.

Data analysis

Quantitative data from the study were entered into Excel spreadsheets, cleaned and analysed using Pivot tables and Statistical Package for the Social Sciences (SPSS). Audio-recorded data from interviews and focus group discussions were transcribed. Qualitative data were coded and analysed according to themes. Field notes supplemented the other quantitative or qualitative data.

Data obtained from secondary sources served as background information to this study or for triangulation purposes. In some cases the secondary data were already analysed while for other cases I analysed the data myself. For example, in the block assessment, I had to extract data from the Wewak-ESP Baseline survey, with permission from lead researchers, and analyse the data myself. Research Project Data Storage, Retention and Dissemination Details Data storage, retention and dissemination are as described in Appendix 7.

Research ethics

The ethical considerations in this study took into account national ethical standards of practice for Australia as stated by the National Health and Medical Research Council (2007). The study was given ethical approval by Curtin University Human Research Ethics Committee. Information collected from secondary sources and from institutional offices was guided by the institutions' code of ethics. All information from individuals remains confidential and participants' identities concealed except for my host families and others who agreed to have their photos taken and included in this thesis. In cases where there were no clear boundaries on ethical issues governing the research practice, the researcher resorted to the parameters of the Singapore Statement on Research Integrity which spelled out Honesty, Accountability, Professional Courtesy and Fairness and Good Stewardship of Research (2nd World Conference on Research Integrity, 2010) as the key guide to responsible research.

All participants provided free, prior and informed consent. A participant information sheet and the consent form were developed according to the National Statement on Ethical Conduct in Human Research (2014) and the ethical processes stipulated by the Curtin Human Research Ethics Committee (2009) (Appendix 10 and 11). Information in the participant information sheet was read to each participant. It explained the purpose of the study, the reason participation by the smallholder farmers was being sought, ethical responsibilities by the researcher (see Howitt & Cramer, 2011), and how the study may benefit the community. It also detailed participants' rights. Participants who consented to participate in the study signed a consent form.

Relationships between the migrants and the host community was a contentious issue in Dagua. As a researcher I had to be careful not to ignite any existing tensions between the migrants and the landowner communities in the way I conducted the study. And so, it was important to understand situations that may not be visible. For example, tensions between rival landowners, groups or migrants and landowner groups. Also, both communities have their own development needs, and so research activities focused on one group may be easily interpreted as being biased by another group. This could ignite conflicts especially for migrants, who are deemed outsiders by the landowners. To avoid this, the conduct of the research was done as fairly as possible. For example, selection of participants, key informants, interviews, informal stories and so forth were conducted fairly for both groups. This helped people understand the legitimacy of this study. Finally, sensitive information

shared by individual members in this study was kept confidential to avoid misunderstandings that may occur from members of the migrant or the landowner communities.

Conclusion

In this chapter I presented the methodological framework used in this study. I argue that a case study approach employing a combination of qualitative and quantitative methods presented the best way to understand people's place-based responses to livelihood stress. This is because the multiple methods used each added insights into migrants' and landowners' responses to the impact of CPB. The chapter further highlighted the rewards of living with the community to better understand coping and adaptation strategies amongst migrants and landowners.

Having discussed the methodology and community characteristics in this study, Chapter 5 will present the livelihood context of migrants and landowners, and the place of cocoa within their livelihoods. This sets the context for people's livelihood responses to the CPB epidemic discussed in Chapters 6, 7 and 8.

CHAPTER 5

A LIVELIHOOD PERSPECTIVE ON COCOA PRODUCTION OF MIGRANTS AND LANDOWNERS IN DAGUA

Introduction

In this chapter I examine the place of cocoa production within the broader livelihoods of migrants and landowners. I argue that while cocoa is a significant livelihood commodity for both migrants and landowners, differences in land access and other resources determined how smallholders responded to CPB which reflected differences in the degree of resilience and vulnerability of the two groups. This is because, although the first of the migrant community settled in Dagua in the 1940-1950s from a nearby area (Chapter 1), and many sociocultural norms are common across the two groups, migrants are still perceived as 'outsiders'. The chapter first recounts the introduction of cocoa, a commodity crop that the colonial administration hoped would pull people out of poverty. Second, I provide a general overview of migrants' and landowners' livelihoods prior to the CPB incursion. Third, I highlight the key differences in migrants and landowners' livelihood strategies prior to the incursion of CPB (Table 5.3). Lastly, how land access shaped the livelihood strategies of migrants and landowners prior to the CPB incursion is demonstrated. In this chapter I provide the context for understanding the impact of CPB on cocoa smallholders (Chapter 6), and their responses to CPB in terms of block management strategies (Chapter 7) and their livelihood strategies following the arrival of CPB (Chapter 8).

The introduction of cocoa into Dagua

Commencing in the 1950s, cocoa, together with coffee, peanut, rice, rubber and coconut (palms had been destroyed in the war), were introduced into Dagua with the aim of developing village commercial enterprises to improve people's living standards (Allen, 1976). Even though rice production was keenly adopted, with villagers believing it would bring them wealth, it was coconut and later cocoa that, eventually, were more widely adopted. The introduction of these commodity crops into Dagua was to engage people in commercial farming and also to rebuild the livelihoods of the communities after the Second World War, which saw village houses, pigs and chickens, food gardens, sago palms, coconut palms and potential agricultural lands destroyed by bombings. After the war, PNG experienced major transformations in both cash and food crop farming (Bourke 2009:21). Prior to the war, people had been subsistence farmers, but following the war people began to engage

increasingly with the broader market economy, which redefined their interactions with each other and the environment.

Cocoa was introduced into the Dagua area by the late Sir Pita Simogun in 1949/50 with the aim of developing commercial village enterprises (Allen, 1976).[1] Simogun was not originally from the Dagua area, but settled at Makopin, then at Urip, and became influential and highly regarded throughout the Dagua area. His influence in Dagua stems from his exposure to the 'outside'. As a child he was schooled at Salamaua in Morobe Province. There he learned Pidgin and got acquainted with Europeans. As an adult, he worked with the police and was widely regarded as a war hero. Having visited Australia during the war he learned about the use of cooperatives in smallholder farming systems in Queensland (Allen, 1976). The war period also provided him the opportunity to create contacts with other resourceful people including other police officers.

According to Allen (2012), Pita Simogun returned to Urip after the war. One of his post-war achievements was leading the agriculture revolution in the Dagua area by re-establishing coconut palms, which were destroyed during the war, and introducing other crops including cocoa, coffee, rice and peanuts (Allen, 2012; Roscoe, 1994). This spurred the migration of people from a certain community in West Yangoru (also known as the Mountain Arapesh) into Dagua, where they now live at Urip.[2] Cocoa cultivation became popular in the community, and between 1960 and 1970 interest in cocoa spread to other communities within the Dagua area.

Coconuts were reintroduced to Dagua from Samarai and Kairiru Island because the existing palms had been felled by the Japanese during the war. By introducing these crops, Simogun hoped that a cooperative society would be developed similar to those he had seen during his trips to Australia (Allen, 1976). This did not eventuate; nevertheless, a Rural Progress Society was formed in 1950. Simogun believed that in order for people to be financially secure, they must work the land and not expect money to come from supernatural sources. This was an important breakthrough by Simogun given that in the post-war period there was a rise in millenarian or 'cargo cult' movements in the Sepik region (Allen, 1976; Cochrane, 1970; Lawrence, 1964; Worsley, 1957). Generally, participants in these movements believed that Western goods including money were going to come from their ancestors but 'the white men' had intercepted these gifts and took them for themselves (Allen, 1976).

[1] This discussion draws on Bryant Allen's research and his interview with the late Sir Pita Simogun.
[2] West Yangoru people are also known as the Mountain Arapesh people.

Simogun's goal for agricultural development in Dagua was to rid people of their cargo cult mentality. He pointed this out in various community gatherings where he stressed that cargo and money were going to come through individual effort and hard work. To demonstrate this, he introduced cocoa, peanut, coffee, rice and coconuts - crops he thought had the potential to generate cash to improve people's living standards. He also obtained a block of land at Urip and established his own cocoa and coconut farm. This led farmers to cultivate these crops on their own land. Cocoa and coconut, which had established markets, proved successful introductions. Peanut failed as an export crop, although it was incorporated into the local subsistence farming system. Coffee, on the other hand, became redundant as prices declined, and rice production was undermined by insect attacks.

For most people, growing cocoa signified a shift from total reliance on traditional subsistence farming to participating in a new livelihood activity where generating cash, like 'the white men', would be a reality. Yet people did not abandon subsistence farming altogether but kept their existing livelihood activities and shifted their labour between subsistence and cocoa production. Apart from generating household cash incomes, cash crop production also sparked rural development initiatives in Dagua and neighbouring communities through the formation of associations and networks such as the Rural Progress Society at Urip. The transition, however, was entangled with expectations and uncertainties. To local leaders, like Simogun, it was a positive move towards better living. However, many people expected to accumulate material possessions and be like foreigners. People were caught between their traditional social and economic lives and the modern market economy (Curry, 2003). Similar agricultural transitions occurred in many parts of PNG around the same time (see, for example, Allen *et al*., 1995; Denoon 1985).

In the Dagua area, migrants were the earliest adopters of cocoa. They migrated to Dagua to engage in the modern economy. They also had better access to planting material from nurseries established by Simogun at Urip. Migrants' livelihoods soon became heavily dependent on cocoa production, which was reinforced by their desire for consumption of modern items such as rice, tinned fish, tinned meat, flour, cooking oil, sugar, powdered coffee, powdered milk, noodles, cigarettes, clothes, cooking utensils, kerosene, and gardening tools. Landowners were slower to adopt cocoa because they were still heavily engaged in traditional subsistence living. This observation is common in other parts of PNG (G. Curry, pers. comm., 2023). The timing of the adoption of cocoa by migrant and landowner

households can be seen in Figure 5.1 which presents data from my survey of cocoa block holders.

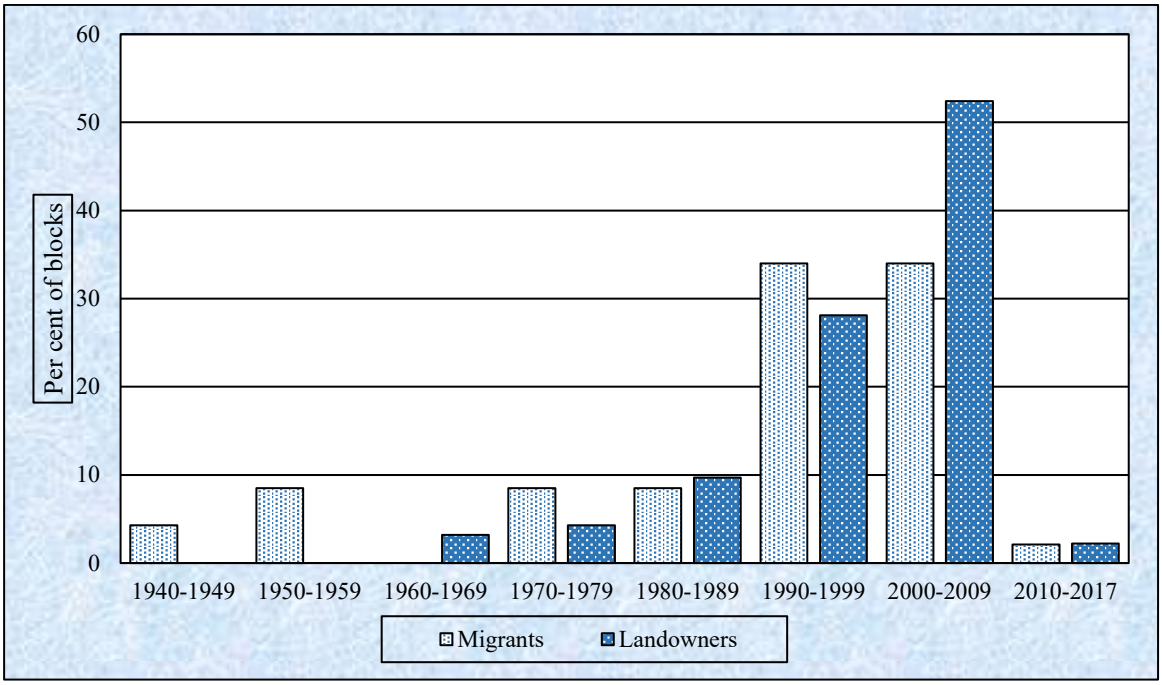

Figure 5.1: Planting dates of new cocoa blocks by migrants and landowners (1940 – 2017).

It was impossible to obtain the exact dates of block establishment as farmers did not have written records. Farmers, however, were able to identify the decade in which a block was first planted with cocoa. Cocoa blocks were slowly established by migrants between the 1940s and 1980s, with around a third of migrants' blocks established by the end of the 1980s. Most migrants' blocks were, however, planted in the 1990s and 2000s. In the 1960s, landowners in the area began growing cocoa, however by the end of the 1980s only 17% of landowner cocoa blocks had been established. A much greater expansion of cocoa production by landowners occurred after then, with 28% of landowner blocks established in the 1990s, and 52% in the 2000s. The initial slow uptake of cocoa production was because apart from cocoa, farmers were also adapting themselves to the commercial production of other new crops such as rice, peanut, coffee and coconuts, which were emphasised by the Rural Progress Society. However, in his interview with Bryant Allen, Simogun stated that low market prices, and incidences of pests and diseases, reduced farmers' motivation to fully maintain cultivation of these alternative crops (Allen, 1976). Cocoa eventually picked up as the main cash-earning commodity for farmers. Cocoa cultivation increased in the 1990s because Robusta coffee prices fell, and farmers abandoned the crop (Mellor, 2010). Many farmers replaced their Robusta coffee with cocoa by the year 2000, and significant planting of cocoa continued to

occur through the 2000s. According to a Sibugen-Maguer ward councillor, land disputes between major landowner groups were common prior to 1990, and this also inhibited the expansion of cocoa production. Conflicts caused uncertainties over land-use rights for migrants and some landowner families deterred them from establishing cocoa. These conflicts, although present, lessened in the 1990s leading to people being more assured of their settlement and access to land to cultivate cocoa. Between 2010 and 2017, very few blocks were established mainly because old cocoa trees had to be replaced, and aging parents passed on the blocks to the children without the children having to establish new blocks, although land pressures for some people began to emerge. Over the 1990s and 2000s, cocoa became the dominant cash crop in Dagua, where it has been incorporated into existing livelihood portfolios.

General Overview of Livelihoods in Dagua prior to CPB

In this section the general livelihoods of migrants and landowners are described. The background to people's livelihoods before the intrusion of CPB is also discussed. I argue in the section that most of migrants' and landowners' livelihood activities were similar prior to the CPB incursion, and that both groups faced many of the same challenges, though important differences existed between the two groups.

The settlements at Dagua

Dagua is situated on the coastal plain of Wewak District, East Sepik Province. Most people live in villages with a small number living along the main highway that links East and West Sepik provinces (Figure 4.4). Makopins, who consider themselves as key landowners, reside to the west near the hills and rivers. Sibugen-Maguer reside on the flat land with portions of swampy sites towards the coastline. The migrants live along the highway and near Dagua Station. The road from Wewak town to Dagua is part of the national highway that links Wewak to Aitape, then to Vanimo and finally to the Indonesian city of Jayapura. At the time of fieldwork, the road was sealed and in good condition from Wewak town to Banak Village, a few kilometres to the east of Dagua. After Banak Village the road was unsealed and in poor condition. There were gullies at certain locations, washed-out bridges, and overgrown shrubs along the roadside. Not all PMVs could travel that stretch, only four-wheel drive vehicles, and this impacted villagers' access to markets and services. These conditions reflect the lack of government service delivery in rural communities, including relatively accessible communities. In the late 2000s, Digicel installed a mobile phone tower near the village and

this has enhanced people's ability to communicate beyond the village. Most landowners and migrants now have access to a mobile phone.

The majority of landowner and migrant families live in houses built from bush materials, with a small number of families living in permanent or semi-permanent houses. There is no electricity supply in the villages and so people use small solar lamps. A small number of households have small petrol generators. Most households source water from nearby creeks or dug-out wells, although a few of the permanently built homes have water tanks, used mainly for drinking.

Government services are limited in Dagua. There are no banking services in Dagua, and migrants or landowners who wish to access banking services have to travel to Wewak to do so. There is one rural health centre which is accessed by migrants and landowners. Aid posts are present in the landowner and migrant communities but are run down and have limited supplies of medical drugs such as pain killers and anti-malarial tablets. Dagua has an elementary school, a primary school and a high school, all located at the Catholic Mission on the coast. Apart from serving the migrant and landowner communities, children from neighbouring villages also attend the schools. Students walk to and from school every day. Some students have to walk for two to three hours to reach the school. This can be tiring and unsafe, hence, some students, especially girls, have left school. Most students leave school after completing primary level education (Table 4.4). Few continue beyond primary school.

Agricultural system and food production

Prior to the Mountain Arapesh migrants' movement to Dagua, they were accustomed to a slightly different agricultural system to that of the Daguans. Key differences are in the staple food crops, fallow type, fallow period, number of plantings before fallowing, intensity of land use, garden segregation, crop segregation, and crop sequences (Table 5.1). These differences are spelt out broadly for the Dagua and Yangoru locations in Allen *et al.* (2002:21-27). However, Mead (1938: 202) provides some agricultural description for the Mountain Arapesh area. This is useful to understand the agricultural background of the migrants at Urip. According to Mead, the Mountain Arapesh land was infertile and it was difficult to plant proper gardens. Moreover, because of the steep slopes, rainwater drains fast into the valley below leading to loss of fertile soil for gardening. Foods such as sago, banana, yam, taro, and stimulants such as betel nut, betel pepper and tobacco were cultivated.

When the migrants arrived on the coast, they had to acquaint themselves with the environment and agricultural system in Dagua. For example, in Dagua, sago is the dominant staple food. It is cultivated as well as harvested from wild stands. Sago palms take 12 to 15 years to mature and can yield up to 180 kg per palm (Bourke *et al*., 2009: 152). Sago is planted by obtaining young suckers and replanting in swampy sites near food gardens. During the growth stage, sago requires little labour input, and the harvesting of starch takes less than a day, making food readily available (Plate 5.1). This makes it possible for people to engage in other livelihood activities.

Apart from the sago starch, the palms also provide other resources. For example, the leaves are used in thatched roofing and cooking. Sago bark is used for walling, floor construction, fencing, the build benches and shelves, and for firewood. Starch not harvested from the top side of felled sago trunks provides site for the sago beetle to lay its eggs. The eggs later develop into sago grubs which are harvested. Sago grubs provide a rich source of protein and are a local delicacy.

Plate 5.1: Pounding sago pith before straining with water to obtain starch.

Other staple food crops cultivated in food gardens include banana, Chinese taro, taro, sweet potato, yam and, and coconut. Common vegetables are *aibika, aupa*, winged bean, corn, cassava lowland pitpit, pumpkin tulip, common bean and snake bean. Fruits and nuts cultivated include mango, pandanus, pawpaw, pineapple, sugarcane, taun, breadfruit and okari nut. These are often intercropped with coconut, black palm or betel nut: coconut for food and

cash income, black palm to supply building material, and betel nut for personal consumption and to sell for cash income. Stimulants consumed include betel nut, betel pepper and tobacco (Allen *et al*., 2002:21).

Land-use intensity is very low. Land for new gardens is cleared from tall woody regrowth, which is cut and left to dry before being burned. The land is typically cultivated for only a single planting, before it is generally left to fallow for at least five or six years. Some food crops continue to be harvested during the fallow phase. The agricultural system at Dagua, is part of a very extensive agricultural system, the characteristics of which are described by Allen *et al*. (2002:21-23) and are summarised in Table 5.1.[2] And so, when the Mountain Arapesh people migrated to Dagua, there were some livelihood practices they were familiar with, and some they had to adopt or develop.

The food crops discussed are farmed in a subsistence manner where a low-input production system is common. The yields are low and maintaining household food supply was the main reason for production. Surpluses are sold at the local fresh food market, small amounts at school market or exchanged for seafood from the neighbouring islands of Kairiru, Mushu, Wallis or Tarawai.

There is very little difference in the way labour is organised between migrants and landowners. In the Mountain Arapesh, men would do the heavier tasks such as felling trees and clearing the bush for gardening. Although women assist, they take on the lighter aspects such as removing smaller debris, piling at the edge of the garden and burning. Men also construct fences around the garden to keep out wild pigs. Women plant taro, banana and greens while men plant sago and yams (Mead, 1938:282). In sago making, men fell the sago palm while women wash the pounded pith to extract the starch. Men hunt including setting nets and traps to catch wild animals such as pigs, flying foxes, birds and bush rats using skill learnt from a very young age. They are also responsible for butchering pigs during their hunting expeditions. Household tasks including preparing meals, laundry, and raising of children is done by women (Mead, 1938:282). However, when the migrants moved to Dagua, they had to adjust to the new environment. For example, land is no longer at their disposal to

[2] The agricultural systems across PNG are diverse. Allen *et al* (2002:1) state "an agricultural system is identified when a set of similar agricultural crops and practices occur within a defined area". In their work on Mapping Agriculture Systems in PNG, they provide six key criteria to differentiate one system from another. These are: (1) fallow type; (2) fallow period; (3) cultivation intensity; (4) the staple or most important crops; (5) garden and crop segregation; and (6) soil fertility maintenance techniques. Source: Allen *et al*., 2002.

Table: 5.1: Differences between the Dagua (1402) and the Mountain Arapesh (1403) Agricultural Systems

Criterion	Mountain Arapesh (West Yangoru)	Dagua
Dominant staple food crop	Taro (*Colocasia*), Yam (*D. esculenta*)	Sago
Staples subdominant	Banana, Coconut, Sago	Banana, Chinese taro, coconut and taro (*Colocasia*)
Staples present	Banana, Chinese taro, Coconut, Sago, Sweet potato, Taro (*Colocasia*), Yam (*D. alata*), Yam (*D. esculenta*)	Banana, Chinese taro, Coconut, Sago, Sweet potato, Taro (*Colocasia*), Yam (*D. alata*), Yam (*D. esculenta*)
Other vegetables	Aibika, Amaranthus spp., Winged bean, Corn, Lowland pitpit, Tulip, Bean (snake)	Aibika, Amaranthus spp., Bean (winged), Corn, Kumu mosong, Lowland pitpit, Pumpkin tips, Tulip, Bean (snake), Fern.
Fruits and nuts	Mango, Marita pandanus, Pineapple, Sugarcane, Ton Breadfruit	Mango, Marita pandanus, Pawpaw, Pineapple, Sugarcane, Ton, Breadfruit, Galip, Okari
Narcotics	Betel nut (lowland), Betel pepper (lowland), Tobacco	Betel nut (lowland), Betel pepper (lowland), Tobacco
Fallow type	Short woody regrowth	Tall woody regrowth
Long fallow period	5-15 years	Greater than 15 years
Burn fallow vegetation	Very significant	Very significant
Number of plantings before fallow	Two	One
Intensity of land use *(ratio of cropping period to fallow period)*	Low	Very low
Garden segregation	None	Minor
Crop segregation	Significant	Minor
Household gardens	Minor	Minor

cultivate their staple food – yam and taro. A negative consequence of this would be the loss of traditional skills and knowledge in yam and taro cultivation as well as values placed on these traditional crops (see Mead, 1938:167). These changes would ultimately require migrants to adjust and adapt. Most of the skills and knowledge in livelihood making are derived from friends and families. In the absence of agriculture extension services, farmers learn from each other. Farmers also share planting materials obtained from friends or families within the community or outside of Dagua.

Although migrants and landowners were engaged in cocoa production prior to the CPB period, they also combined other livelihood activities to produce food, generate income,

produce bush medicine, provide building materials or supply materials for social ceremonies such as traditional *singsing* – dance performances. For landowners, food gardening, discussed above, is crucial in maintaining household food supply and earning cash. Hunting of bush meat such as flying foxes, bandicoots, wild pigs or fishing in fresh water are also popular activities. Fishing in the sea is done only by the few who owned canoes. It seems the less interest in open sea fishing has not changed from the days of Mead, who made a similar observation (Mead, 1938: 226).

Migrants also cultivated food gardens; however, these were usually smaller in size than landowner gardens as migrants' access to land was limited. Food crops cultivated were the same planted by the landowners. Mixed gardening and intercropping was particularly crucial for migrants to maintain household food supply, earn income, meet other family needs such as building materials, or cultural obligations such as decorations for traditional dances. Hunting and fishing were rarely pursued, however, cash earned from cocoa, coconut or remittances from families working in West New Britain and elsewhere in Papua New Guinea aid in purchasing tinned fish or meat from local tradestore or Wewak.

With the introduction of cocoa into Dagua, gender-specific roles and responsibilities in cocoa production emerged. In PNG, women are more heavily involved in vegetable farming and selling, than cash cropping, however, women in Dagua contributed substantially to cocoa farming, as women do in cash crop production elsewhere in PNG (see Curry *et al*., 2007 and Koczberski *et al*., 2001). Although women generally do not own the cocoa blocks, they participate in tasks such as block cleaning, digging planting holes, planting cocoa seedlings, grass slashing, pruning, harvesting and selling wet-beans. During focus group interviews most women reported that they assisted with cocoa work because it was the family's main income source. Some expressed that since their husbands lacked some cocoa production skills, they had to step in. For example, Jacinta described how she assisted her husband:

> My husband, since his youth, has been away from home for a long period of time, schooling and working in other provinces. He was not working with cocoa in those provinces and does not know how to cultivate cocoa. When we planted our cocoa block, I taught him how to plant, prune and harvest. Now he knows how to do it. I grew up with cocoa and have learned how to do these activities.

Many other women in migrant and landowner communities shared the same experience as Jacinta. Other women stated that they let their husbands do all cocoa work while they concentrated on the house chores. The concept of labour payments for migrants and landowners was similar. It is important to note that labour value in the economy, especially for smallholder rural farmers, is not strictly defined in economic terms but is also shaped by socio-cultural factors, including relations of kinship (Curry & Koczberski, 2012). For labour hire, different groups have their own rates but often there is flexibility where negotiations can be made to have part of the payment done by providing a substantial meal to the hired group before or after the completion of the task. Hire price for a group could range between K20.00 to K80.00 per day depending on the type and size of group, the type of work to be done, and whether food was also included or not. Similar rates for hiring groups was reported by pineapple farmers in Bena in Eastern Highlands province where pineapple farmers hire groups for K50.00 per day of work (Inu, 2015:139). Labour provided by families or friends would often be compensated with a meal with the understanding that labour will be reciprocated later on, as is the cultural norm. This norm is also reported in other parts of the country, including amongst cocoa farmers in ENBP and ARoB (Curry *et al.*, 2007; Lummani, 2006).

Because of no banking services in the community those wishing to save their money in a bank must travel to Wewak. In Dagua, personal money raised from sales of garden produce, cocoa, coffee, coconut or betel nut is used to finance small business ventures. However, amongst the migrants, remittances from children or siblings in Kimbe and other parts of the country are an important source of cash to maintain livelihoods or start small business projects.

Savings are important features of being financially secure or having a safety net in situations of vulnerability. From the focus group discussions, almost all migrants and landowners stated that they did not save money earned from cocoa mainly because they did not have access to banking services and due to lack of information access and distance to Wewak. Only a few saved by either locking the cash away in their homes or depositing it in the bank when in town. However, those who saved agreed that savings did not last long in the bank as the money was often withdrawn and used as needed.

Cash earning activities

In the early 1990s, people were engaged in cocoa and coconut, however, these were not so popular and dominant cash earning activities within the broader agricultural system of the area, including the Dagua area (see Allen *et al.,* 2002:21). Cash earning activity increased through the 1990s and 2000s with the rise in cocoa production in the Dagua area, and with the vanilla boom of the early 2000s, when a kilogram of cured vanilla beans was selling for K800 (Allen, 2018). Through the 1990s, the scale of long-distance betel nut trading also increased, with betel nut buyers from the highlands visiting coastal areas of East Sepik, including Dagua, to buy the nut (Sharp, 2012). People at Dagua also earn small amounts of money from the sale of fresh food. The community market, apart from the school market, is the main place farmers sell their produce including bush meat, smoked fish, fruits, nuts, and vegetables. Sellers and buyers also come from neighbouring villages of Kotai, Smain, Woginara or Sapuain. Sellers who wish to sell their produce at the market in Dagua arrive a day earlier and stay with friends or relatives in Dagua to sell their produce the next day. The market opens as early as 5 am and lasts for only an hour and a half every Saturday morning. This early morning routine is done because this market venue is along the roadside located on the junction of the Aitape-Wewak highway, and the exit road to Woginara and Sapuain (see Figure 4.5). By 6:30-7:00 am the road is clear for vehicles to use and no more selling is conducted there until the following Saturday. Unsold food items are taken back home for family consumption, or for those who travelled in – food items not sold are given to families in Dagua. People from Dagua less frequently sell produce in Wewak, if they have surplus to sell. Travel to town is expensive and people prefer to travel there when they also have other activities to do there. A small number of households earn cash from operating trade stores, selling trade store goods on the roadside, sewing clothes or selling kerosene.

The cash income is used to purchase store goods such as soap, salt, sugar, rice, tinned fish, tinned meat, flour, chicken, fresh meat, oil, batteries, matches, cigarette lighters, clothes, and other personal items. The cash earned is also used to pay school and hospital fees, and transport. Cash is also today important component of meeting social obligations such as for marriages, mortuary expenses and compensation payments.

Land

Migrants are settlers and do not have full ownership rights to the land. All land belongs to the landowners. According to the agreement between Simogun and the landowners, the migrants are allowed to use the land, however, they are not able to establish permanent settlement on

the land or to use the sago patches in nearby swamps. According to the Urip ward councillor the initial arrangement was intended to be for a short duration: that is, once migrants had acquired farming skills, they were to return to their homes in the mountains to develop their community. This, however, did not occur, and migrants are uncertain about whether they will need to return to their original home areas. Moreover, migrants had not appointed or agreed on a lead clan within the clan groups to be responsible for migrants' settlement issues. This has caused uncertainty in their settlement and a feeling of insecurity. A key informant in this study, Peter, son of a senior migrant who also contributed to this thesis but passed on before this thesis was completed, described how he made payments to landowners during his father's funeral.

> My father was living in Kimbe until the time of his death. I buried him at Urip. Before I could do that, I had to pay the landowners K1000, and a huge live pig. This is to get permission from the landowners to bury my father at Urip, and to pay respect to their authority. I am just a land user; I cannot just go and bury my father anywhere I want (Peter, 2023).

Peter's story highlights the struggle migrants endure. Migrants have to seek permission to harvest sago, expand homes, collect timber from the forest or access additional land to grow crops. Landowners, in contrast, do not go through these stressful experiences. One of the strategies to access land is social and kinship relationships.

Significance of kinship and social networks in accessing land

Relationships and associations between households, clans, and migrant and landowners are significant in the livelihoods of Daguans, as they are throughout PNG. A number of clans make up the Urip community; however, no one clan is dominant. For example, although the Topokinem clan was instrumental in moving the migrants to Dagua through Simogun, it cooperates well with other clans living with it in Dagua as they were allies back in the mountains during times of tribal warfare. And so, this makes the Local Level Government system important for those in the Urip community because the ward councillor is perceived to be the ultimate authority in the community, with whom everyone must cooperate. Landowners distributed land to the migrants by clan. That is, some migrant clans were grouped together and allocated portions of land on one side of the now Wewak-Aitape Highway, while others were allocated land on the opposite side of the highway. The migrant clans were given permission to only use the land, and resources such as sago palms on that particular land still

belong to the landowners. To harvest sago, migrants had to seek permission from the landowners. When migrants engaged in cocoa production, land occupied by each family became crucial for their livelihoods. A sense of semi-privatization of the land emerged leading to each family managing the land as if it owned it but with the understanding that ultimately they were just land users, not owners.

For migrants, there are two key considerations. First, land access and livelihood security depended on cultivating strong relationships with landowners. This is done through intermarriages, friendships or community group activities such as sports groups and church groups. Second, maintaining strong bonds amongst themselves is crucial in addressing common livelihood issues such as limited access to land within their community. This is also done through friendships or intermarriages between the clans in Urip.

Intermarriages between migrants and landowners played an important role in establishing and strengthening ties between families and clans. Though not coerced, marriages between daughters of migrant families and sons of landowners' families are welcomed by families on both sides. This helps provide access to resources like land for the bride's parents and siblings. For migrants, with ongoing land insecurity, and limited access to resources, marriages play significant roles in building bonds and relationships between people. Such bonds have become important during situations of vulnerability, such as the income shock faced when CPB struck.

Family and clan relations

Family and clans are significant in people's identity and bring a sense of belonging. Individuals identify as belonging to a clan group and have allegiance to that clan. This is an important attribute because it helps individuals acknowledge structures and values that exist within their clan and how these relate to other clans in the community. The migrants had several clans back in the mountains which identified separately from each other. However, in Dagua, they stuck together as a group and did not settle with people they traded with. Clan identities and allegiances within the migrant group are considered of limited importance – more important is their shared identity as *'outsiders'* with no land ownership rights. Land allocated to individual families and households is crucial in ensuring members of these units access land to build homes and cultivate crops. The context of landowners is slightly different. Landowners have lead clans and sub-clans to which they establish their identity and allegiance, and this gives them the right to access land.

In sum, there are many similarities in the livelihoods of both groups. Moreover, social and economic challenges of development remain similar to many other parts of the country. However, access to land remains the key factor determining many of their livelihood activities.

Key differences in landowner and migrants' livelihoods

Land access

Land access is the key differentiating factor between migrants and landowners. Land in the Dagua area is controlled by patrilineal clan groups. Makopin landowners have two head clans Megigebus and Sobrumun, with a number of minor sub-clans including Mirebus, Bariakibus and Sekeribus who have control over land. Likewise, Sibugen-Maguer have two head clans, Segir and Rimrim and key sub-clans such as Anipinem, Wakibus, Debashomibus, Kotagribus, Yenebus, Jebinebus, Kuajumemibus, Juaribus, Biomi, Atrihimi and Jirokinibus which control land on the Sibugen-Maguer side. Although land is controlled by patrilineal clan groups, not all members have equal say over the use of the land. The first born sons have a large say on how land is subdivided amongst male siblings. This gives lesser power to subsequent born siblings. Men also have limited rights to use land belonging to their mother's clan. The death or long-term absence of a clan leader also creates disputes around clan leadership. Members of the landowning clan groups resolve this by negotiating amongst themselves on how resources are used. Although some disparities amongst landowners exist, on the whole landowners have sufficient access to land to support their livelihoods.

More limited access to land amongst migrants constrains their capacity to adapt to the stresses they face, as will be discussed in relation to their responses to CPB (Chapter 6). Furthermore, migrants wanting to use additional land for private purposes or community development initiatives must first obtain approval from the landowners. There are no strict rules or formal processes by which approvals are obtained, and as such, approvals can take a long time. Often delays in decision-making reflect internal conflicts amongst landowners themselves, and this may be caused by factors such as contestation over clan leadership. For landowners, those from the main clans would usually have the liberty to use land in whatever way they wish, while members of minor clans do not enjoy that liberty; rather, they are allocated land portions by the head clans.

Building on the description of the migrants' settlement history given in Chapter 4, the consequence of having no formal agreement between the two communities is a major concern

for migrants, and many migrant families expressed concern about the future of their children in Dagua. Families stated that land is the key resource by which land-based resources like cash crops and forest products can be accessed to maintain livelihoods. Without secure land tenure their hopes of a better living remains uncertain.

Differential access to land is central to understanding differences in the livelihood strategies of migrants and landowners, and their approaches to livelihood decision-making. Below I describe differences in key livelihood activities between the two groups in respect to differential access to land. I also described key aspects of this relationship and why migrants see it as important to maintain harmony with landowners.

Landowners have good social connections that extend to the east, west and south to communities including Woginara, Sapuain, Smain, Kotai, Dogur, Salami, Boikin, and Ulau in West Sepik Province. Landowners have strong social bonds amongst themselves, which they utilise to assist them meet social obligations such as contributions to bride price, mortuary obligations, and school fees and to obtain labour for clearing fallow vegetation for gardening. Migrants' social connections, by contrast, do not extend much to the surrounding communities, yet they have strong social ties amongst themselves, reinforced by family connections, and common beliefs, values and norms. They are therefore much more dependent on local relationships (amongst themselves and with local landowners) than landowners who have more extensive relationships that extend beyond the local community.

Migrant women's marriages to the landowning groups is an important long-term strategy for migrants to maintain access to land and land-based resources such as building materials and fishing grounds in Dagua.

Marriage was encouraged by the Mountain Arapesh people as a means to form new contacts with people from coastal villages (Mead, 1938. pp. 330-331). According to Mead, these marriages not only provided the disadvantaged Mountain Arapesh people with access to resources from the coast but also for the safety of their young women from sorcery. These past intermarriages brought connections between the coastal and Mountain Arapesh people. Mead described intermarriages between the two groups as not only bringing individual households together but also the clans and those associated with the clans. The present generation has maintained this practice as it was important for survival. Migrant women played an important role in this because by marrying landowner men family ties were

established and resource access strengthened. In 2017, Manuel, an elder from the migrant group recalled:

> Our fathers married women from Sibugen-Maguer, Makopin and the neighbouring village Dogur. These are the landowners of Urip, and so when our parents bore children, these children brought peace.

The situation for men marrying into their landowner host lineages is much more precarious, with such men and their male descendants at risk of losing land rights in both their host lineages and their original birth lineages. As Curry (1994. pp 163-164) reported for the Wosera Abelam:

> An in-marrying male is dependent on the patriline of his wife's brothers for resource access. It is said disparagingly of such men: "*man bai kamap olsem meri, na meri bai kamap olsem man*" - which refers to the reversal of the conventional practice of women joining their husbands' patriline, and also implies, that like women, these men have no claim to land. … The children of such a marriage live with their MBs [mother's brothers], the next generation with their FMBs [father's mother's brothers], and so on … After several generations the agnatic rights of the immigrant patriline lapse in the subclan from which they originally migrated. Thus, they are in a double bind of insecure tenure in their host subclan and also in the subclan from which they hailed…

Intermarriages ultimately strengthen social bonds. And so, it is important that potential partners are scrutinised by family members from each side right from the beginning of the courtship. Under the patrilineal system of customary land tenure, male children born in a marriage between migrant females and male landowners are entitled to inherit land. Female children also have some claim, though not as strong.

When asked if intermarriages benefited the migrants, Manuel replied:

> Yes, intermarriage is a common practice. This is when the father-in-law shows the son-in-law or daughter-in-law where to use the river, or harvest sago. He also shows him or her where to fish or hunt on landowner's land.

Intermarriages establish ties between the husband's and wife's families. These ties ensure migrants have access to land to cultivate gardens, and cocoa blocks to harvest from. Migrants also make use of these linkages as safety nets to obtain financial assistance to meet social obligations and other expenses. In communities riddled with stress and conflicts, marriages play significant roles in building bonds and relationships between people (James & Paton 2015:213).

Migrants treated cultural obligations as important, especially with landowners. When asked if migrants positively participate in activities organized by landowners, Manuel, a migrant, responded:

> Yes, we do assist the landowners. We help with compensation, marriage and death ceremonies, and other ceremonies. We also go fishing together. We also participate in big *'singsings'* [singing festival], celebrate big yam harvests. Generally, we help the landowners.

Manuel was alluding to the fact that social stability and good relations were an important factor in maintaining bonds with landowners. According to migrants, maintaining peace and harmony were important strategies to maintain land access, because disputes with landowners could result in them losing access to land.

Another factor that disadvantages migrants is Local Level Government (LLG) politics. Landowners have two ward councillors while migrants have one. The migrants' ward councillor revealed that when it comes to discussing land use planning proposed by migrants on portions of land allocated to migrants, landowners have the upper hand in decision-making. Projects such as a community hall, road expansion and water supply were difficult to implement because permission has to be sought from the landowners, who usually have land conflicts amongst themselves and therefore do not give priority to migrants' requests. Migrants would not protest over this as doing so would compromise their land security.

Another compromising situation for migrants in local politics is the election of leaders in the National General Elections. Migrants' voting patterns are often influenced during elections. For example, during the 2017 campaign period, landowners had their preferred candidates and migrants had theirs. However, some migrants unwillingly showed support to candidates favoured by landowners. Migrants did this to avoid confrontations with landowners that may result in threats to land security.

Agricultural intensification

A clear difference between migrants and landowners is in their levels of agricultural intensification prior to the CPB incursion (intensification practices adopted by migrants after the CPB incursion are discussed in Chapter 8). Prior to the incursion of CPB there was some existing evidence of agricultural intensification in the migrant group, much less so amongst landowners. This can be attributed to land pressure. When migrants moved to Dagua they occupied small land portions. Key intensification practices that differentiate migrants from landowners are: (1) their choice of crops; (2) a single garden area with all crops planted in a fixed area of land; (3) shorter fallow periods; and (4) intercropping of leafy vegetables, fruit and nut trees are mostly in the blocks, house gardens and around homes for food, income, shade and to assert land claims over their allocated land portions. Each is discussed further below.

Migrants planted perennial crops on their allocated land portions and around their houses. These included black palm, sago, betel nut, breadfruit and fruit and nut trees, as well as cocoa, coconut and Robusta coffee. These are perennial crops, maintained over extended periods of time. As well as being an economic resource, they importantly stake 'ownership' over the land portions migrants had been granted and also serve as property boundaries between households. Households without perennial crops are regarded as lacking vital resources to maintain food supply or cash income. Migrants are also more likely than landowners to cultivate small mixed food gardens close to their houses with crops such as Aibika, corn, aupa, banana, pumpkin, peanut, tobacco or sugarcane.

Garden segregation refers to whether specific staple food crops are cultivated in different gardens (Allen *et al.,* 2002:9). The level of garden segregation clearly distinguishes migrants from landowners. Migrants do not practise garden segregation because it was impossible to do so without access to additional land. Most gardens of migrants are 'mixed cropping'. Landowners, on the other hand, are able to segregate their annual food gardens from perennials because they pointed out that food crops cultivated together with coconuts, betel nut or cocoa have poorer yields. An added advantage for landowners is that they have additional land available to trial out new crops. For instance, when rice was re-introduced into Dagua from Maprik in 2016, each landowner was able to cultivate half a hectare of rice. This was not possible for migrants because they had much smaller areas of land.

Another key difference between the landowners and migrants is the length of garden fallow periods. Landowners have one cropping round, followed by a fallow of up to 10 years before re-use of that land. After fallowing the regrowth would usually comprise thick bushes, crawling vines, and young, tall woody trees. Most of the landowners' gardens are cultivated in secondary forests, and rarely under coconut stands or cocoa trees as is the case of migrants. Migrants, in contrast, tend to have multiple cropping rounds (longer cultivation periods) and shorter fallows of less than 5 years for those who have access to larger portions of land for food gardening. The fallowed land is covered with tall grasses and shrubs before it is recultivated. For migrants with smaller portions of land fallow is not obvious because garden produce was obtained from the house gardens around homes where land was rarely left to fallow. In addition, there is continuous planting and harvesting of crops in cocoa blocks. In other words, land on which cocoa is planted is rarely fallowed, but continuously cultivated with a variety of crops in small quantities. After one crop is harvested a shorter period of less than a year is given before the same land is replanted with another crop.

Intercropping was also practised to maximise output from same land area. For migrants this was crucial because of their much smaller land holdings. So, strategic decisions had to be made on the type of crop to intercrop. It is also a useful adaptive strategy to maintain food supply and earn cash income (Koczberski *et al.*, 2018; Koczberski & Curry, 2005). Intercropping also occurs as a strategy to infill gaps created when cocoa trees die. The gap may be filled with another cocoa plant, if available, or other crops such as banana, sago or betel nut. Migrants also typically plant small patches of other crops such as, Aibika*, tulip, aupa, karakap, pitpit,* cassava, Singapore taro, sweet potato pumpkin and long bean in their blocks. When new cocoa seedlings are not available for replanting, migrants are quick to replace dead cocoa trees with other crops that are of market value. Food and income earned from this practice are attractive; however, this reduces the number of cocoa trees in the block. By contrast, landowners are often slow to fill gaps in the cocoa block left by dead trees. This results in weeds taking over.

The use of intercropping also signifies other differences between migrants and landowners. Two important ones are the use of economic trees to provide shade for cocoa, and markers for landownership. Migrants use more economic food crops as shade trees for cocoa, to extract more from the limited cultivated land area (Plate 5.2). Crops used include coconuts, betel nut, bananas, fruit and nut trees rather than other shade trees which they perceive to have limited direct economic value (Table 5.2). Although Gliricidia and Leuceana are popular as shade

trees, the disadvantage with Gliricidia is that it needs a lot of pruning otherwise the cocoa becomes over-shaded. Leuceana provides good timber for fence posts and axe handles. The 2017 East Sepik Baseline survey revealed that a higher proportion of migrants opted to replace Gliricidia and Leuceana with crops of direct economic value like betel nut (Table 5.2). For instance, betel nut is in high demand in the community. It is also sold at roadside markets in both communities.[3] The trading of betel nut with highlanders has also encouraged Daguans to plant more. It is an important source of income for migrants. Migrants also cultivate more fruit and nut trees than landowners. These are perennials that continue to provide income for migrants every season. A galip nut is sold for 20 toea and farmers make more than K200 from one tree per season. Mangoes, depending on size, are sold at 50 toea, K1.00, K1.50 or K2.00 per fruit at the school and village markets. Coconut is a multipurpose crop. Amongst its many uses, coconut provides food and water, building materials, material for baskets, oil, medicine, brooms, mats, eating utensils, crafts and decorations. Table 5.2 also indicates that landowners still maintain Gliricidia, Leuceana and bush trees. Migrants are more likely to cultivate fruit and nut trees to generate a sustainable income than maintain Gliricidia, Leuceana and bush trees.

Table 5.2: Proportion of households using various shade species for cocoa

Shade type	Migrants (%) (n=10)	Landowners (%) (n=17)
Leuceana	10	12
Gliricidia	40	59
Coconut	80	53
Banana	80	59
Betel nut	80	18
Bush tree	0	24
Fruit tree	50	29
Galip nut	50	24
Other (including black palm, sago)	50	24

Source: Adapted from Wewak-ESP 2017 Baseline Survey

[3] Depending on their size, betel nuts are sold for K0.10 – K1.00.

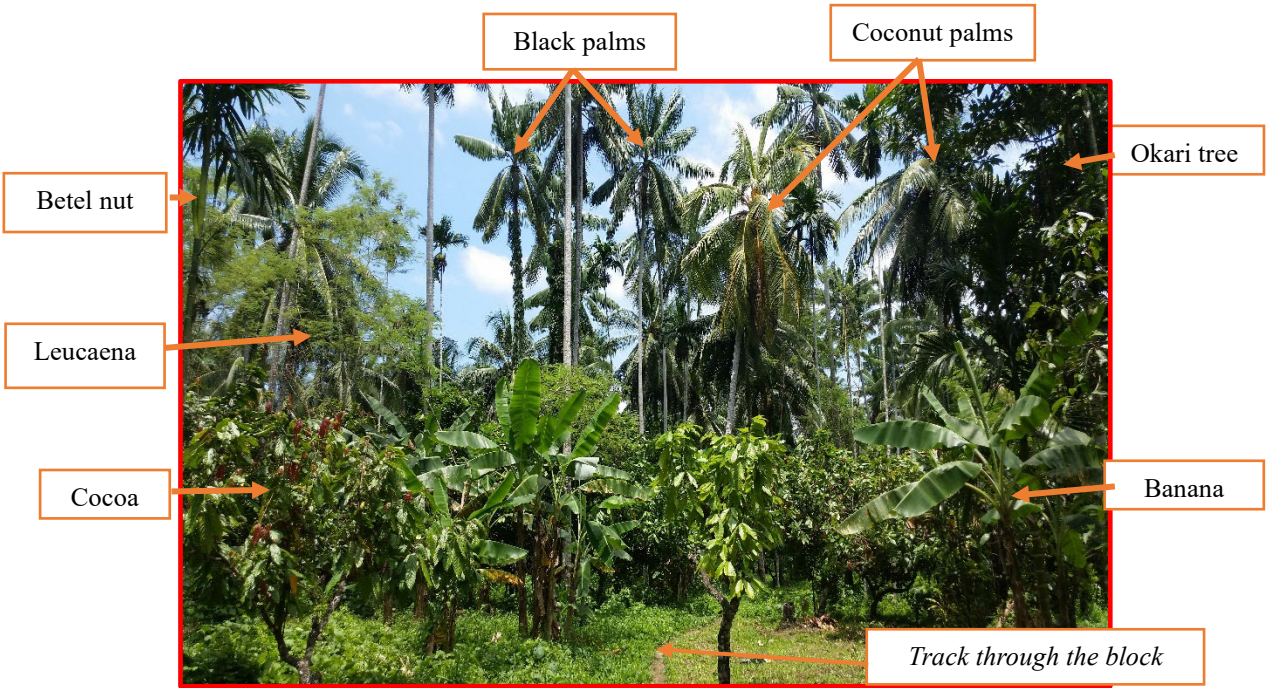

Plate 5.2: Cocoa intercropped with other crops in a typical migrant block.

Intercropping also aids in establishing land access rights among migrant households. This again signifies the benefits of intercropping as a strategy that goes beyond cash income and food production (Vergara & Nair, 1985). Planting perennials helps to demarcate land boundaries or ownership of land. Both migrants and landowners utilize this strategy to affirm land ownership boundaries, and to avoid land conflicts, however, this is particularly significant for migrants. This is because unlike landowners who have land boundaries clearly marked using streams, swamps or boulders, migrants are settled in a big community where boundaries of food gardens, cocoa blocks or home can be indistinct. Disagreements amongst migrants over boundaries are common. So, intercropping perennials in food gardens or cocoa blocks helps establish land ownership.

In sum, prior to the CPB incursion, intensification practices were important for migrants. The key practices distinguishing gardening practices of migrants and landowners related to crop selection, crop segregation and numbers of gardens, length of fallow period and intercropping practices (Table 5.3). Being 'outsiders' with limited land rights, migrants have proactively used these strategies to optimise use of available land resources, to obtain multiple benefits and secure access to land. Landowners, on the other hand, were not under the same pressure to intensify land use.

Table 5.3: Common livelihood differences and similarities between landowners and migrants.

		Migrants	Landowners
Natural capital	*Access to land for food gardening	Poor Limited access to land, settlement uncertainty.	Very good Can use own land or that of their relatives to cultivate food gardens.
	*Fallow period	Unable to fallow or very short fallow	Can fallow for up to 10 years.
	*Crop segregation	Poor. Unable to do so.	Very good. Able to do so.
	*Access to land for cocoa production	Very limited to land currently available to them. Will be problematic when population increases. Have much less land per capita, limiting land-based livelihoods. Benefiting from a relative's block is less of an option because households do not have additional blocks to benefit from, unless they have a daughter married into a landowner group.	Very good Can plant more than one block on own land. Can expand the block. Able to make arrangements for disadvantaged relatives (e.g., widows) to benefit from blocks belonging to other family members.
	*Intercropping in gardens	Yes Most have blocks intercropped with crops of economic value such as coconut and betel nut. Planted and management is better. Higher crop diversity and planting density per unit area of land. High planting density Most also cultivate food crops such as green leafy vegetables, root crops and fruit trees such as pawpaw and bananas. Traditional shade trees like Gliricidia and Leuceana are replaced with crops that have economic value. Few unplanted gaps in the blocks.	Yes Most blocks are intercropped with food crops, fruit and economic trees. Planted but management effort is less. Lower crop diversity and planting density per unit area of land. Low planting density Shade trees, such as, Gliricidia, Leuceana, or bush trees are evident. Many unplanted gaps in the blocks.
	*Access to land to collect firewood	Poor Collect firewood from trees within the block or nearby bushes within the community.	Very good Able to obtain firewood from trees and bushes within the community or the open forest away from the village.
	*Access to clean water	Poor Few have access to water sources such as water tanks, dug-out wells and rivers. During drought access to water is a real challenge.	Good Most have access to multiple water sources such as water tanks, dug-out wells, streams and rivers. During drought access to water is not a challenge.
Physical Capital	Access to roads	Yes All live near main highway (less than five minutes to reach the highway).	Yes Those living near the road take less than five minutes while those further inland

			and in the hills take an hour or so to reach the highway.
	Access to markets	Good Commonly use roadside markets, community markets, and occasionally Wewak market.	Good Commonly use the community markets and occasionally Wewak market.
	Access to government services at Dagua Station.	Very good Less than a thirty minute-walk to the station.	Good Majority take more than a thirty minute-walk to the station.
Social Capital	*Social ties and land	Poor Limited to (i) community itself; or (ii) with neighbouring communities that have migrant populations who originated from Mountain Arapesh area (iii) subject to households' connections with other households for other reasons.	Good Wide and extensive along the Wewak west coast and other neighbouring communities.
	*Marriage ties	Yes A female who marries a male landowner is able to help her natal family access food or cocoa from the husband's side.	Yes Okay for male landowners to marry migrant women but not vice versa.
	Migration *(Intentions for movement varied)*	Evident Intention of many to move to other places was because of better education or employment opportunities. For example, those who moved to Kimbe pursued work opportunities in the Oil Palm estates.	Evident Although some moved to pursue education and employment opportunities, the intention of many to move to other places was to avoid land conflicts, jealousy and witchcraft.
Human Capital	*Highest level of education completed (Table 4.3)	Grade 12 - 8.5% of head of households Grade 10 - 21.3% of head of households	Grade 12 - 2.7% of head of households Grade 10 - 12.9% of head of households
	*Average Household size (Table 4.9)	6.7	6.4
	Cocoa husbandry skills	Farmers possess basic husbandry skills. Low input farming practices maintained.	Farmers possess basic husbandry skills. Low input farming practices maintained.
	*Decision for crop choices to cultivate	Under pressure to decide the types of crops to cultivate.	Not under pressure to decide what crop to adopt
	*Political representation	One councillor	One ward councillor per community
Financial Capital	Access to banks and credit Remittances	Majority do not have a bank account. Important source of cash to maintain livelihoods or start small business projects.	Majority do not have a bank account.

*Key areas of difference

Conclusion

To avoid a state of vulnerability, migrants utilised resources available to them to enhance their adaptive capacity. The key factor explaining the differences in agricultural practices between migrants and landowners is land access. When migrants first arrived in the area they were allocated fixed portions of land to settle and farm without agreement to acquire additional land. Having limited access to land, migrants developed agricultural intensive approaches to cultivate food gardens at the same time cultivate cocoa, coconut, peanut, rice and coffee. The crops planted played multiple roles such as to raise incomes, add to household food supply, provide shade for cocoa, and to assert land 'ownership' claims. Migrants also reduced fallow periods, extended the cropping period, limited segregation of their crops, and adopted useful intercropping practices, all of which was about using land more intensively than landowners. Agricultural intensification practices and social cohesion were key strategies used by migrants to ensure food and land security.

Migrants also had to invest in good relations with landowners. This was important for maintaining and securing land access. Their limited access to land has also led migrants to maintain strong social cohesion amongst themselves. Unlike landowners, who have social connections and ties with neighbouring villages, migrants would keep to themselves, and so their social networks were truncated with a much more local focus compared with landowners. This would prove crucial when CPB arrived (Chapter 6). Migrants also value and cultivate their connections with their relatives in Kimbe. These relatives have continuously supported their families in Dagua, largely by sending remittances.

Women from the migrant group who marry men from the landowner group provide the opportunity to create social ties with both parties, and these become useful for the migrant family to have access to land and other land-based resources. This is an important strategy, and women are encouraged to marry landowners. Girls from migrant families who are in school are also encouraged to work hard and earn their living elsewhere in PNG to avoid the challenges faced by their families in Dagua.

In conclusion, livelihood adaptation practices by migrants and landowners of Dagua, prior to the incursion of Cocoa Pod Borer (CPB), were similar to migrant groups elsewhere. For example, migrants tend to intensify and diversify their income sources (Koczberski *et al*., 2012: Bue, 2013:106) or invest more in education than the local inhabitants (Nawrotzki *et al*., 2012). However, the context for migrants and landowners differed from many other places

because their migration was from one rural area to another with no formal land agreement, which places the migrants of Dagua in a disadvantaged position. And so, they had to develop long-term adaptive strategies that shaped their livelihoods (Table 5.3). These were displayed in the way they interacted with the landowners, and how they managed the portions of land allocated to them for cocoa farming. Migrants also maintained strong bonds amongst themselves as a safety net in times of need. Strategies employed by the migrants of Dagua in response to CPB are further discussed in chapters 7 and 8.

In the next chapter I discuss the intrusion of CPB and its impact on cocoa blocks, incomes of cocoa farmers and on socio-cultural obligations.

CHAPTER 6

THE IMMEDIATE IMPACT OF CPB AND INITIAL LIVELIHOOD COPING STRATEGIES

Introduction

In the preceding chapter I discussed key livelihood differences between migrants and landowners and highlighted the significance of cocoa income in their livelihoods prior to the incursion of the Cocoa Pod Borer (CPB) pest. In this chapter I present findings on the impact of CPB on cash income and the initial livelihood strategies households developed to cope with the financial shock experienced. I argue that the differences in migrant and landowner livelihood assets led migrants and landowners to pursue different coping strategies. I also argue that while migrants were hard hit, they developed a range of strategies to cope with the shock. These were driven both by economic necessity, ensuring they maintained some finances through the crisis, as well as being socially motivated by the need to maintain good relations and live harmoniously with the landowners. I argue in the chapter that most of the livelihood strategies utilized by migrants were drawn from their livelihood circumstances prior to the CPB period, discussed in the preceding chapter.

I reveal in this chapter that the impact of CPB on incomes was similar to the CPB impacts reported for cocoa farmers in East New Britain during the initial onset of CPB there in 2006, where incomes declined drastically and livelihoods were significantly disrupted (Curry *et al*., 2011). In the chapter I examine coping strategies of landowners and migrant settlers immediately following the CPB incursion. The focus on the differential impact of CPB on a landowner and migrant population within a community, and their differing vulnerabilities, resources and coping strategies, distinguishes the present research from the research undertaken on CPB in ENB where there were fewer stark differences within the communities in terms of land access. In this study, land access and land tenure security, were key factors that distinguished impacts and responses by migrants and landowners during the epidemic and led to substantively different strategies being adopted by the two groups.

In the chapter I first describe the general CPB impact on household income and the immediate response by farmers. Cocoa growing households were asked about changes in their livelihood communities following the CPB impact, along with detailed interviews exploring the reported changes. Health workers, teachers, agriculture officers, and village court magistrates in the

community were also interviewed to provide an overview of the impact of CPB on how people accessed government services in the community. Community leaders and village elders also provided information on how the pest impacted on the community as a whole. The rest of the chapter discusses differences between migrants and landowners in relation to the CPB impacts on families, community, business, education, health services, social fundraising activities, family support systems and finally some law and order issues in the communities. In this chapter I set the context for discussions of block management responses in Chapter 7, and longer-term adaptation strategies in Chapter 8.

Impact on household cocoa income

I proceed in this section to describe the general impacts of CPB that were experienced by migrants and landowners. Most of these impacts were similar to those experienced in ENB after the arrival of CPB. First of these is income losses due to the decline in the sale of cocoa beans both in terms of quality and quantity. This produced a shock and farmers were not sure how to respond. For most people the shock caused a feeling of misery and hopelessness. Many made comparisons to experiences encountered in previous shocks, such as the impact experienced from the fluctuating prices of copra that occurred at various times in the 1970s, 1990s and 2000s. According to farmers, low and unstable prices had led them to pay less attention to maintaining their coconut palms and concentrated on other livelihood activities such as Robusta coffee, vanilla and cocoa. Vanilla, in the early 2000s could fetch growers more than K900 per kilogram in East Sepik, however, this too declined significantly towards the end of the decade, and at the time CPB struck few farmers were growing vanilla in any significant volume. Since cocoa was earning better income for farmers, most farmers in Dagua had become dependent on cocoa income for many years.

The arrival of CPB and the drastic fall in income was a disaster for families. For migrants, this was a critical failure in livelihoods as cocoa was the key income source for all of them. When CPB struck, the incomes of both migrants and landowners declined dramatically. For migrant farmers, their calculated average annual cocoa income dropped from K4446 prior to CPB to K270 following the arrival of CPB (Table 6.1). Landowners' average annual income from cocoa dropped from K5775.10, to K324.50 after the CPB incursion. This is similar to the decline observed in cocoa production and incomes following the arrival of CPB in East New Britain where Curry *et al*., (2009:21) documented crop losses of over 90% amongst the sample of cocoa holdings in 2008.

In Dagua, both migrant and landowner households were not able to harvest and sell quality beans. Farmers reported they were harvesting fewer pods off each tree each harvest and were harvesting less frequently (see Table 6.1). In desperation to obtain cash most farmers turned to an extreme 'foraging' strategy where they walked through the grass and trees to harvest any healthy pods they could find (G. Curry, pers. comm., 2023).

Cocoa harvest greatly declined when CPB struck. Farmers were asked to provide information on the harvest rounds per year, average number of pods harvested per tree, weight of wet beans harvest and amount earned. Since farmers do not keep written records of their harvests and income earned, data provided were from what they could recall.

Table 6.1: Reported cocoa harvests and estimated earnings, before and after CPB incursion.

	Migrants			Landowners		
	Pre-CPB	*Post-CPB incursion*	*% diff.*	*Pre-CPB*	*Post-CPB incursion*	*% diff.*
Average number of harvests/year	26.0	11.5	-56	25.0	11.7	-53
Average number of pods harvested/tree/harvest	14.0	3.0	-79	12.9	2.9	-78
Avg. weight of wet bean (kg)/harvested	95.0	8.0	-92	123.4	9.6	-92
Avg. income earned/harvest (Calculated at K1.80/kg pre-CPB, and K1.30 post-CPB)	171.0	10.40	-94	222.12	12.48	-92
Av. Income earned per year	4446.0	270.4	-94	5775.1	324.5	-94

An immediate response to the sudden decline in income was that a majority of the farmers modified their livelihood activities in an attempt to ensure household food supply, and to maintain income. The most common responses were for farmers to sell garden produce, market on the roadside, and seek financial assistance from family living elsewhere. These responses were similar to the initial coping strategies displayed by ENB farmers (Curry *et al*., 2011:52), and demonstrate the resilience of cocoa farming families and their ability develop strategies to cope with impacts of shocks and stresses. It was clear, however, that incomes from these other sources were substantially lower than their incomes had been prior to the CPB period. This is further discussed in Chapter 8.

In the rest of the chapter I discuss the impacts of reduced cash on livelihoods and initial responses of the migrants and landowners. It argues that people modified their livelihood activities to cope with the impact of CPB on their incomes. Specifically, it makes comparisons between the two groups on key aspects related to the impacts on consumption and diet, local businesses, access to education and health services, travel, and law and order issues within the community, and on social support networks.

Impact on diets

A key change evident in both groups was a change in diet. Prior to CPB, all households reported to regularly consume store goods in addition to garden foods and sago. This meant households had access to at least one store food item such as rice, tinned fish, flour, noodles, sugar, coffee or tea in a day's meal. After the incursion of CPB and incomes fell most people in both communities shifted to mainly consuming garden food and sago with store foods consumed in smaller amounts and less frequently (Figure 6.1).

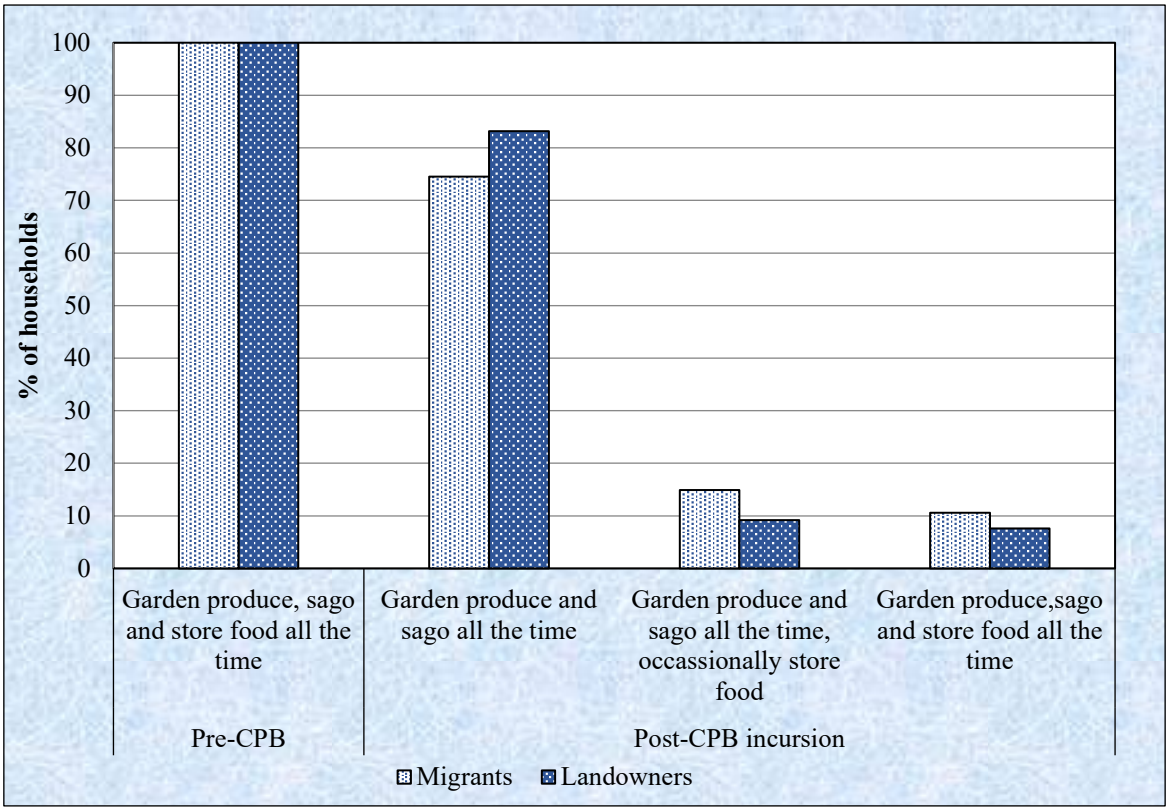

Figure 6.1: Changes in diet before and after the CPB incursion.

Garden food and sago were the key staples for both communities. A higher proportion of migrants continued to include store foods in their diet compared to landowners. This was because the small land areas available to these migrant households were not sufficient to maintain household food consumption from garden produce and sago alone and so they needed to continue to supplement their diets with store foods. Store foods, however, were consumed less often and was dominated by necessities such as rice, tinned fish, noodles, salt and stock cubes. One young migrant male stated: 'sometimes we are tired of eating sago over and over again. We go to the store to buy at least a tin of fish or stock cube to change the taste'. Cash earned from sales of items such as betel nut, fruits and coconuts assisted migrants

acquire store food. Remittances from migrants' families elsewhere in the country, especially Kimbe in West New Britain Province, assisted in maintaining migrants' livelihoods. An elderly migrant widower stated: 'I always eat garden foods and sago. I eat store foods when my son sends me money' (SH #200, 26/03/16). A migrant male stated: 'Sometimes we sell garden foods and buy store foods' (SH #196, 1/04/2016). Another said: 'I get store foods on credit basis and pay later when I have money' (SH #112, 12/04/16). According to migrants, they were able to maintain purchases of trade store items, unlike landowners who were not purchasing much from the store, rather resorting to sago and garden food to maintain household food supply.

A major difference was found in the consumption of sago – the staple food of Daguans. The study reveals that more landowners (83.2%) ate sago after the CPB intrusion than migrants (74.5%). Landowners had free access to sago palms. The palms were either cultivated or grew wild and are located on large patches of swamp lands located between Urip, Sibugen-Maguer, Makopin, Woginara, Kotai, Dogur, Smain and the coastline. Migrants, on the other hand, had no access to the sago palms on these sites. Most of the sago consumed by migrants came from the limited palms on their blocks. They also purchased sago from the local market or Wewak. Family connections through intermarriages also provided opportunities for migrants to source sago from landowners. This suggests that landowners were under no pressure to maintain household food supply because sago was readily available. Migrants however, had to draw on other resources such as gardens surrounding the houses, and food intercropped with cocoa, to maintain household food supply at homes. While sago was consumed by both migrant and landowner households, migrants were clearly consuming much less of it compared to landowners. Generally, both groups were impacted by the financial losses caused by CPB and reached out to food sources accessible to them to respond to the shock faced. Landowner's adaptive capacity was latent, meaning the resources were available however, not fully utilized prior to the CPB incursion. Migrants, in contrast, reorganized the use of existing resources to cope with the impact of CPB.

Impact on people's mobility

The impact of CPB on people's cash income also impacted the frequency of people's travel to and from Dagua. Participants were asked how frequently they travelled to Wewak before and after the incursion of CPB. All participants agreed that prior to CPB, when they had greater access to money, they were able to travel more frequently to Wewak. Based on this, Likert-type categories were used to help participants compare the number of times they travelled

before and after the pest incursion. The scales were: *Regularly* (more than two times per week); *Often* (once per week); *Sometimes* (once per month); *Rarely* (once every three months); and '*Never'* (do not travel at all) (Figure 6.2).

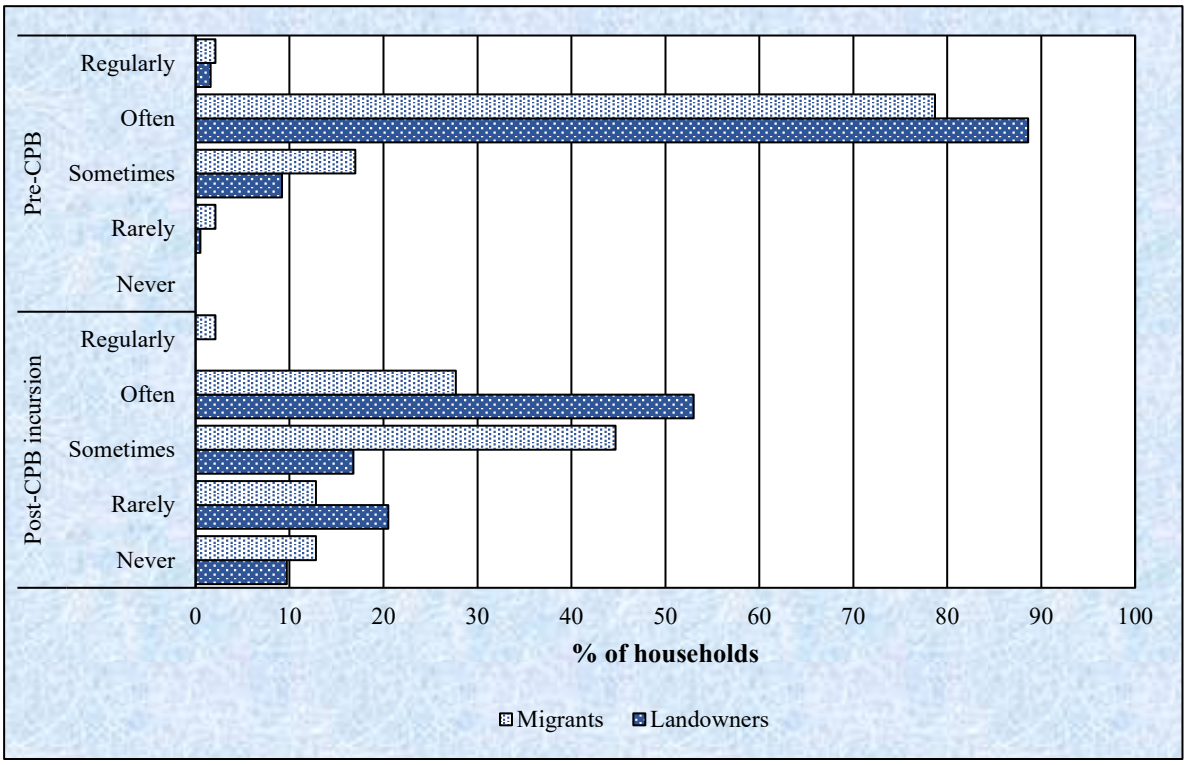

Figure 6.2: Frequency of travel to Wewak before and after the CPB incursion.

Prior to the CPB incursion almost all migrant and landowner respondents had travelled to Wewak at least monthly, with the great majority typically traveling one or more times a week. After the incursion of CPB, there was a decline in the number of people traveling to town. The number of migrants travelling to Wewak dropped. Migrants had reduced the frequency of travel to town more so than landowners because they needed to reserve what little money they had to purchase food, including sago. People only travelled for genuine reasons such as to access services such as health, banking, education, selling garden produce at Wewak market or attending to important social issues such as bride price ceremonies. Apart from not having sufficient cash to spend in town, participants reported that they were unable to pay the PMV fare of K20 (AU$6.74) for a return trip. One migrant male participant stated: 'Our incomes from cocoa cannot help us afford the cost of goods and bus fare of K20' (*SH #22, 25/03/2016).* Another woman also from the migrant group, who sometimes went to town said: '…I no longer go to town. I only go when my husband sends me money' *(SH #193,*

18/03/2016). Another farmer said: 'I don't go into town much. I, however, make use of a family member who goes into town. I give them money to buy stuff for me and bring to me' *(SH #108, 09/04/2016).* This strategy is used by many migrants to save the cost of traveling themselves. Landowners shared similar sentiments; however, many were able to continue to travel. Two of the vehicles in Dagua were owned by migrants. Because migrants were very conscious of maintaining good relationships with the landowners in the area, individuals from the landowning groups were often able to negotiate a reduced PMV fare or to avoid the payment of fares. In general, however, landowners were less dependent than migrants on travel to sustain themselves, with many of the migrant households needing to travel so as to have a means to earn money. The responses by migrants and landowners imply the dynamic aspect of adaptive capacity where other factors such as personal finances together with social harmony with landowners are taken into account when responding to the financial shock.

Impact on local businesses

The decline in incomes within the communities had a major impact on local businesses. Purchasing of trade store goods, as demonstrated above, declined abruptly when CPB attacked. Most households in both groups resorted to only consuming garden foods and sago. While 26% of migrants and 17% of landowner households maintained some consumption of store foods, the amount of store foods they consumed was much less than before the incursion of CPB. Interviews with store owners revealed that the common items sold were rice, tinned fish, noodles and salt. This is because most households were not able to afford other food items they would have liked such as flour, cooking oil, tinned meat and biscuits. Also, migrants stated that sugar, coffee and tea were unnecessary expenses which they only bought if they had extra cash. Below is an example of how CPB impacted on the operations of a trade store.

Charlie, a landowner and store operator, explained that when CPB struck customers were not frequenting his store like they used to. Moreover, the quantities of items stocked in the store had fallen and half the shelves were empty. According to Charlie, many customers sought store items on credit. This eventually affected the cash flow for Charlie's business, resulting in Charlie no longer traveling into town to purchase stock for his store. Charlie had to reduce the number of items he stocked as items such as tinned meat, flour, coffee, milk and milo were selling very slowly. This led him to only stocking items that he was sure he would be able to sell quickly such as rice, tinned fish, biscuits, noodles, salt, oil and stock cubes. Charlie explained that this loss of business has made him unable to meet his family's needs. Charlie

now attends to his gardens too to make a living. Charlie's response to limit the quantity and range of stock was a coping strategy also used by other trade store owners.

CPB also led to a decline in PMV services and a decline in the incomes of PMV owners. During the fieldwork period, only three PMVs serviced the community. These PMVs made money from vehicle hire, passenger fares, and if cargoes were transported to or from Dagua, a fee was charged which varied from K2 to K10 depending on the cargo transported. According to the PMV owners, since the CPB incursion, vehicle hires have declined, fewer passengers were commuting to and from Dagua with reduced cargoes, and passengers were not paying full fares or not paying at all. PMV businesses, as a result, suffered significant declines in income. For example, prior to the CPB incursion the 36-seater truck typically did two return trips and was earning more than K1440 (AU$487), each day. Following the impact of CPB, the truck was only making a single trip, and earnings had more than halved. A PMV driver stated:

> We have no choice. It was not like before where the truck is always full of passengers traveling to and from town and we make money. We do not make much these days. To make up for this I have to stop returning to the village on the same day to make a second trip. I stay back in town and do short trips within Wewak town and the nearby communities. I also have the truck available for hire within these communities. In this way, I am able to collect some money. In the afternoon around 4 pm, I make the return trip home. Also, the condition of the road is very bad and vehicle maintenance is very expensive. The government has really forgotten us.

A major challenge for the truck owners was also the partial or non-payment of fares by passengers from the landowner community. For example, one landowner commuter who frequented town prior to the CPB impact said: 'Sometimes I go to town, but I travel on credit basis in the hope that I pay later on. Sometimes I don't pay full PMV fare' (*SH #195, 15/03/2016*). Another stated: 'I don't have the urge to go into town. If I do go, then I board the PMV without paying' *(SH #109, 09/04).* Young men and women landowners were particularly likely not to pay or under-pay due to their belief that as landowners they should not be forced to pay. This points to their privileged position as landowners over the migrants. It was therefore challenging for migrant drivers or crews to argue as consequences would be a physical confrontation and consequently threats over relinquishing their land back to landowners.

CPB also impacted those running the cocoa fermentaries. Prior to the CPB incursion migrants had few dryers, these are however, no longer operational. Cocoa fermenting and drying was only done by landowners. Issues such as lack of access to firewood existed prior to CPB, however, became the key constraint for migrants in operating a dryer. According to a former migrant fermentary operator, firewood was purchased from landowners because migrants had no access to the forest in Dagua. When CPB struck, it became too expensive to meet the cost of firewood. Other costs that also made it challenging to operate the business are labour costs for purchase and movement of wet beans in the community and transporting of dried beans to Wewak. Migrants fermentary owners therefore opted to forgo the fermentary business and develop other means of supporting themselves such as selling coconuts or betel nuts.

The impact of financial losses on businesses reveals the vulnerable status of the businesses in migrant and landowner communities. Because the businesses were not able to sustain themselves, business owners had to develop strategies to counter the impact of the financial shock. This included scaling down on items sold in trade stores to only the basic necessities, scaling down on PMV operations, and scaling down or abandoning the fermentary business, as in the case of migrants.

Impact on education

The loss of income due to CPB also impacted on the schools in the community, and on the ability of community members to attend school. Education and literacy remain important aspects of human adaptive capacity. The impacts of social, economic or environmental disturbances/disasters on education have been documented repeatedly (de Vreyer *et al*., 2014; Curry *et al.,* 2011:31). Shocks and stress have been shown to impact on children's ability to learn (for example, Rush, 2018; Udmale *et al*., 2014; Mudavanhu, 2014; Conteh, 2015; Hoffmann & Muttarak, 2017; Ryan, 2015). Prior to the incursion of CPB, households were able to meet the cost of school fees. After the incursion, it was challenging for them to meet the required fees resulting in some children leaving school (Figure 6.3).

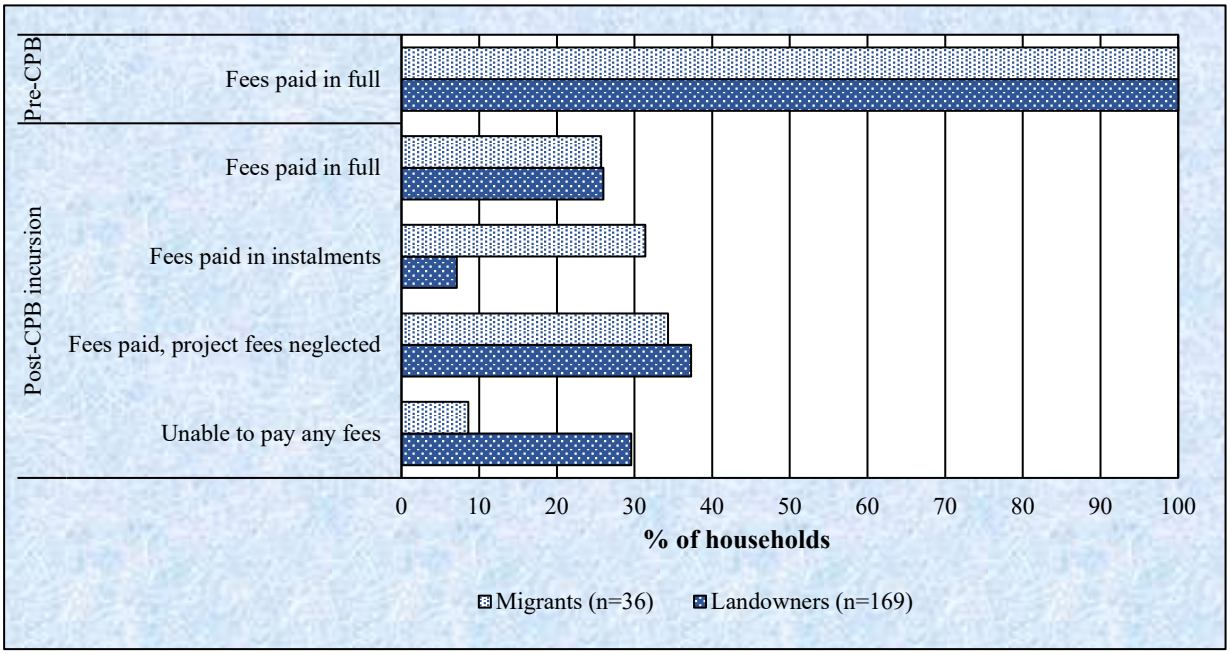

Figure 6.3: Percentage of migrant and landowner households adopting different approaches to payment of fees before and after the CPB incursion.

Declines in income following the arrival of CPB also led to a decline in the ability of households to pay school fees. Prior to the CPB incursion, migrants and landowners had been able to pay their fees in full. During the CPB period, the impact on incomes led to only 26% of migrants and 26% of landowners being able to pay their fees in full. For many migrants, they did this with the help from relatives in Kimbe, Wewak or other towns in PNG. For landowners, a range of land-based resources were utilized to raise school fees. For example, a landowner stated: 'We harvest sago and sell them for K30 per bag. That is how we meet the school fees' *(SH #163, 23/03/2016).* This was, however, only for small portion of landowners.

The majority of the migrants were proactive in paying fees and also approached the school to negotiate how this could be done. A key strategy suggested to the school was for parents to pay in instalments. During their negotiation with the schools' administration team, migrants were careful because the majority of the board members of the school belonged to the landowner group. It was important that migrants presented their request with respect because doing so aggressively could lead to a negative response by landowners and eventually being reminded that they were only settlers and had no right to instruct the school on what to do. When the school agreed to paying school fees through instalments, many migrant parents utilized this to their advantage. For example, 31.4% of migrants opted to pay in instalments compared to only 7.1% of landowner household. A migrant stated: 'School fees are a little

okay because there is a family member working in Wewak. But we do fall short of funds when the school requests that full fees be paid right up front' *(SH #206, 25/03/2016).* Paying in instalments provided flexibility for migrants to source additional funds to complete the payments. Interestingly, a greater percentage of landowners (29.6%) were unable to pay any fees at all compared to migrants (8.6%) leading to children having to withdraw from school. An important reason for this attitude is that there was less pressure on landowners because they had greater access to land-based resources and incomes. Migrants were more likely to think of education as contributing to the families' future livelihood strategy. The example below tells the story of a young student whose education was disturbed because his family were unable to pay his school fees.

Vincent was a Grade 8 student at Dagua Upper Primary school. He left school and now works on the family's cocoa blocks to raise income for his school fees. Vincent explained:

> The lack of school fees was the reason I left school. My father died many years ago and my mother couldn't afford my fees and other school needs. I had to leave our family home inland to come to stay here with my sister and her husband in this part of Sibugen-Maguer, in the hope that I can be assisted financially to complete my studies. However, as I now realize, it is difficult for them to cater for my school needs, so I decided to leave school and stay at home.

When asked what his plans for the future were, Vincent replied: 'I want to continue my education, but I will have to raise money for school fees'. Even though Vincent was taken care of by his sister and her husband, another distant family member opened her home to Vincent. The new family has decided to help Vincent continue his education.

Vincent's story highlights how families, especially from the landowner group, struggled to cope with the impact of CPB, resulting in children being withdrawn from school. Although many landowner households could have sold betelnut, coconut or sago to earn income to pay for children's fees, often they chose not to do so. For migrants, education is seen as much more important to livelihood strategy, with investment in children's education seen as a means to address the livelihood insecurity they feel, particularly stemming from their limited and insecure access to land. Education is therefore pursued more vigorously by migrants. They were proactive and willing to negotiate with the school on how fees were paid. Paying their

school fees in instalments also meant that household income could, when required, be directed to their immediate needs.

The impact and response by migrants and landowners illustrated a dynamic and context-specific ability to adapt. Even though both communities were hard hit, options to cope were negotiated with the school. These lessened the pressure on their financial resources. Furthermore, the options chosen ensured migrants paid some fees in order to not instigate ill feelings with management of the school board, who were mostly members of the landowners group. Landowners, on the other hand, paid some fees, but the majority were not able to cultivate the potential they had to use the land to raise income to pay school fees.

Impact on access to health services

The Dagua community health facility comprises one rural hospital located at the main station and aid posts located in each of the three communities. The aid posts provide free health care for minor ailments while more serious cases are referred to the Dagua hospital. In the past, all respondents reported that they had paid hospital fees in full, however, after the incursion of CPB the payment of hospital fees became a challenge for many families (see Figure 6.4).

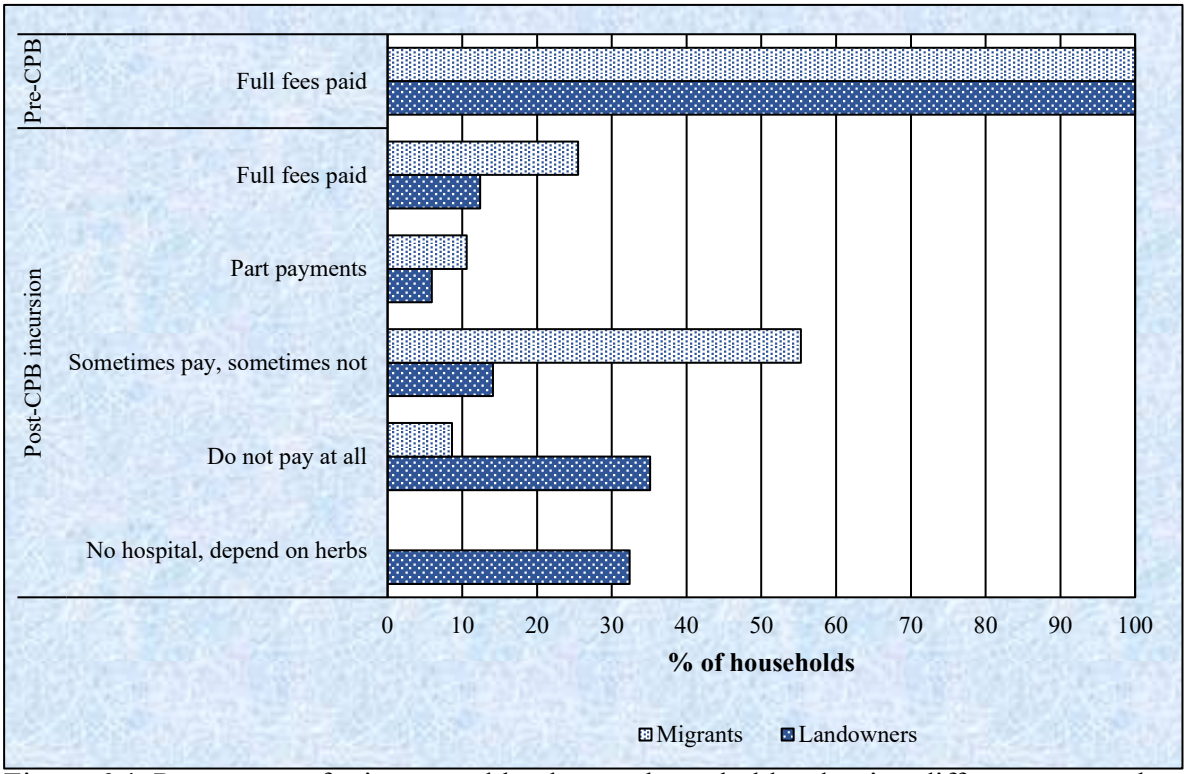

Figure 6.4: Percentage of migrant and landowner households adopting different approaches to payment of hospital fees before and after the CPB incursion.

The loss of income caused by CPB had a profound impact on the way people accessed health services. The outpatient fee per treatment charged by the hospital is K2.00 (AU$0.69) for children and K5.00 (AU$1.73) for adults. For more serious cases a K20.00 (AU$6.92) fee is charged. The hospital fees did not change after the CPB incursion and therefore it was possible to examine people's ability to meet the fees.

After the intrusion of CPB, migrants were more willing to pay hospital fees than landowners. Some migrants opted to make partial payments and others reported that they sometimes paid. Considering the flexible options to pay fees, migrants were more likely to make payments compared to the landowners who were unlikely to pay the full fees. According to the hospital chairman, the hospital staff understood that people's livelihoods were disrupted, and people had limited cash to make full payments. This led some staff to be less strict on payment of fees. While 37% of migrants reported paying either part or all of their fees, only 18% of landowners reported to do so. The majority of migrants (55.3%) reported paying sometimes. In contrast, 35% of landowners reported that they attended the hospital but did not make any contribution. While all migrants reported to continue to use hospital services during the CPB crisis, a third of landowners, for whom funds were particularly limited, no longer sought formal healthcare and instead relied on herbal medicines. Sometimes complications such as miscarriage resulted in death. A woman from the landowner group stated: 'Treatment from the health centre costs K2.00 to K20.00. When the case is serious and there is no money to seek assistance from the hospital, people often lose their lives' (SH #34, 17/03/2016).

Responses by migrants reveal that they were proactive in identifying strategies that would help them to continue to access health services, and to retain funds for other personal or household necessities. For a substantial number of landowners, the availability of bush doctors, herbal treatments at little, or no cost led them to rely on these traditional strategies rather than to attend the hospital.

Impact on cultural obligations and social fundraising activities

Farmers reported a decline in their financial contributions towards cultural obligations and social fundraising activities after the incursion of CPB. Community or family fundraising is often done to cater for cultural obligations such as bride price, mortuary payments and compensation payments, or to meet medical expenses or the financial needs of a women's group or sports club. Financial contributions are obtained from immediate and extended family and other community members depending on the purpose. Cultural obligations are

perceived as mandatory because contributions given are reciprocated in future. It maintains the bond within family and relatives. Individuals have more choice about whether they contribute to social activities.

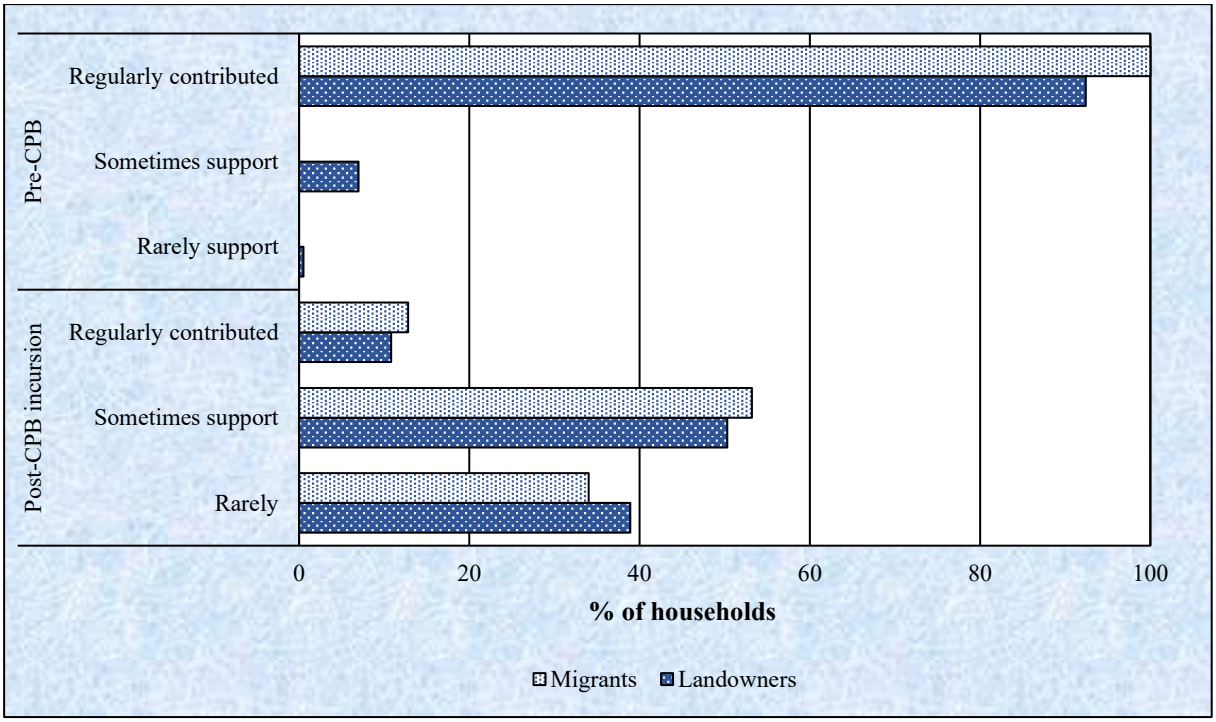

Figure 6.5: Percentage of migrants and landowners and the regularity with which they make contributions to customary obligations and fundraising activities before and after CPB incursion.

The vast majority of the farmers from both groups reported that prior to CPB they regularly contributed funds to customary obligations and to fundraising activities. This trend changed after the CPB incursion, with only 11% of landowners and 13% of migrants continuing to contribute financially on a regular basis. About half of the farmers in both groups report to make contributions 'sometimes'. Migrant farmers were slightly more likely than landowners to make more regular financial contributions, though the differences between the two groups was minimal. People reported providing financial support when money was available. Both groups of farmers also reported that they were more selective in activities that they contributed to. They also expressed that the amount contributed was lower compared to amounts they typically gave prior to the incursion of CPB. A respondent stated: 'Prior to CPB we contributed amounts such as K5 but now we are giving less than K2' *(SH #110, 11/04/2016).*

Responses by migrants and landowners illustrated an adaptive capacity where the normal practice of contributing at a particular scale, and the amount contributed at that scale was

readjusted. For migrants, being very selective of the type of activities they contributed to was important so that their financial resources are not completely depleted. In addition, despite their situation of cash scarcity they still had to contribute to cultural obligations and fundraising activities of owners of the land they are settling on. These responses are examples of dynamic, scale-determined and context specific adaptive capacities of smallholders.

Impact on the family support system

The fall in incomes also impacted on how families supported extended relatives financially. This is discussed from the gift perspective, following Curry & Koczberski (2012), who describe its significance in social identification, relationship building and maintenance, and reciprocal dependence between transactors. All migrant and landowner households revealed that prior to CPB they gave more financial support to their families and extended relatives than they did following the CPB incursion.

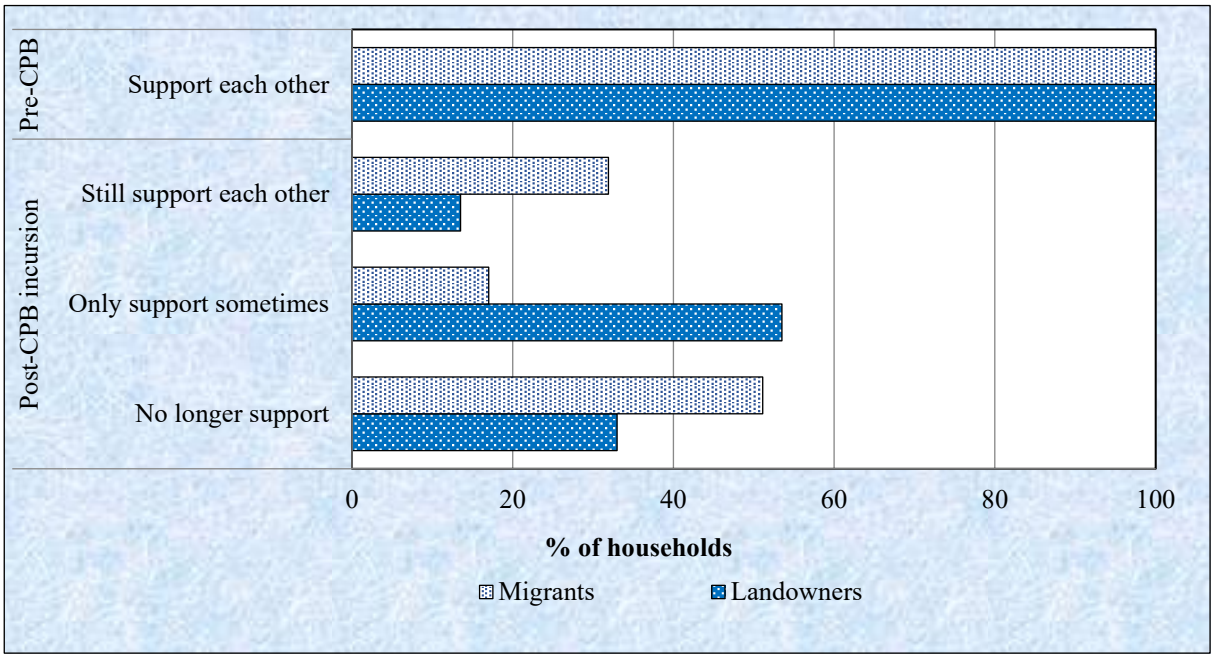

Figure 6.6: Percentage of migrant and landowner households giving different levels of support to extended relatives before and after the CPB incursion.

When household incomes fell after the CPB incursion, a third of migrant households continued to give regular financial support to relatives, however, only important requests such as school fees or serious medical conditions were entertained. As one male migrant stated: 'All fathers, mothers, and children: we all live in the same area, and we help each other. This is good' *(SH #112, 12/04/2016).* And so, a sense of connectivity was maintained even during the crisis. All members of the community understood the financial struggle every family was

going through, and so understood if relatives were not in a position to contribute. Even if not able to contribute, the people emphasized the importance of maintaining their bonds through the difficult period. This was echoed by a respondent who stated: 'We do not help each other much like before. But the families understand that we are all facing the same financial problems' *(SH #223, 20/03/2016).*

Some migrants pointed out that their relationships that stemmed from their shared identity as 'outsiders' prior to CPB helped them cope with the impact of CPB when incomes fell. A respondent stated: 'We are lucky because we have been assisting each other long before CPB arrived. And so we still maintain the practice of helping one another' *(SH #107, 10/10/2016).* However, some migrants also admitted that they limited spending money on unnecessary expenses such as social gatherings or unnecessary cash gifts to family members. This they stated was important in order to save money for important spending and to sustain their living.

Migrants' responses showed that despite being hard hit they already had a prevailing strong social cohesion. This was significant because it was not defined or confined to monetary contributions only, rather other social means such as sharing surplus food, taking care of the sick, or providing non-paid labour to others. Taking advantage of this, they focussed on maintaining moral support for each other. These helped lessen, to some extent, the weight of financial pressure they were going through. When it came to financial assistance lending to others, some migrants admitted that they stopped supporting families altogether because they were financially struggling themselves. And so, there existed pressure within migrants as on whether or not to support others, and to what extent. Landowners, on the other hand, have land-based resources readily available, and so, were not under much pressure to assist others. The majority stated that they only supported sometimes implying that each has land available that they can utilize to cultivate food crops for food or incomes. There was no sense of urgency to really support others.

Responses by migrants and landowners illustrated adaptive capacities that were very dynamic and context specific. Migrants maintained social bonds, and were selective in what and how much they contributed to others. Landowners, in contrast, had the option to use their land to support their livelihoods.

Impact on law and order

In this section I discuss the law and order situation in the community, and how offenders coped with court fines. Participants from both groups were asked about their perspectives on

changes to the law and order situation in the community post-CPB. People commented that one of the ways they spent cocoa income prior to the CPB invasion was purchasing and consuming of alcohol. Participants from both communities admitted that this was because people, mostly males, had a lot of money. They agreed that this behaviour caused a lot of law and order problems such as group fights, noise pollution from loud music, and use of obscene language from drunkards.

Migrants and landowners had quite different views on the law and order situation following the CPB intrusion. Most landowners (76.8%) believed there was a decline in law and order problems in the community, whereas two-thirds of migrants (66%) stated that the law and order situation had worsened. Migrants felt this way because of their insecure land access, and random instances of assault they experienced from random members of the landowner group regarding their settlement. For example, when under the influence of alcohol, members of the landowner group would threaten eviction of the migrants. Young landowners felt that as landowners they could do what they wanted. For example, on some occasions when youths from the landowner group were drunk, they would intimidate or verbally abuse members of migrant community they come across. Migrants were reluctant to retaliate because doing so would lead to being reminded that they were only settlers and can be evicted anytime. Migrants would however react by trying to resolve the issue and discourage members of their group from fighting back. It was because of this, that migrants often felt insecure and anxious when minor incidents occurred. The threats when landowners are drunk may also reflect underlying resentment by young landowners towards migrants which may result in future uncertainty in their land occupation at Dagua.

The reduced number of law and order issues reported generally for the Dagua community is reflected in a decline in the number of cases referred to the village court after the incursion of CPB. According to the community magistrate, this was because people had no cash to pay fines. There were differences in the types of cases brought to the village court against migrants and landowners respectively (Table 6.2).

Most of the cases were civil cases and were dealt with at a village level. According to the village magistrate, appropriate penalties are given on a case-by-case basis, however, more often issues are settled out of court, which helps offenders avoid having to pay hefty fees. However, there were cases involving land claims that village courts are not able to deal with and therefore complainants and defendants have to spend money to fight the case. Participants

in this study reported that after the CPB incursion it was challenging to meet the cost if the case is appealed to higher courts.

Table 6.2: Number of cases reported to the village court against migrants and landowners

Case	Number of reported cases from 2010-2016			
	Migrants	Cases per 100 migrants (414)	Landowners	Cases per 100 landowners (990)
Adultery	1	0.2	1	0.1
Alcohol abuse	2	0.5	14	1.4
Assault (physical)	4	1.0	16	1.6
Assault (verbal)	6	1.4	2	0.2
Broken marriage	0	0.0	1	0.1
Cult worship	0	0.0	1	0.1
Destruction of built property	0	0.0	6	0.6
Dispute over sago harvest	1	0.2	0	0.0
Domestic violence	1	0.2	5	0.5
False accusation	0	0.0	2	0.2
Food-garden destruction by domesticated pigs	0	0.0	5	0.5
Land dispute	3	0.7	7	0.7
Non-payment of debt	3	0.7	2	0.2
Illegal possession of firearm	0	0.0	1	0.1
Sexual harassment	0	0.0	1	0.1
Stealing	2	0.5	8	0.8
Threatening public	0	0.0	1	0.1
Trespassing	0	0.0	1	0.1
Total reported cases	**23**	**5.6**	**74**	**7.5**

Source: Central Dagua village court. Population data from 2011 census

There were some key differences in the types of cases brought against migrants and landowners. Amongst the migrant community there was a degree of social regulation of people's behaviour due to the potential impact of negative social behaviour on the relationships between the migrants and their hosts. Migrants were very conscious that anti-social behaviour could weaken their livelihood security and this, I argue, is reflected in the proportionally smaller number of cases brought to the village court against members of the migrant group. Migrants were also more dependent on money for their food security and so were also conscious of avoiding doing things that may lead to them being fined by the village

court. As a migrant stated: ‘Cocoa is no longer thriving, and I am scared of causing any trouble. Because I don’t have any money to pay fines’ *(SH #184, 06/04/2016).* Consumption of alcohol, physical assaults, destruction of built property, land disputes, and stealing are more frequent in the landowner community than the migrant’s (Table 6.3). These cases incur legal costs and destroy relationships either within the migrant community members or between migrants and landowners. For example, migrants have confrontations regarding use of property such as use harvesting of sago from a sago patch shared by multiple families. In their anger, confrontations and verbal abuse are commonly expressed avoiding use of physical fights as this requires more valued items such as money or pigs to settle – items that migrants are already disadvantaged with. Property use and disagreements require landowners to be present during the hearing to assist in decision-making by confirming who the rightful user was. It was important that conflicts between members of the migrant group were resolved amicably because to them maintaining social harmony was crucial for their survival. Even though similar crimes are reported by landowners, there is less pressure to resolve issues quickly because unlike the migrants, social insecurity is not a pressing issue. This results in prolonged tensions between the parties involved.

After the arrival of CPB, most migrants and landowners struggled to find enough money to pay court fines. The village magistrate said that migrants were more likely to refrain from activities that would land them in court. Often it was difficult for police to attend to arrests due to lack of resources such as fuel. And so, victims would often be required to pay for vehicle fuel to assist police attend to the case. Migrants and landowners often did not have such resources after the incursion of CPB. Secondly, out of court settlements were encouraged for minor offenses, such as gossip, or theft of betel nuts or food from food gardens. Thirdly, goods can be accepted as payment if the offender is not able to meet the full fee in cash, which would be a minimum of K50 (AU$17.33) or a maximum of K300 (AU$103.98). Offenders also have the option to do community service if they are unable to pay the fees. According to the magistrate, out of court settlements and doing community services were preferred by offenders from the migrant group. This was because it did not put less stress on their finances, and because they risked onerous settlements such payments in pigs or sago. One strategy for migrants was to refrain from engaging in activities that would land them in court. Landowners, on the other hand, were less concerned about potentially breaking laws because they perceived themselves as in a dominant position relative to landowners, and so were therefore more confident.

Table 6.3: Summary of key differences between migrants and landowners in impact, coping and adaptive responses to CPB.

	Migrants	Landowners
Household food choices	Reduced consumption of store food. More limited range of store foods consumed. Limited access to gardening land meant some store foods still consumed.	Reduced consumption of store food. More limited range of store foods consumed.
Payment of school fees	Reduced ability to pay school fees in full. Many households arranged to pay fees in instalments. Many received financial assistance from families and relatives.	Reduced ability to pay school fees in full. A substantial number of households did not pay their school fees. Were not under pressure to pay full fees and so many ignored paying full fees compared to the migrants.
Payment of hospital fees	Unable to pay full fees. Were under pressure to at least make part payment.	Many either did not pay or did not seek formal medical treatment and instead relied on medicinal plants.
Mobility	Reduced frequency of travelling.	Reduced frequency of travelling.
Business	Occasional purchase of store goods in trade stores. Fermentary business ceased as there was limited access to forest to collect firewood. PMV's reduced number of trips.	Store goods rarely purchased. Fermentaries downsized on operation.
Contributions to fundraising and customary obligations	Reduced size and frequency of contributions.	Reduced size and frequency of contributions.
Support to relatives	Reduced size and frequency of support. Very selective on the type of activities to support.	Reduced size and frequency of support. Supporting others was an option.
Law & Order	Avoided offences that would lead them to paying court fines or compensation. Avoided social disharmony with landowners because provoking landowners into a confrontation would lead to land insecurity issues.	There was less pressure on landowners in avoiding offences because as landowners they perceived themselves to have authority over migrants.

Conclusion

In this chapter I summarised the adaptive life responses of migrants and landowners to the incursion of CPB. I have examined the overall impact of CPB on incomes and livelihoods and explored the differential impacts on migrants and landowners, and how their positions in terms of access to material and social resources shaped their adaptive capacity. In the chapter I highlighted that prior to CPB, good fortnightly incomes from cocoa made it possible for people to meet their personal and household needs as well as pay for services such as health, education and transport. They were also able to engage meaningfully in social and cultural

obligations. However, because they were heavily dependent on cocoa, the loss of cash income due to CPB, had a significant impact on their material standard of living.

In the chapter I argued that the CPB crisis had a greater impact on migrants than landowners, and that this stemmed primarily from their differential access to land. In responding to the financial shock, farmers initially abandoned their blocks and resorted to alternative sources of livelihood and looked to reduce their spending. The strategies employed differed between migrants and landowners, with their different coping strategies reflecting their context and resources, and their capacity to adapt. Landowners were under limited pressure because of their access to land-based resources to sustain themselves. Landowners shifted to subsistence farming and consumption of sago. This reflected the advantage in adaptive capacity landowners have over migrants where they own large portions of land they could cultivate and harvest wild or cultivated sago palms. However, their businesses such as trade stores were in a vulnerable condition after the CPB incursion because people rarely made purchases from the stores, thus affecting cash flow. This differed to the approach adopted by migrants where they reduced their spending at trade stores, but still purchased small quantities of basic items such as rice, tinned fish and noodles. They also added garden food and sago into their diet because these were cheaper, and also made it possible for them not to run out of cash.

The impact of CPB and responses are also seen in how they responded to other activities such as mobility, payment of school and hospital fees, how they assisted families, contribution to fundraising activities, and approaches to law and order. Because of their status as 'outsiders', migrants had to maintain a positive relationship with community institutions that have landowners as members on the governing board, such as the schools and hospital. And so, migrants made attempts to pay complete school fees, hospital fees, and refrained from antisocial behaviour that would make them easy target of blame in the community. This illustrates the vulnerability of the migrant community at Dagua. Both landowners and migrants were economically driven by the rapid reduction on income, but importantly the coping responses of migrants were also socially motivated, targeted both at both managing the immediate shock from CPB, but also focussed on the long-term livelihood security in Dagua.

I have demonstrated in this chapter that migrants and landowners' adaptive capacities differ due to their different livelihood contexts. For landowners, their better access to land influenced much of their coping responses to the financial shock. In contrast, migrants'

livelihood decisions are influenced by their limited access to land, their vulnerable status as migrants in the community and the insecurity of their land tenure.

In the next chapter the impact of CPB on the cocoa block maintenance practices of these two different groups is analysed and discussed.

CHAPTER 7

BLOCK MAINTENANCE RESPONSES BY SMALLHOLDER FARMERS

Introduction

In this chapter I discuss the impact of CPB on cocoa harvesting and block maintenance by migrants and landowners. I illustrate in the chapter that, generally, growers in both communities were not able to adequately respond to the sudden impact of CPB due to the more labour-intensive, high-input production system required to control the pest. I argue that growers' inability to adjust their cocoa farming practices to manage CPB was because they were accustomed to a low input farming system where limited labour and external inputs were used. The initial response to the shock was to abandon their cocoa blocks resulting in over-shaded blocks and invasion of weeds, pests and diseases. The total abandoning of blocks was temporary, however, and farmers began to return to their cocoa when they realized that CPB was there to stay.

In differentiating migrants and landowners' block management responses, the chapter argues that the need for cash forced migrants, who depended more on cash for food consumption, to neglect cocoa management practices and to shift immediately to alternative livelihood income-generating activities. Landowners, in contrast, were not under immediate financial pressure to maintain incomes because they had easy access to foods such as sago, wild greens and garden produce. The response by migrants was more immediate and involved greater adaptation. This was because when incomes fell drastically, as discussed in Chapter 6, migrants realised the urgency to switch to other income generating activities to maintain cash to purchase food and pay for other essential needs such as school fees, transport and hospital fees.

In the first part of the chapter I present the differences in the characteristics of cocoa blocks for migrants and landowners. It then discusses the initial differences in block maintenance responses by migrants and landowners following the impact of CPB. Finally, I discuss migrants and landowners' perceptions on labour and maintenance of cocoa blocks.

Block characteristics

Block ownership refers to the block possession by a smallholder farmer who is responsible for block cultivation and management and is bestowed the right to benefit from the block. Of the blocks that were surveyed, 47 were owned by migrants and 185 were owned by landowners. Because migrants and landowners adhere to a patrilineal landownership system, males in both groups dominate block ownership. Women did not own the blocks, however, in both groups there were women who managed and benefited from blocks in the absence of their husbands or sons (Chapter 4). Most landowners (87%) indicated that they had more than one block, whereas only 40% of migrants had more than one block. It should be noted that not all blocks were used for economic reasons, rather, were also used to assert ownership over a piece of land.

In this study I focused on migrants and landowners' blocks that were nearest participants' houses. This was because the nearest blocks were frequented more often by growers, and it was easy for growers to count the number of trees, harvests, and maintenance activities before and after CPB. According to the farmers, distant blocks were rarely visited and maintained. The reason for this is because distant blocks were established not to increase production, rather for land security reasons. Such practice is common elsewhere in PNG (Daniel *et al*., 2011b). The block maintenance practices reported on in this chapter thus reflect the growers' best managed blocks.

The amount of land used for cocoa cultivation differed amongst households. The average area of land per household devoted to cocoa cultivation was 0.44 ha for migrants and 0.50 ha for landowners. The amount of land devoted to cocoa was estimated based on the number of trees and the spacing requirement of 3m x 4m. This method of estimation was also used in the ENB study as described in Curry *et al*. (2011). The actual area under cultivation will, however, differ slightly from the estimations as there are wide variations in plant spacing within and between cocoa blocks, including due to the different recommended spacing for older varieties and the newer hybrid varieties. In Dagua, spacing of cocoa trees is also affected when other crops are intercropped with cocoa.

There was very little difference in the average area planted by migrants and landowner households. The majority planted between 100 and 500 trees on a block (Figure 7.1). For both communities, the data presented is the number of cocoa trees in the blocks planted closest to their homes. For landowners, access to a cocoa block near the village gave them ready access

to wet bean to meet immediate cash needs. But for migrants, the small area of land near their houses was all the land available to them for food production, housing and for cocoa production.

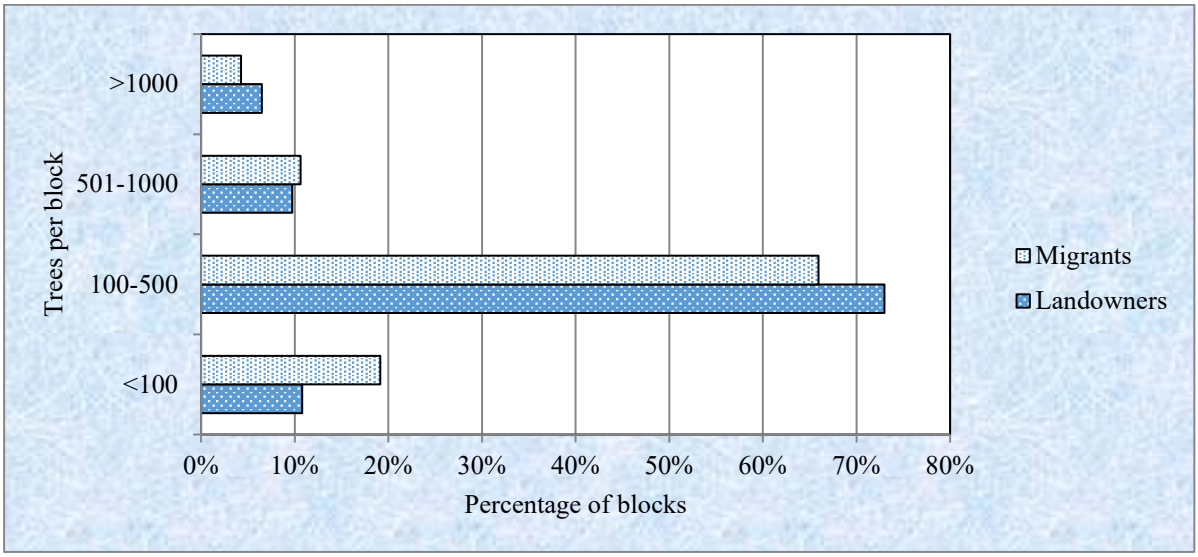

Figure 7.1: The percentage of landowner and migrant blocks containing different numbers of cocoa trees, Dagua, ESP, 2016.

In general, the migrant and landowner communities planted similar numbers of cocoa trees on their nearest cocoa block (see Figure 7.1). Migrants were, however, much more likely to possess very small cocoa blocks. While 19% of migrants had cocoa blocks with less than 100 trees only 11% of landowner households had very small blocks. This reflects the small land areas that these migrant households had available to them, and also the need for them to use available land for food production. Some migrants have fewer trees because cocoa trees were removed to make land available to build homes. The majority of both migrant households (66%) and landowner households (73%) had planted between 100 and 500 cocoa trees in their nearest block. This was considered a manageable sized block. While migrants and landowners had planted similar numbers of cocoa trees in their nearest blocks, it is important to note that the great majority of landowners had multiple blocks, while few migrant households had more than a single block. Thus, the average number of trees owned across all their blocks would be substantially greater for landowners.

Time taken to reach the nearest cocoa block is important because it indicates how regularly a farmer is likely to visit the block and the level of labour likely to be invested in the block. Migrants tended to have their nearest cocoa block closer to their houses than did landowners (Figure 7.2). While 30% of migrants had cocoa blocks within a 5-minute walk from their house, only 17% of landowners had very close cocoa blocks. More migrants had cocoa in

very close proximity to their houses because they lived next to or within the block. Landowners were, by contrast, more likely to have more distant blocks with 34% of landowners, but 23% of migrants, owning cocoa blocks more than a 20-minute walk from their house.

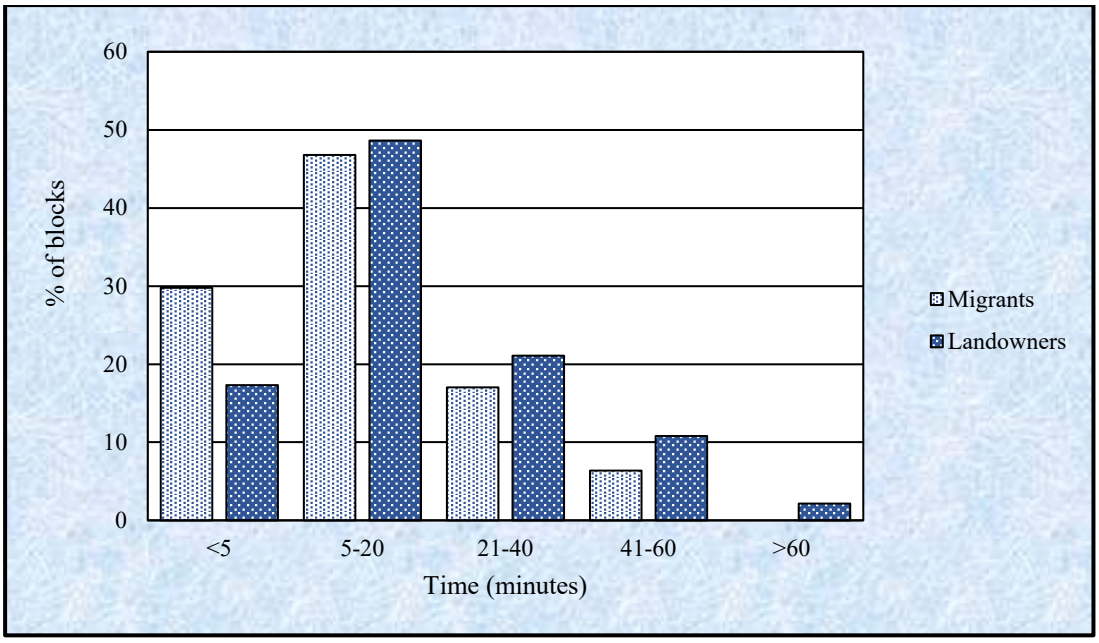

Figure 7.2: Time taken by migrant and landowner farmers to access cocoa blocks, Dagua, ESP, 2016.

Initial block maintenance response to CPB

In this section I discuss changes in the amount of time and labour inputs put into harvesting, pruning, shade control, grass-slashing and pest and disease control by migrants and landowner farmers. I argue that the sudden intrusion of CPB farmers caused shock and confusion amongst farmers which led most farmers to initially abandon their blocks because of the high labour requirements to combat CPB. In this section I argue that migrants reduced time spent on cocoa maintenance practices and spent more time on other livelihood activities to generate income (see Chapter 6).

Before examining the impact of CPB on block maintenance practices, it is important to note that, even before the arrival of CPB, cocoa smallholders in Dagua adopted what Curry *et al*. (2007) describe as a low input low output production strategy (see Chapter 3). In this strategy smallholders undertake minimal block maintenance. In East New Britain, Curry *et al*. (2007: 71) described that on most blocks almost no pruning occurred, shade control was minimal or absent, and no pest or disease control was undertaken. They reported that weeding did occur

to near adequate levels in younger blocks around the main harvest period, but often not in other blocks. Blocks are also commonly under-harvested. This highlights that the declines in block maintenance observed after CPB occurred in a context where block maintenance was already at very low levels.

Harvesting

Prior to the CPB period, harvesting was done fortnightly. After the CPB intrusion, farmers were advised to improve their harvesting practices. This included, increasing their harvesting effort, and the removal of affected pods and breaking and burying the pods at a central location to minimize spread of CPB in the block (Konam *et al*., 2008; PNGCCIL, 2017: 86-89). Findings from this study, however, revealed that after the CPB period, most growers, migrants and landowners, reduced the amount of time they spent harvesting, including CPB-affected pods (Figure 7.3).

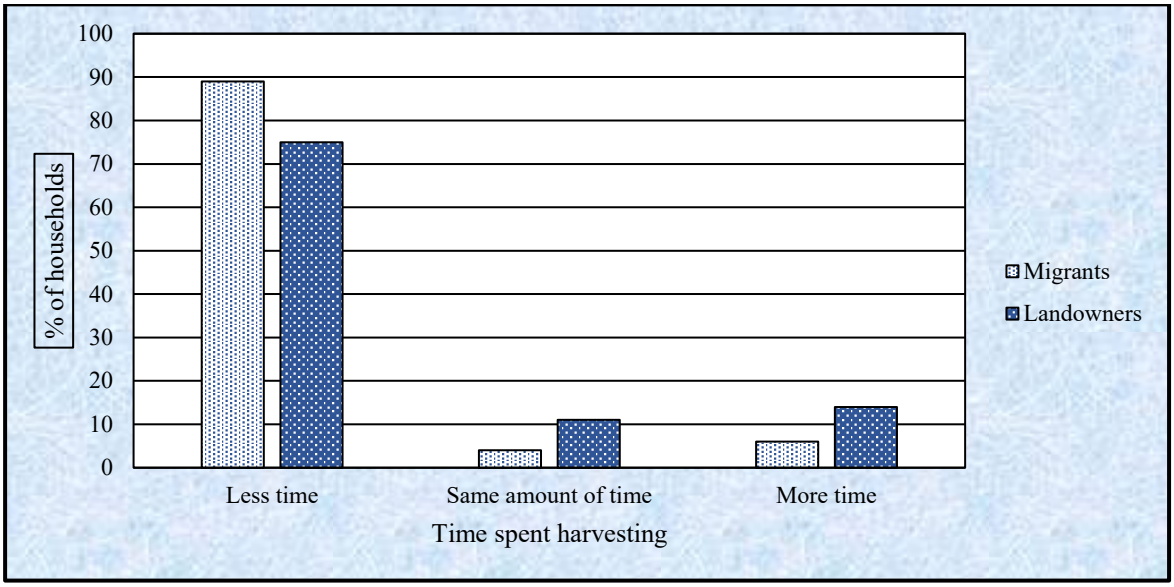

Figure 7.3: Growers' perception of the relative amount of time spent on harvesting after CPB intrusion, Dagua, ESP, 2016.

Soon after the intrusion of CPB, most migrants (89%) and landowners (75%) spent less time on proper harvesting practices. Only 11% of landowners and 4% of migrants reported that they continued attending to harvesting practices as they did prior to the incursion of the pest. Fourteen per cent of landowners and only 6% of migrants reported allocating more time to harvesting cocoa in their blocks. These farmers were desperate for cash and had few other options to raise income, and so spent more time searching for good pods in their blocks.

Pruning

The vast majority of cocoa farmers also reported that they spent less time on pruning (Figure 7.4). The recommended practice was to prune monthly maintaining five pod-bearing branches and adequate low and open canopy (PNGCCIL, 2017:44-46). This was not practised by the growers. This response is similar to that reported by Curry *et al*. (2011:50) where more than 70% of farmers in East New Britain admitted spending less time on pruning.

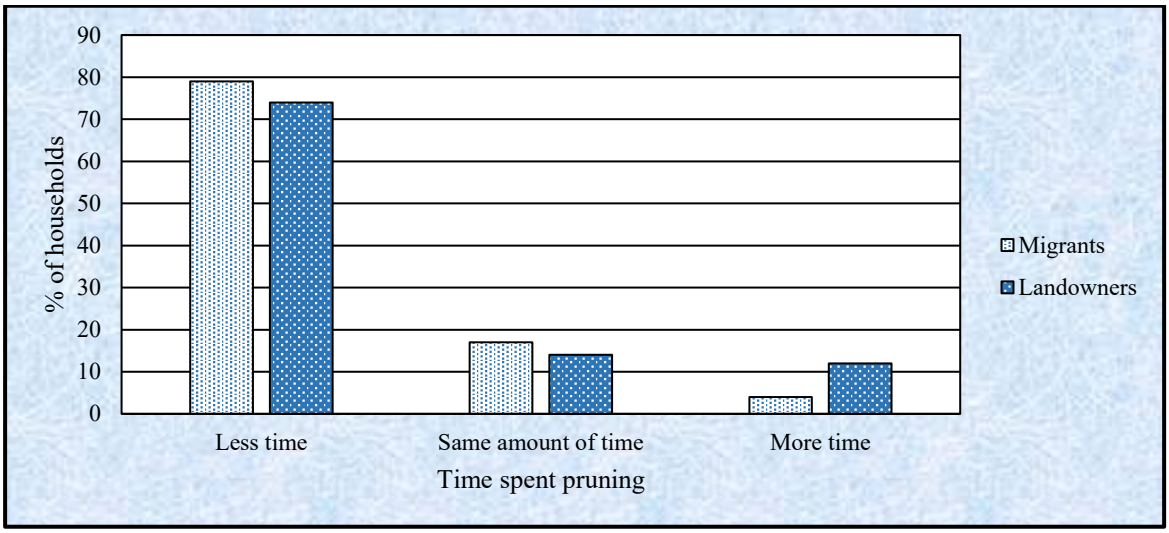

Figure 7.4: Growers' perceptions of the relative amount of time spent on pruning after CPB intrusion, Dagua, ESP, 2016.

There was no marked difference between the migrants and landowners. However, in each category, there is still the tendency that the proportion of migrants who had initially abandoned block maintenance practices in their cocoa blocks was a little higher. A higher proportion of landowners, than migrants, increased their pruning effort. The cocoa block assessment from the East Sepik Baseline Survey data[4] again confirms this finding, showing that landowners were more likely, than migrants, to have pruned their cocoa (Figure 7.5).

The minimal investment of time in pruning by migrants was primarily because they were spending more time on other livelihood activities to generate income. Most migrants in the informal interviews stated that it was difficult working with cocoa because the income was very low, and that they rather spend time on other livelihood activities that earned better income.

[4] Wewak-ESP Baseline Survey was an ACIAR funded project led by Philip Keane and colleagues conducted between 2016 and 2020 in ESP, Madang and Chimbu, and later published in Keane *et al*., (2021). The findings presented in this chapter are from the dataset provided to me by the project on the 13th February 2018.

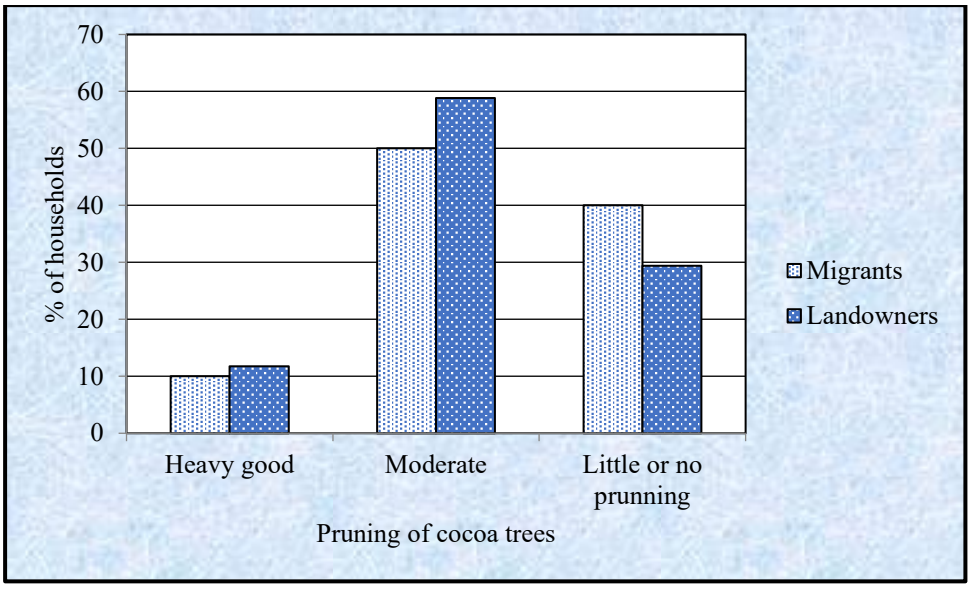

Figure 7.5: Degree of pruning of cocoa trees in migrant and landowner blocks, Dagua, ESP, 2016. *(migrants, n=10; landowners, n=17)*
Source: Wewak-ESP Baseline Survey data

Shade control

Maintaining correct sunlight intensity in the block was also ignored during the intitial abandonment of the blocks (Figure 7.6). Pruning of shade trees is important to maintaining an adequate amount of sunlight to induce flowering and reduce incidences of pests and diseases in the blocks. The recommended pratice is to conduct monthly pruning of shade trees to allow for 80% of sunlight to penetrate (PNGCCIL, 2017:42, 47-48). The great majority of farmers revealed that after CPB, the time they spent maintaining shade was reduced.

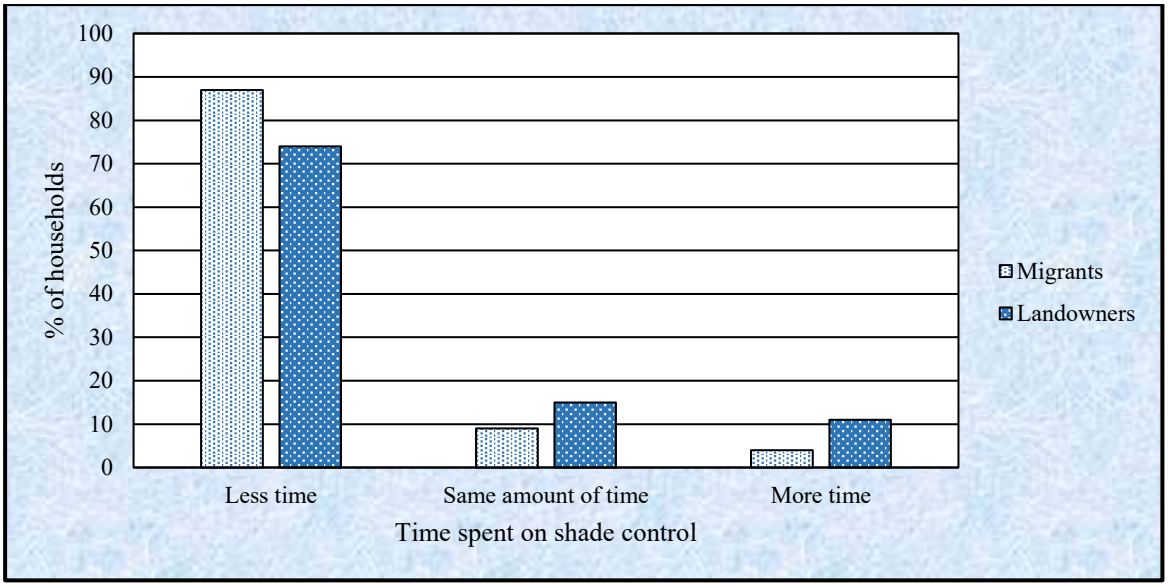

Figure 7.6: Growers' perceptions of the relative amount of time spent on shade control after CPB intrusion, Dagua, ESP, 2016.

Findings reveal that 87% of the migrants and 74% of landowners spent less time on shade control. This again was because of the initial abandonment of their blocks. This response is similar to that reported by Curry *et al*. (2007:50) where shade control was less attended to by the majority of the cocoa growers in East New Britain due to the overwhelming impact of CPB. In Dagua, landowners were more likely to have maintained or increased their shade pruning effort following the arrival of CPB. Very few migrants (4%) were willing to spend more time attending to shade control. For migrants this was partly because they typically had other economic trees, like black palm, breadfruit and coconut, planted in their cocoa blocks (also see Chapters 5 and 8) which either did not require pruning or which they were reluctant to prune due to the impact that pruning the tree would have on the food or income derived from that tree.

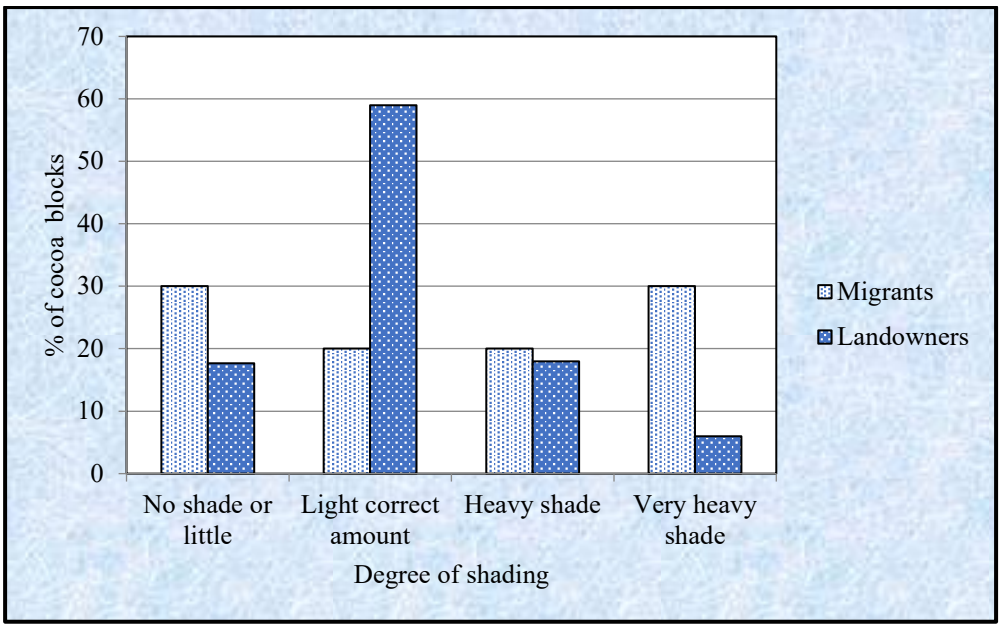

Figure 7.7: Degree of shading in migrant and landowner blocks, Dagua, ESP, 2016. (*migrants, n=10; landowners, n=17)*
Source: Unpublished survey data from ACIAR project HORT/2014/096, see Keane *et al*. 2021

Block assessments from the East Sepik Baseline Survey data also showed that landowners were much more likely than migrants to have correctly shaded cocoa blocks (Figure 7.7). Analysis on pruning of shade trees from the same baseline survey revealed that while half of the migrants and landowners surveys conducted little pruning of shade trees, landowners were more likely to be conducting heavy pruning (Figure 7.8). Many landowners stated that in an attempt to control CPB they were trialling pruning shade trees to see the effect this would have on the presence of CPB.

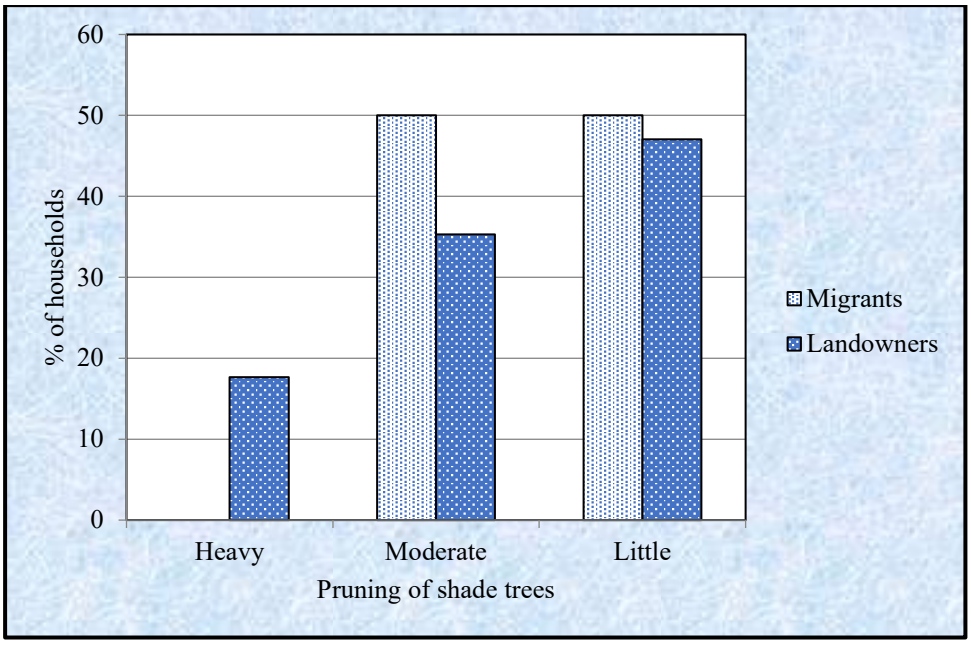

Figure 7.8: Degree of pruning of shade trees in migrant and landowner blocks, Dagua, ESP, 2016. *(migrants, n=10; landowners, n=17)*
Source: Unpublished survey data from ACIAR project HORT/2014/096, see Keane *et al*. 2021

Grass-slashing and weeding

Grass-slashing is important for reducing competition for soil nutrients, water and sunlight with cocoa trees and shade trees. It is critical in reducing incidences of weeds becoming potential hosts to pests and diseases. According to PNGCCIL (2017: 49-50), slashing of grass is part of weed management strategy and is done alongside manual weeding and use of herbicides. These practices require sufficient time for effective weed control. After the CPB incursion most growers spent less time attending to weed management practices (see Figure 7.9). This left the blocks overgrown with weeds. In Dagua, 81% of migrants and 69% of landowners spent less time on grass-slashing on their blocks following the impact of CPB. A small proportion of landowners (15%) and very few migrants (4%) were willing to spend more on slashing grass in their blocks. Blocks abandoned were overgrown with vegetation. Blocks that were still visited by farmers were covered with weeds to a height of 30 – 50 cm.

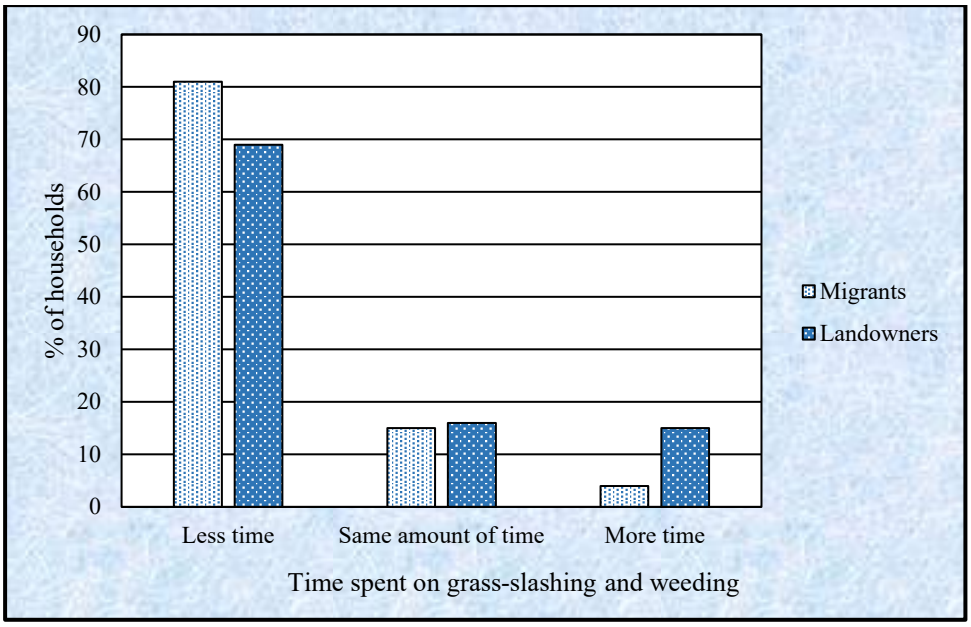

Figure 7.9: Growers' perceptions of the relative amount of time spent on grass-slashing and weeding after CPB intrusion, Dagua, ESP, 2016.

Similar responses were evident in ENB, where the majority of the smallholder farmers spent less time on grass-slashing after CPB attacked (Curry *et al*., 2011:50). The findings were also consistent with data from the Wewak-ESP Baseline Survey (see Figure 7.10). Similar to the observations of other block maintenance practices, landowner blocks were more likely to show good or moderate block management (71%). By contrast, 60% of migrant blocks surveys showed evidence of no or little weeding.

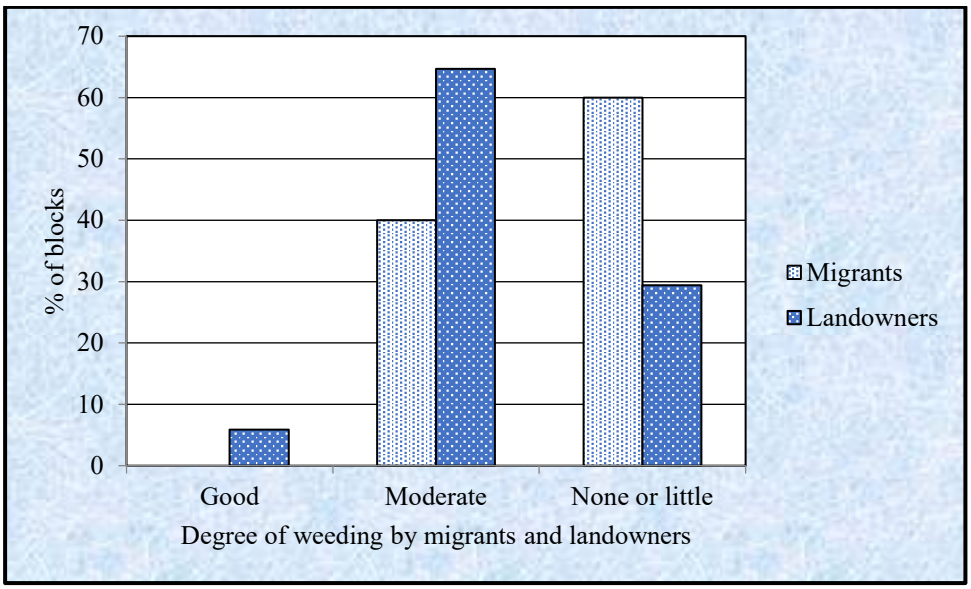

Figure 7.10: Degree of weeding in migrant and landowner blocks, Dagua, ESP, 2016. *(migrants, n=10; landowners, n=17)*
Source: Unpublished survey data from ACIAR project HORT/2014/096, see Keane *et al*. 2021.

Blocks that were neatly taken care of with no weeds or less weeds were rarely evident for migrants. Farmers reported that there was no motivation to continue with grass cutting. Where grass-slashing was done it was primarily to provide access to trees that contained healthy pods or to access other crops that were intercropped in the block. However, it should also be noted that for some migrants, the shade provided by other fruit and nut trees also inhibited the rapid growth of weeds in their blocks.

Pests and disease control

Pests and diseases cause between 20 to 40% of yield losses in agriculture worldwide (Savary *et al*., 2012; Adejumo, 2005). In PNG, 40% of yield losses in cocoa are caused by diseases (Saul 1989 cited in Daniel *et al*., 2011). When farmers abandoned their blocks, pests and disease management practices were not followed. According to PNGCCIL (2017:53-72) there are many different pests and diseases of cocoa which can be managed by performing regular pruning of cocoa and shade trees, removal of plant parts damaged by pests and diseases, manually weeding around cocoa trees, burying infested pods, and by applying herbicides, fungicides and insecticides. For CPB, weekly removal of diseased pods and burying them is recommended in addition to spraying pods with insecticides. With the pressure from CPB, growers need to spend more time on block maintenance in order to obtain an adequate harvest. Counter to this, after the CPB intrusion, most farmers reported that they spent less time on pests and disease control (see Figure 7.11).

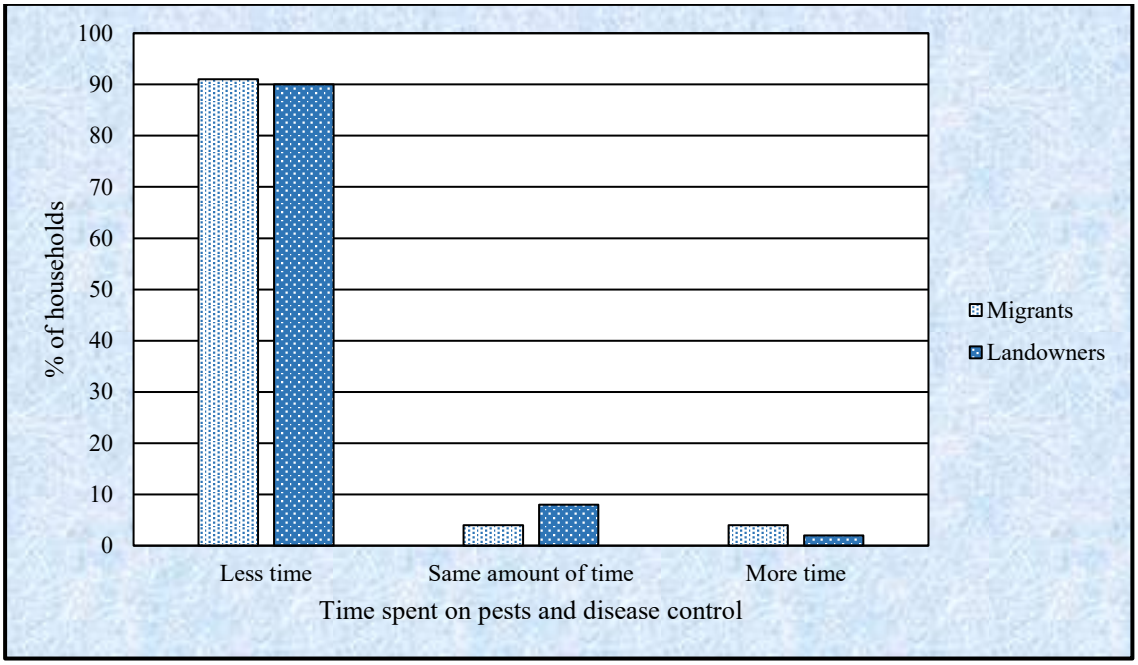

Figure 7.11: Growers' perceptions of the amount of time spent on pests and disease control after CPB intrusion, Dagua, ESP, 2016.

After the CPB incursion in Dagua, 91% of migrants and 90% of landowners reported they spent less time managing pests and diseases. This result is consistent with findings from the East Sepik Baseline Survey which highlighted the presence of many other pests and diseases such as canker and vascular-streak dieback (VSD) in the cocoa blocks of growers in Dagua (also see Keane *et al*., 2021).

Physical appearance of cocoa blocks

Observations were also made of the physical appearances of cocoa blocks to complement farmers' reporting of their block maintenance activities (Figure 7.12). At the time of surveys both groups were at the initial stage of abandoning their blocks and therefore were not maintaining the blocks to required expectations as recommended by CCIL. These surveys showed that the great majority of migrant blocks (83%) were bushy and showed no evidence of maintenance. While most landowner blocks (61%) also showed no evidence of maintenance, 39% landowner blocks were cleaned or had been partially cleaned. The proportion of migrants who attempted to keep their blocks completely or partially clean was very low (17.0%) compared to landowners. The main signs of maintenance on the blocks were grass-slashing and pruning. Other maintenance practices were not obvious. Blocks where maintenance was not evident were typically overgrown with weeds and showed evidence of the presence of pests and diseases such as VSD and canker. The initial phase of block abandonment, however, did not mean deserting the blocks completely. Growers continued forage harvesting from the blocks. A 2010 socio-economic survey on the impact of CPB by Curry *et al*. (2011), reported similar behaviour by ENB farmers when neglecting their cocoa blocks due to the devastation caused by CPB there. The evidence of block maintenance, as well as farmers block management responses indicate that landowners, on the whole, were more reliant than migrants on cocoa as source of cash, but also less reliant on cash to meet their consumption needs.

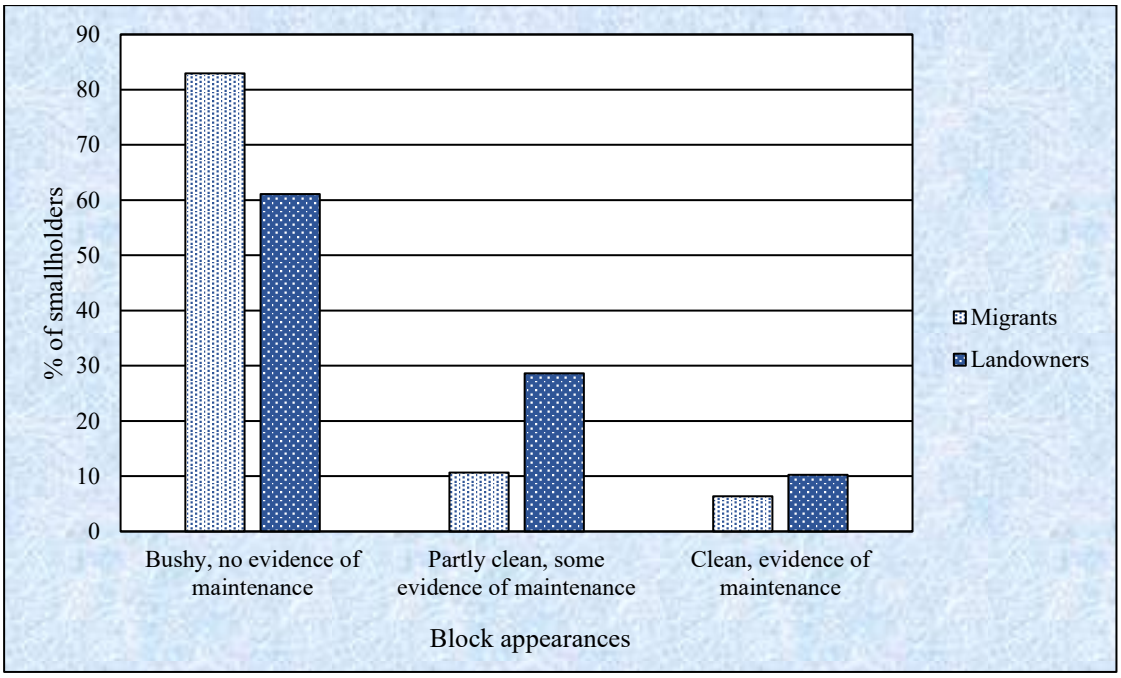

Figure 7.12: Physical appearance for migrant and landowner blocks, Dagua, ESP, 2016.

Farmers' perceptions of their willingness to maintain cocoa blocks during the CPB period

Generally, both communities found the impact of CPB overwhelming. The majority of farmers in both groups reduced the amount of time they spent on the various block maintenance tasks. A small number of landowners increased their maintenance efforts after CPB arrived, but very few migrants did so.

The study also recorded farmers' perceptions on the impact of CPB and on their willingness to carry out maintenance for CPB on their blocks. Farmers' perceptions are important because they indicate their likely responses in the short-term and long-term. Their responses reflected both their initial coping strategies (Chapter 6), and their long-term strategies (Chapter 8). The research asked two key questions with the aim of examining whether or not growers were willing to implement strategies recommended by PNGCCIL such as training and advice from Cocoa Board, weekly intensive harvesting of healthy and sick pods (every pod, every tree, every week), centralised pod breaking, burying of sick pods, pruning and shade control, and target or spot spraying.

First, farmers were asked if they were willing to invest more time into block maintenance to manage CPB. Secondly, farmers were asked if they thought CPB was difficult to control, and their reasons for thinking so.

More than 90% of migrants and landowners agreed that the CPB impact on cocoa blocks was overwhelming. They expressed that it was hopeless attempting to manage CPB because there were no tools, pesticides or training conducted to assist them to stop the spread of CPB. Many believed that it was difficult to counteract the advances of CPB in the blocks because the movement of the pest was poorly understood. And so, most farmers in both groups reported that they were willing to do the work but unable to do so.

Farmers in both groups explained that prior to CPB they often visited their blocks, either to conduct maintenance activities or to harvest. It should however be noted that prior to CPB incursion, they were using the low input strategies with very limited external inputs such as fertilizer, and so not much maintenance was done before CPB. This declined even further with CPB. However, the enthusiasm to continue declined after the pest attack mainly because of the overwhelming impact of CPB on their blocks. When asked if they were willing to spend more time in their blocks, 55.0% (N=47) of migrants and 67.0% (N=185) of landowners stated that they were willing to do so, although this was not evident in what they were doing. The majority of migrants (61.5%), who were willing to spend more time on their blocks explained that maintaining the block was important because the other crops grown on the blocks including betel nut, bananas and other vegetables contributed to their incomes. Migrants also commented that complete abandonment of their cocoa block could result in other landowners expanding cultivation into their portion of land, which would reduce the original land area available to them. This is particularly true when cocoa trees wilted or when vegetable gardens were left unattended. However, none of the landowners expressed the view that maintaining the cocoa blocks was important for land security reasons. Only 25.0% of landowners who expressed that they were willing to spend more time on block maintenance because of other crops intercropped in the blocks.

Because of the impact of CPB, many migrants (45.0%) were not willing to spend additional time on their blocks. Those who were not willing to do so expressed that cocoa work was a waste of time and that their labour could be better utilized on other livelihood activities. One migrant stated: “Prior to CPB, the cocoa trees had diseases, but still I managed to get good harvests. But now CPB is here, and it has affected every tree making me lose all motivation to work on the block anymore” *(SH #163, 23/03/2016).* Only 33.0% of landowners shared similar sentiments.

Migrants were under greater pressure, than landowners, to maintain a source of income. While landowners, who have extensive land resources, had the choice of retreating to subsistence farming, migrants generally did not have sufficient land to do so. Earning income was more critical for the livelihoods of the migrant group to purchase food, to pay other expenses, and to maintain good standing in the community. Migrants generally considered it better to invest their time in other cash-earning activities (also see Chapter 8). For most migrants this was logical because the impact of CPB was so overwhelming that most believed it was not worth spending more time on the block. Labour invested in block maintenance also consumed valuable time which could be used for other income-generating activities.

Farmers in both groups commented that CPB cannot be controlled without tools, pesticides and appropriate training when asked if CPB can be easily managed. The majority of growers in the landowner group (63.8%) expressed that CPB cannot be managed without tools, pesticides and appropriate training. These farmers stated that bush knife was the main tool used to clean the block, do grass-slashing, prune cocoa trees, harvest and break pods. Although migrants provided a similar response, they were disinterested in continuing with cocoa and commented more on investing in other livelihood activities. The responses by migrants were consistent with the efforts in block maintenance discussed in the previous section of this chapter.

In summary, in this section I have discussed the differences in block maintenance activities between migrants and landowners after the intrusion of CPB. I also described their perceptions of CPB and whether they are able to continue working on the block after the sudden shock on their cocoa blocks by the pest. Table 7.1 summarizes these differences.

Table 7.1: Key differences between migrants' and landowners' cocoa block characteristics and changes to cocoa block maintenance practices after CPB incursion, Dagua, ESP, 2016.

Item/Activity	Migrants	Landowners
Block ownership	40% had multiple cocoa blocks.	87% had multiple cocoa blocks. Blocks often established and maintained to reaffirm land ownership.
Number of trees per block	Majority under 500 trees Very small plantings common (19%)	Majority under 500 trees Very small planting less common
Block proximity	Most blocks within a 20-minute walk. Higher proportion of gardens very close to the farmers' houses	Most blocks within a 20-minute walk. Higher proportion of gardens more distant from farmers' houses

Harvesting	Most reduced harvesting time after CPB. 10% of households maintained or increased harvest effort.	Most reduced harvesting time after CPB. 25% of households maintained or increased harvest effort.
Pruning	Most households reduced pruning labour. 21% of household maintained or increased pruning effort. On average migrant blocks showed less evidence of pruning.	Most households reduced pruning labour. 26% of household maintained or increased pruning effort. On average landowner blocks showed more evidence of pruning.
Shade management	Most households reduced shade management labour. 13% of household maintained or increased pruning effort. Most blocks had poor shade management.	Most households reduced shade management labour. 26% of household maintained or increased pruning effort. Most blocks had suitable shade levels.
Weed management	Most households reduced weed management. Fewer migrant blocks showed evidence of weed management – primarily to access other crops in the cocoa block.	Most households reduced weed management. More landowner blocks showed evidence of weed management.
Pest and disease management	Great majority of households reduced labour on pest and disease control	Great majority of households reduced labour on pest and disease control
Block appearance	A large majority (83%) had bushy blocks with no or very little evidence of maintenance.	Most (61%) had bushy blocks with no or very little evidence of maintenance. A greater proportion of landowners (compared to migrants) had blocks which showed evidence of maintenance.
Willingness to spend time in the blocks	55% of migrants were willing to increase block maintenance. Primarily motivated to manage block due to the presence of other economic crops.	67% of landowners willing to increase block maintenance.
Perception on impact and control of CPB	Majority thought it not worth controlling CPB and effort was better put into other livelihood activities.	Some still believed it is worth trying to control CPB, though found it overwhelming.

Conclusion

In this chapter I presented the initial block maintenance and labour responses of smallholders to CPB. I revealed that farmers in both groups were either not able to implement the high input mode of production, or not aware about it as an option, forcing the majority to abandon their cocoa blocks. In the study I showed that when CPB struck, farmers in both groups were

shocked as cocoa yields collapsed and income declined sharply. This placed immense pressure on migrants, more than on landowners, to raise income to support their livelihood. And so, a majority of the migrants immediately either abandoned their blocks and significantly reduced block maintenance activities, primarily to focus their time on other income-generating activities. After initially abandoning their cocoa blocks, many migrants later returned to their blocks, primarily to harvest and maintain other crops within their cocoa blocks for both family consumption and to earn income. This response was similar to the responses of cocoa farmers in ENB observed by Curry *et al*. (2011). It was particularly important for migrants to find alternative sources of income so they could maintain household food supply. The pressure on landowners was less. Most landowners abandoned their cocoa blocks because CPB's impact was overwhelming for them, and not because they were under the pressure to generate incomes to sustain daily living. Landowners had a lower need for cash, and so, despite lower returns to their labour compared to the pre-CPB period, were more likely to continue to harvest and carry out some maintenance of their cocoa blocks.

Both migrants and landowners have demonstrated resilience; however, their responses have clearly differed based on their context. As argued in the previous chapter, migrants expanded their other livelihoods to generate cash for food purchases and payment of basic services such as school fees, health expenses, and to maintain their standing in the community through contributing to customary exchanges. In order to pursue other cash earning activities, migrants overwhelmingly reduced their inputs in cocoa. In contrast, landowners were not under pressure to generate income from other livelihood sources and resorted to their existing livelihood portfolio to earn income or maintain household food supply. Although a higher proportion of landowners than migrants attempted to control CPB by practising block management practices, block maintenance generally did not meet the PNCCIL recommendations.

The responses by migrants and landowners show varied approaches to improving their adaptive capacities. To avoid livelihood risks, uncertainty and conditions of vulnerability, migrants coped by swiftly shifting their attention to other livelihood sources. This implied that migrants were conscious of the repercussions if they did not act quickly. In contrast, vulnerability was not in the foresight of landowners. The majority were not under pressure to reorganize their livelihood activities because of other land-based resources they had access to. While maintaining these resources, some believed it was possible to lessen the impact of the shock by conducting block management practices.

Having discussed farmers' block maintenance responses to the impact of CPB, I describe the longer-term adaptation strategies that farmers employed to maintain and rebuild their livelihoods in the next chapter.

CHAPTER 8

INCOME DIVERSIFICATION AND ADAPTATION STRATEGIES

Introduction

In Chapter 6, farmers' immediate responses and initial coping strategies in response to the sudden unexpected cash decline caused by CPB were discussed. The impact on their livelihood responses on cocoa maintenance was discussed in Chapter 7. Chapter 8 builds on that context to discuss the short-term to long-term income-earning strategies of migrants and landowners. The preceding chapters have demonstrated that land accessibility was the major factor shaping the contrasting immediate responses of landowners and migrants within the community to the impacts of CPB. In this chapter I argue that access to land is also the most important factor shaping people's short-term to long-term livelihood strategies when responding to CPB. For landowners, who have substantial land available to them, the adaptation strategies have largely drawn on their existing natural resources other than their cocoa holdings, particularly through expanding their gardening land. By contrast, migrants, who have much less land available to them, have pursued two main strategies. The first has been intensifying the use of their current land holdings, by intercropping, growing fast-maturing varieties, and growing crops like tobacco and betel nut which are of high value relative to the land area they occupy. The second strategy has been to increase their non-farm-based cash earning activities. Landowners have also done this, however, not to the same extent, and not with the same level of reliance.

In this chapter I argue that migrants have been resilient, but also that the limited livelihood options available to them due to limited access to land may make them economically vulnerable if exposed to further external or internal shocks (see Chambers, 1989; Adger, 1998; and Ashraf & Routray, 2013). Even though migrants were quick to abandon cocoa, their new sources of income were not able to fully replace their previous income from cocoa. Most households shifted to selling betel nut and fresh food as their main sources of income, hoping that the income earned would replace that lost from cocoa. Most households, however, continued foraging from cocoa trees as they realized cash generated from other activities was not able to sustain their livelihoods. Migrants, in response, increasingly invested in social resources such as family connections, and their relationship with landowners to reduce further threats. The greater reliance of migrants on their social relationships was discussed in Chapter

5. To maintain household food supply, migrants were also creative in adopting crops, such as banana, aibika*, karakap* and Japan cheera, which possessed characteristics, such as being able to be grown on less fertile soils or being fast-maturing. In contrast, it is argued that landowners had greater livelihood opportunities than migrants because they were able to draw on their more extensive land-based resources to diversify their sources of income. In the chapter I argue that intensification has enabled migrant households to adapt their livelihoods to life with CPB, but that the options for further intensification may be limited and this may increase the vulnerability of these households to future pressures or shocks. Landowners, on the other hand, although slow to respond to the initial impact of the financial shock brought by CPB, were able to choose an easier option of agriculture extensification where they brought more land into cultivation. This, however, means shorter fallow periods for lands that are within short walking distance of the villages and potentially land shortages in future.

First, I highlight in the chapter the shift in income sources for migrants and landowners following the CPB intrusion. I then discuss reliance on traditional crops as an initial response by migrants and landowners. This leads to the key response by landowners, which is expansion and diversification of farm and land-based income activities. Under this, I describe agriculture extensification and the expansion of food gardens as a key response by landowners. Second, I discuss agricultural intensification, as a key response by migrants to the financial shock experienced. It does so by describing activities that were adopted by migrants in response to financial stress in order to maintain household food supply. Third, I discuss increased reliance on non-farm activities by both groups providing examples of activities they engaged in. Finally, I provide a summary of the key differences between migrants and landowners' adaptation strategies and conclude with implications of these differences for future shocks and stresses.

Increased use of existing resources and diversification of farm and land-based activities

Since cocoa was the key income source for migrants and landowners prior to the CPB incursion, other land-based sources were frequently less utilized to generate cash. For landowners, these resources include betel nut, coconut, sago, firewood, and garden produce. For migrants, these include fruit and nut trees intercropped in their blocks, betel nut and sago. After the pest incursion, the pressure on households to raise income for survival required them to shift their focus to these resources.

Reliance on traditional crops as initial key income sources

Betel nut, sago, and coconut, in addition to fruit and nut trees, were important safety nets during the CPB period. Betel nut, sago and coconut are perennial crops cultivated for many reasons. For example, betel nut is used as a stimulant and is of great cultural importance, including being used in church activities, and bride price ceremonies. Retaining betel nut was therefore very important for the villagers. Similarly, sago is an important traditional staple food for the people and consumed daily. Sago palms also provide building materials, firewood, traditional medicine for treating rashes, and feed for livestock. More importantly, to own a sago patch meant food access and security for the household. However, heavy dependence on sago could result in overharvesting and shortage of mature palms (Sowei, 2017). Coconut, on the other hand, is the 'tree of life'. Parts of the coconut palm are used for food and feed for livestock, medicine, oil, firewood, building materials, cleaning tools, and art and crafts.

These traditional crops are integrated within indigenous socio-cultural, economic and political structures and are critical to people's livelihoods. They indicate people's wealth in terms of land access and food security and reflect people's social status. They were also important to maintaining social connections with friends and relatives through social and cultural interactions such as fundraising activities, church activities, bride price ceremonies or simply sharing of surplus food. During the CPB period, landowners maintained more of their traditional crops than migrants. Although migrants had access to betel nut, sago and coconut, these were not in sufficient quantities to set them on equal standing with landowners.

Common strategies of responding to stress in developing countries include livelihood diversification, agricultural intensification and migration (Ellis, 1998; Hussein & Nelson, 1998; Barrett *et al*., 2001; Whitehead, 2002; Kassie *et al*., 2017). Livelihood diversification is defined as 'the process by which rural families construct a diverse portfolio of activities and social support capabilities in their struggle for survival and in order to improve their standards of living' (Ellis, 1998:4). Diversification is largely determined by context and adaptive capacities of households. When the CPB struck, and cocoa income fell, migrants were first to abandon their cocoa blocks and diversified into and expanded their other livelihood activities to generate cash particularly to maintain food supply. Landowners followed afterwards as there was less pressure on them to quickly explore alternative livelihood income sources due to the availability of food resources.

Prior to the CPB epidemic, cocoa was the primary income source for the majority of migrants (98%) and landowners (91%). People were very dependent on cocoa income to purchase processed food such as rice, tinned fish, tinned meat, flour, salt, sugar, coffee, tea and other household items such as solar lamps, carpentry tools, and personal items such as clothes and shoes. When cocoa income declined people turned to livelihood activities that can easily generate income for them.

Diversification into hunting, fishing and gathering

Because income from cocoa fell, people had to seek alternative sources to generate cash. This is where a key difference between migrants and landowners is displayed. For landowners access to forest lands made available options to hunt and fish in the rivers, and to harvest food items that grew wild. Pigs, bandicoots and flying foxes were more regularly sold compared to pre-CPB period where more protein was obtained from trade stores or from Wewak. Migrants were unable to make the same adaptation because they did not have the same access to forest resources. Although migrants traditionally were hunters back in the mountains, it was not possible for them to shift to hunting or fishing, or to gather emergency food from the wild to generate cash.

Diversification into non-agriculture activities to earn income

Non-agriculture activities provided a better option for migrant households when seeking strategies to raise income after the incursion of CPB. For them, this meant pursuing activities that did not require land. And so, some began selling items such as home-made bread, doughnuts, fried flour, scones, biscuits, noodles, dry cell batteries, kerosene, phone recharge cards and cigarettes. One migrant owned a small petrol generator set. The generator would supply power to his house for the lights; however, he earned K2 from mobile phone users who wish to recharge their phone batteries using his generator. Landowners had similar opportunities however, the availability of land-based resources meant that the focused more on those to generate cash.

Diversification of activities to maintain household food security

While attempting to raise household incomes, people also had the challenge of maintaining household food supply. This is because cash obtained from cocoa prior to the CPB intrusion was primarily used to purchase household food. This was no longer the case during the CPB period. My fieldwork observations and interviews with household members reveal that landowners increased their time spent hunting and in subsistence farming to maintain food

supply. They consumed more of certain foods that were not normally consumed prior to the CPB epidemic with foods including flying foxes, bandicoots, freshwater fish, eels, prawns, wild fern, tulip and *kumu mosong* becoming important additions to people's diets. This, however, did not mean their diets improved; rather people were eating diverse foods but infrequently and in smaller amounts. For example, a local fern variety that had the shoot shaped like the number nine (9) and grew wild in the village became a very popular leafy vegetable in the community. When the supply ran short in the forest, people had to forage for it in other locations. This fern is also eaten in parts of Wosera (Curry. G. pers. comm., 2023). The locals reported that it was rarely consumed prior to the CPB period. The hospital chairman describes it this way:

> We used to eat rice and tinned fish. However, these days we eat this green [known as] 'number nine'. We are in bad times. Every day, every home you go, this number nine is present (Papa Titus, April 2016).[5]

Landowners' access to land and forest resources made it possible for them to engage more strongly in subsistence farming. In doing so, they brought more land into cultivation. This is discussed later in this chapter. The majority of landowners, to a large extent, disengaged from the cash economy in response to the impact caused by CPB. Migrants, on the other hand, had to rely more on the crops intercropped with cocoa or planted in house gardens to supply household food.

Engagement in land-based income earning activities

Land-based income earning activities were crucial to people's livelihood after the incursion of CPB. Activities such as expanding food crop production for home consumption and sales at local markets, rearing of livestock, reliance on remittances, and planting new crops have been reported by Curry *et al.* (2011) for East New Britain farmers who experienced financial crisis when CPB destroyed cocoa. In Dagua, landowners shifted to betel nut, sago, coconut and firewood to raise income and maintain household food supply. Many migrants also diversified into other land-based resources, however, the approach they took differed to the responses of landowners. Migrants intensified their use of land and were selective of the crops they cultivated. In particular, they adopted crops that had special characteristics such being fast-

[5] *"Bipo mipla kaikai rais na tinpis. Tasol nau mipla olgeta kaikai displa kumu namba nain tasol. Yumi stap long taim nogut, olgeta wan wan haus yu go, olgeta dei namba nain isave stap)".*

maturing or tolerant of poorer soils. These are discussed further in the later part of this chapter.

Most income sources for migrants and landowners were derived from land-based resources, and this illustrates the significance of land access in determining people's adaptive capacity. Since migrants had limited land access, they are less able to resort to subsistence production than the land-rich landowners and had fewer regular sources of income (Figure 8.1). Landowners, in contrast, did not face the additional challenge of accessing land, and so were more easily able to benefit from various land-based livelihood activities, including scaling up subsistence production. These differences highlight the greater vulnerability of migrants.

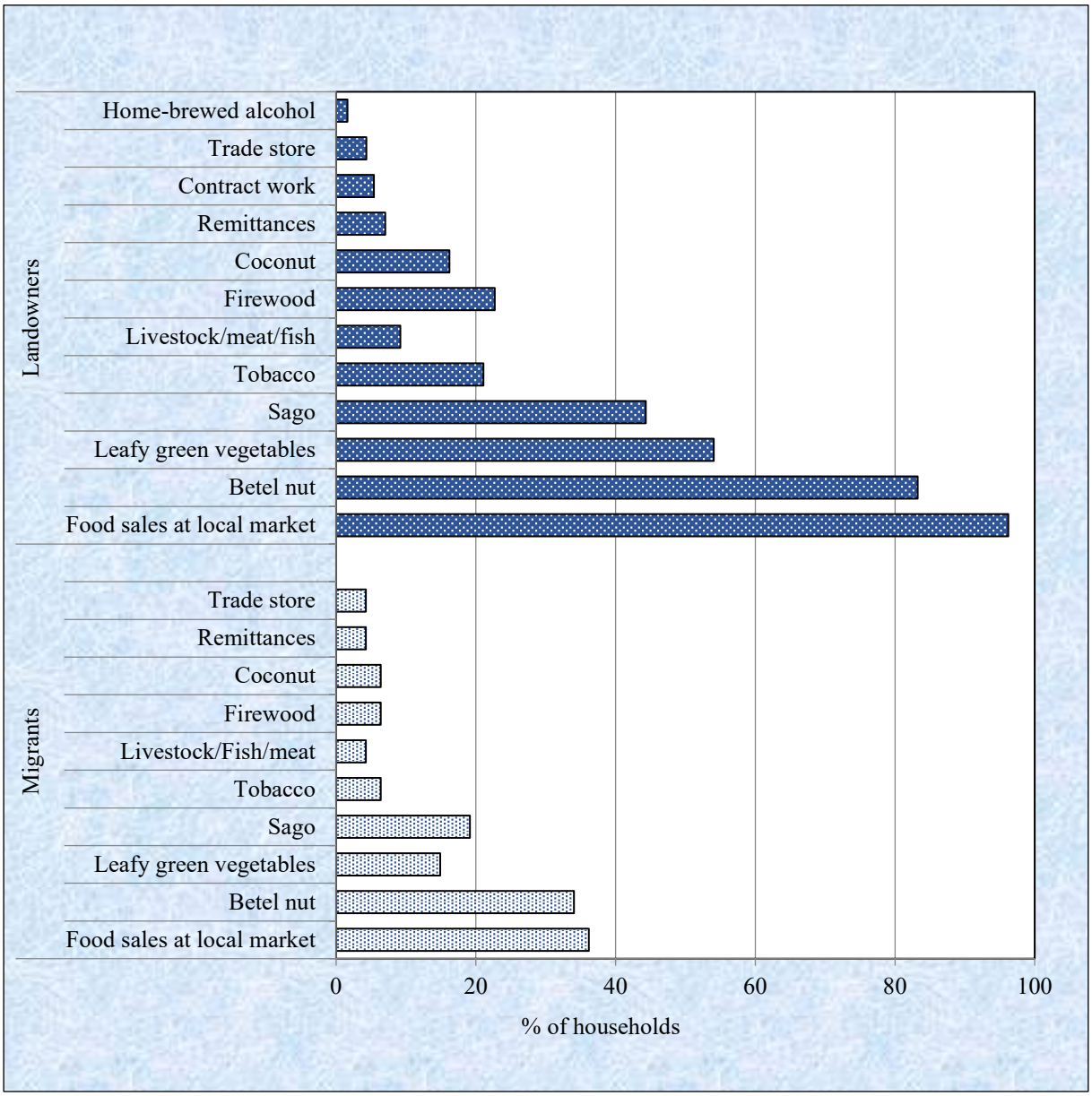

Figure 8.1: Most frequently reported regular income sources for migrants and landowners after intrusion of CPB.

Increased sales of betel nut

Betel nut, a crop that was readily available, became an important source of income for both migrant and landowner households. It became a regular source of income for 83% of landowner households. A further 14% of landowner households earned income from betel nut on a non-regular basis. Migrant households also earned money from betel nut. Betel nut provided a regular source of income to 34% of migrant households, and a further 49% earned money from it intermittently. Because of access to plenty of land, landowners cultivated betel nut in food gardens, around the homes and in cocoa blocks. When garden lands were left to fallow, betel nut palms remained and kept producing. As people cleared new food gardens sites, they inter-planted the food crops with betel nut. This increased the number of palms landowners owned. The ability to draw on betel nut for income demonstrates the better access to land amongst landowners. And so, although both communities cultivated betel nut, a majority of landowners were able to shift quickly to betel nut selling when cocoa income fell. Betel nut was sold by landowners within the community or to Wewak. Migrants who engaged in betel nut selling mostly sold in smaller quantities at roadside stalls. Migrants are not able to supply Wewak market or other distant markets as they generally do not produce sufficient quantity of betel nut to make such trade viable. A greater opportunity to raise income from betel nut arises when betel nut traders from the highlands travel to Dagua to purchase betel nut in bulk for resale in the highlands (for a discussion of the betel nut trade between highland buyers and coastal suppliers, see Sharp (2012). To the highland traders, betel nut trading is a very lucrative business and buyers travel throughout Papua New Guinea including the East Sepik province sourcing betel nut (Sharp, 2012). Because landowners own more palms than migrants, they are better positioned to supply the highland buyers.

Food sales at local markets

Sale of garden produce is an important livelihood activity for many Papua New Guineans (Bue, 2013; Curry *et al.,* 2007; Koczberski *et al.,* 2001). Fresh food marketing is often adopted to buffer the impacts of stress on people's livelihoods. An example of this is displayed amongst the oil palm growers in the West New Britain Province. Bue (2013:104-24) explained how smallholders, in response to pressure on land due to an increasing population, intensified food crop production to maintain household food supply as well as to generate additional income. Curry *et al.* (2007, 55-6) have also described the significant role gardening and local markets played in generating income following the impact of CPB in East New Britain Province. A similar response is evident in Dagua with 96% of landowners and 36% of

migrants regularly earning money by selling food at local markets. This included cooked food such as scones, doughnuts or *'karamap'*[6] and vegetables other than leafy vegetables. Landowners' access to land meant that they were more likely to cultivate more food crops in response to CPB than the migrants.

Leafy green vegetables

Demand for leafy green vegetables, which are a typical part of people's daily meals, provided another opportunity for people to sell. Leafy green vegetables are either cultivated or harvested from the wild. Common cultivated leafy vegetables include *aibika aupa* and pumpkin tips. During the fieldwork (2015-2016) an extended dry spell, associated with an El Niño event, made it difficult to cultivate these and other leafy vegetables such as watercress and Kangkong. Other leafy greens that were harvested from the wild include *tulip*, *kumu mosong* and various local species of fern. The greens harvested from the wild were able to withstand the drought, and so were harvested for consumption and sale. Harvesting from the wild in response to drought is a common adaptation strategy by people in PNG (see Haley, 2001); however, this is not the centre of discussion in this section.

A key difference between the landowners and migrants is that landowners have access to the vast forest to harvest wild leafy vegetables. The forest provided the safety-net where in times of catastrophes such as drought, people turn to for survival. When CPB struck and incomes fell, landowners had the advantage of land and forest as key safety-nets from which they cultivated and harvested from. Migrants, on the other hand, are reduced to cultivating common crops such as aibika, aupa, spring onion or pumpkin and less commonly tulip all on the limited land they have. Clear differences between landowners and migrants are evident with 54% of landowners but only 6% of migrants engaged in selling leafy green vegetables. This highlights how migrant adaptation strategies were constrained, and how the compounding shocks of drought and CPB impacted them.

Sago

Many more landowners (44%) were earning income from sago on a regular basis compared to migrants (15%). Sago palms take more than a decade to mature, and so they are a carefully conserved resource. They are also important as an emergency food source when other crops fail. Sago however, presented an easy option for most landowners to make money in response to the household income stress. Sago was rarely sold prior to CPB; however, due to the need

[6] A *karamap* is a small parcel of cooked food wrapped in leaves prepared for immediate consumption.

for cash, excess sago is sold. The starch is packed in empty rice or flour bags and sold for K20 to K30 in the local market or at Wewak Market. The crop can be cultivated, and also can proliferate naturally in wet places such as swamps, and beside rivers and creeks, making it readily available for use. Much of the input is in the form of labour during harvesting of the starch. The planting and management of the crop requires little labour. Most landowners have ready access to sago palms, whereas migrants have much more limited access to land and to sago palms. The few sago palms in the migrant community were mostly planted by migrants. Suckers developing from the original palms if not transplanted grow on their own, and these belong to the original landowners. However, with the increasing population, and increased utilization of sago for food and income, shortage of sago palms is likely to happen in the long run which would place people in conditions of food insecurity. Most sago produced by migrants is for household consumption as they did not possess sufficient stands of sago to be able to increase their production during the CPB period.

Coconut

Coconut, which is commonly intercropped with cocoa, played an important role in generating income for some households during the CPB epidemic despite the fall in copra prices in the early and mid-2000s (see Mellor, 2010). The sale of coconut was a regular activity for 16% of landowners and 4% of migrants. However, an additional 4% of landowners and 11% of migrants reported coconut as a non-regular source of income. Because copra prices were low, migrants shifted the use of coconut to meeting household needs. It was also more profitable to sell coconuts as *kulau* – green drinking coconuts – and dry coconuts for consumption rather than processing to copra. Increased sales of dry coconuts and *kulau* was also a common response by cocoa growing households in ENB in response to CPB and low copra prices (Sharp *et al*., 2022). Migrants were able to sell *kulau* at their roadside stalls for K1.50 to K2.00 depending on the size. Migrants had limited existing plantings and were not able to expand their coconut plantings because land was not available to them. Landowners, in contrast, were able to sell *kulau* and dry coconuts at Wewak.

Firewood

The sale of firewood also increased after the arrival of CPB, mostly amongst landowners with 23% of landowner households reporting to regularly earn income from firewood sales, compared to only 4% of migrant households. Demand for firewood existed in Wewak prior to the CPB period, however, Daguans only identified this opportunity after CPB struck and the need for cash became imminent. Firewood work is mostly done by women and became an

important activity for women to generate cash for the household during the CPB period. Women are involved in collecting wood from the forest, chopping into manageable pieces, packing into bundles which are stacked at the roadside awaiting the village PMV truck to transport it to various selling points in Wewak (Plate 8.1). The bundles were sold for K3, K5, K7 or K10 depending on bundle size and wood quality. Bigger sizes and longer burning woods are more expensive than small bundles or low-quality wood. Selling of firewood requires women to sit at the market in the hope of selling all bundles in a day. Those women with unsold bundles may overnight with relatives in town to continue selling the next day. Firewood can also be left with relatives to sell, though they typically need to pay the relative doing the sales. This is an additional cost, on top of the other costs involved such as passenger fare and cargo fees charged by the PMV truck owner.

Plate 8.1: Packed firewood and dry coconuts ready to be transported to Wewak.

Migrants rarely sell firewood as they do not have access to wood in the forest. The few, who sold firewood, did so opportunistically when, for example, a tree had fallen in their cocoa blocks. However, this is not a regular activity and was only done if there was no need to use the wood at home.

In sum, in response to the economic impact of CPB, both landowner households and migrant households responded by falling back onto existing resources that were underutilised. They did so both as an immediate coping response and as a short-term, and potentially longer-term, adaptation of their livelihoods. But beyond this, landowners and migrants developed different adaptation strategies. Landowner households, with their extensive access to land-based resources primarily adapted through expanding their garden areas. Migrants, on the other

hand, with limited land resources, adopted an intensification approach. Once again, land access was the critical factor determining the different approaches and fortunes of landowners and migrants.

Agricultural intensification

According to Boserup's theory, as population density increases so does agricultural innovation and land use intensification. In PNG, evidence of agricultural innovation and intensification in the subsistence production system were studied and the conclusion drawn that such practices were present and continue to emerge when communities are faced with population pressure. This is evident through initiatives such as adopting high-yielding crop species, changing agricultural techniques, acquiring additional land for cultivation of crops, and working harder (Koczberski *et al*., 2018; Bourke, 2001; Ningal *et al*., 2008; Bue 2013). However, it should also be noted that people's attitudes also determine intensification practices. For example, Allen (2018:111) stated that fallow periods on lands closer to homes were shortened because the younger generation were not willing to walk long distances to clear taller forest trees for gardening. This resulted in reduced fallow on land closer to homes as people regularly cultivated them. This observation is slightly similar for Dagua where landowners shorten the fallow length of nearby gardens and are they less likely to establish more distant gardens (Plate 8.12).

The primary driver for agricultural intensification by migrants is poor land access which does not allow them to expand as landowners are doing. Migrants' response was similar to the settlers in West New Britain who ran out of land space to expand production and so had to intensify (Koczberski *et al*., 2018:805). This section presents evidence demonstrating the significant decisions migrants made to maintain household food supply as well as raise cash in response to the impact of CPB. It discusses increased intercropping, more cropping of house gardens, adoption of crops that are more tolerant of high-density planting, shade and poor soils, as well as fast-maturing crop varieties. These intensification strategies are discussed below.

Increased intercropping in cocoa blocks and house gardens

The loss of income from CPB threatened food and income security. A strategic response by people was to increase intercropping in their cocoa blocks and around their homes. This strategy was more pronounced among migrants than landowners. Because of their limited

land assets they had to plant mixed crops in house gardens and in their cocoa blocks. Plate 8.2 illustrates some crop species that are planted by migrants in house gardens. Migrants seek to cultivate crops that serve a particular purpose. Their need to cultivate crops for food, such as *tulip*; home building, such as the black palm; and for income, such as the nut trees, means crops are typically planted at higher densities than would usually occur. The implications of this on soil fertility and perceived long-term vulnerability are discussed in Chapter 9.

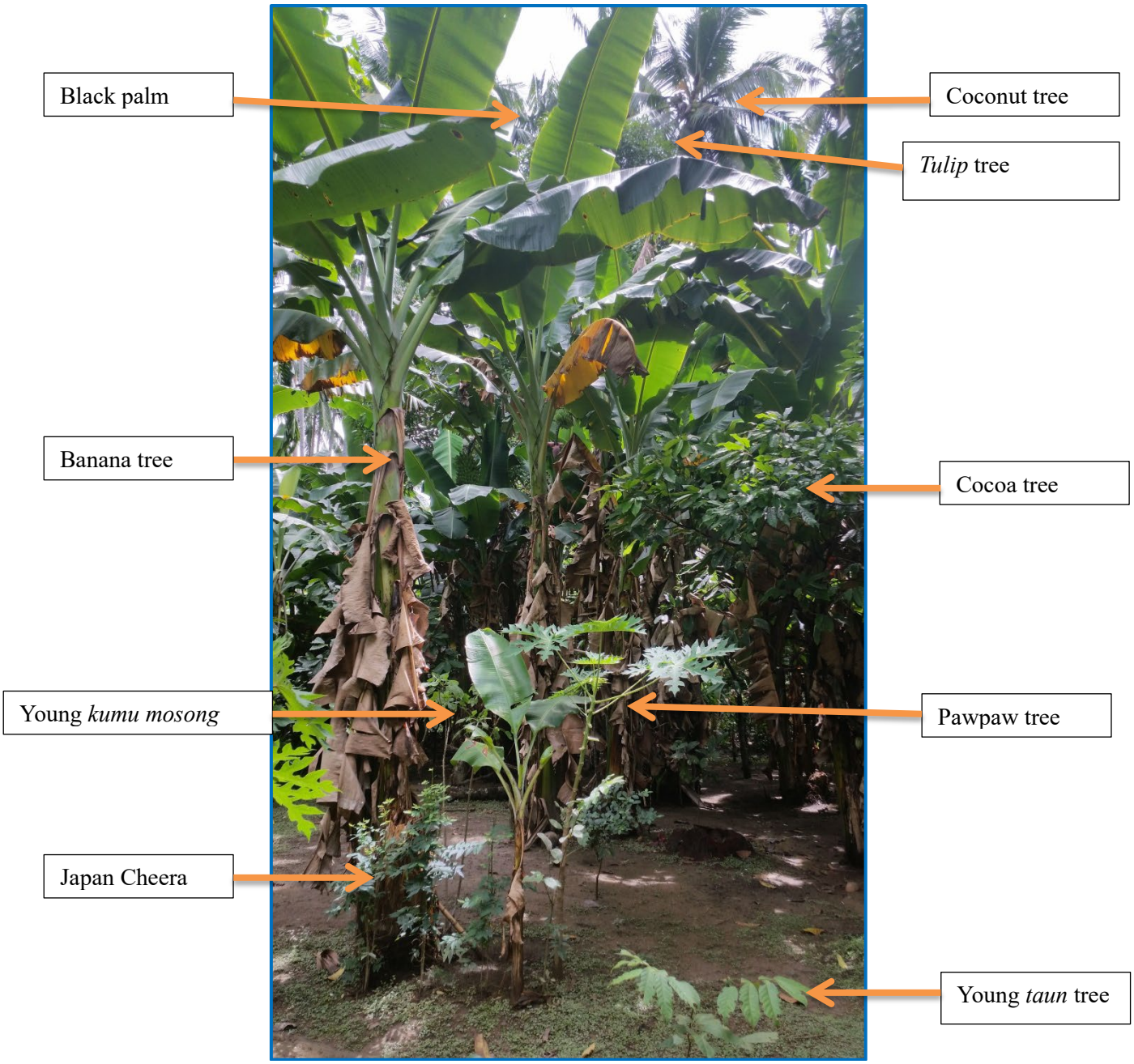

Plate 8.2: A migrant house garden with block in the background where cocoa is intercropped with black palm, coconut and *tulip*

Adoption of tolerant crops

An important decision migrants make is choosing the type of crop they adopt into their gardens and blocks. The key factor in their decisions is the amount of land they have access to. This leads migrants to adopt crops that are vigorous, tolerate poor soil, shade-tolerant, and fast-maturing is crucial considering the amount of land they have. Such crops include banana, cassava, aibika, Japan Cheera *(Sauropus androgynous),* and *karakap (Solanum Americanum).*

A banana variety (Plate 8.3) and tobacco (Plate 8.4) provide two examples of crops migrants have adopted and increased their plantings of due to their tolerance of high planting densities.

Plate 8.3: Migrants' ward councillor displaying his banana patch grown intensively at his front yard.

The banana variety in Plate 8.3 is a quick-maturing cooking banana which has a high cultural value. It is traditionally known by as *seminauk*. Because it was introduced into Dagua from the Autonomous Region of Bougainville specifically Buka, it is also called '*meri* Buka' (as in Buka woman). '*Meri*' or woman figuratively symbolises its ability to provide food for the household. It possesses a slender and shorter pseudo stem. These features are important because it requires less space, and so, more of it can be planted in house gardens.

Furthermore, kitchen waste is often scattered at the base, thus, enriching soil fertility. Migrants were encouraged by a ward councillor to grow this banana in small patches around their homes because of both its morphological features and its cultural value. During the interview, the migrant ward councillor explained, “I am doing this so people can see and follow. I am telling our people to grow bananas like this because we do not have much land”. As displayed in Plate 8.3, it is planted in neat rows with sugarcane, taro or sweet potato in between. This was an important response by migrants because it demonstrated their traditional knowledge about bananas, and how this knowledge can be utilized when adapting to food and income shocks. At the market, because of the banana’s high cultural value, a whole bunch of the banana is sold for K40-K50 depending on the size of the bunch. This is a significantly higher price than for other banana varieties.

Tobacco *(Nicotiana tabacum)*, *brus* in Tok Pisin, is another high value crop that was adopted by migrants (Plate 8.4). During the El Niño in 2015-2016 cultivation of *brus* was affected, however, 11% of migrants and 6% of landowners reported that they increased the planting of the crop when their incomes fell after the intrusion of CPB. Migrants’ up-scaling of tobacco production during the CPB period was for two reasons.

Plate 8.4: Dried *brus* leaves and bundles at the market.

First, it was a high-value crop and generated attractive income for growers as the demand was high, and its high value to weight ratio makes it suitable to trade to long distance markets including Wewak, Madang or Kimbe. Secondly, tobacco requires minimal space to cultivate and so could be easily cultivated around people's houses. Tobacco is not suitable to intercrop with other crops such as cocoa, betel nut or coconut in the cocoa blocks because the tree crops would over-shade or out-compete tobacco for soil nutrients. Landowners who planted *brus* had the option to plant around their homes or next to food gardens in the forest. The majority preferred the forest.

Migrants also adopted another variety of cooking banana which is vigorous, tolerant of poor soils and able to withstand shade (Plate 8.5). There is no traditional name for the banana is locally called *ain* banana (as in iron banana). The term was given to describe its strong ability to thrive under shady conditions and poor soil. It is thought to have been introduced into Dagua from the coastal area of nearby West Sepik Province by Daguans who visited relatives there. Because it was introduced there is no traditional name given to it. It is planted in gardens but can also be planted on less preferred locations such as next to swamps, along roadsides, on dry land and on hill sides.

Plate 8.5: A popular banana, shade and poor soil tolerant.

The variety also produces many suckers, and so, provides a lot of planting material. The adoption of this banana into migrants' blocks was a useful inclusion as it thrives without much attention yet produces yields which are mostly used for household consumption. Its lower sale value means it is rarely sold at the markets.

Cassava is another crop that was adopted by migrants. Cassava is popular in coastal communities of PNG. Where cassava has not become a dominant food crop it is often used as a backup food source when other garden crops fail (Curry. G. pers. comm., 2023). Production for rural villagers is estimated at 65 kg/persons/year (Bourke *et al*., 2009: 140). Cassava is maintained because it is tolerant of poorer soil conditions even though yields may be small.

Migrants adopted cassava because it was a better fit with the more intensive gardening system that they pursued. It is often intercropped with other crops such as sweet potato (Plate 8.6). Planting material was easily sourced from the gardens of friends or family. Because it can tolerate a wide range of soil types, farmers planted it in house gardens as well as intercropped it with cocoa in their cocoa blocks. Cassava was mostly grown to maintain household food supply. It is occasionally sold.

Plate 8.6: Cassava patch cultivated in a house garden

Adoption of fast-maturing leafy vegetables

Crucial to maintaining household food supply for all migrant households is adoption of crops that are easily cultivated, require less labour to maintain, are fast-maturing, and can be harvested multiple times. Households have adopted a certain variety of *aibika* (Plate 8.7), Japan cheera (Plate 8.8), and *karakap* (Plate 8.9). A potential emerging crop – *valangur* (Plate 8.10) is slowly being adopted by Daguans.

The fast-maturing *aibika* variety adopted by migrants is locally known as *3-pinga* (3 fingers) aibika because of the three extended leaf blades it possesses (Plate 8.7). This *aibika* is very vigorous in its growth. In fallowed gardens, the crop thrives amongst weeds. The inclusion of fast-maturing and weed tolerant aibika into gardens is another example of people's creativity in adopting beneficial crops to maintain household food security by intensifying their use of the land. It is not known how this aibika variety was introduced into Dagua; however, it has become popular amongst the migrants and a regular addition to their evening meals.

Plate 8.7: A fast-maturing *aibika* variety planted in a migrant's house garden.

Harvesting of this *aibika* continues even after the garden has been left to fallow. The crop also thrives in sites less suitable for cultivating other crops including swamps or hillsides. This *aibika* is not easily suppressed by weeds such as grass and vines and continues to produce

many growing shoots which are harvested multiple times. This *aibika* is not sold at the market to generate income because it grows wild along tracks, roads and in fallowed garden and so there is no demand for it.

Another fast-maturing crop that has been adopted in Dagua is the Japanese cheera vegetable *(Sauropus androgynous)* (Plate 8.8). The vegetable is popular only in certain coastal and islands provinces of Papua New Guinea. I first came across the vegetable in the late 1990s at Kamkumung settlement in Lae, Morobe Province. In Madang, this is often named in Tok Pisin *'tri-deis kumu'* or 'three-day greens' following its early maturing characteristic. New tips sprout three to five days after older tips are harvested.

Plate 8.8: Japan Cheera vegetable cultivated in a house garden.

People freely cultivated this vegetable near their homes in small patches. The vegetable is convenient for migrants because it requires minimal space. The shrub can grow up to two meters in height and produces leaves more than five centimetres in length. It also produces multiple upright stems, with many branches. New branches develop after shoot tips are harvested making multiple harvesting possible. This contributes to maintaining food supply. The crop is rarely sold at the market.

Another fast-maturing traditional crop that has become popular is karakap *(Solanum americanum)* (Plate 8.9). It is a traditional crop and widely grown in PNG (Bourke *et al*., 2009). *Karakap* is grown around homes and in food gardens. The vegetable produces multiple growing tips which are harvested mainly for household consumption. Migrants have adopted the crop because it can be easily cultivated in house gardens and does not require much land space. Its ability to mature quickly makes it possible to harvest multiple times, thus maintaining household food supply.

Plate 8.9: Karakap cultivated in a house garden.

One potential crop that is slowly being adopted is Valangur (*Polyscias verticillata)* (Plate 8.10). Valangur is listed amongst the important crops cultivated by rural people in PNG (Bourke & Allen, 2009b:202) and is popular in other provinces such as East New Britain. The crop may have been present in Dagua for some time, however, not widely used until recently. Informal discussions with locals reveal that the crop was introduced and commonly eaten by migrant households who once lived in East New Britain. Young leaves are harvested, cooked and eaten together with meats such as fish, giving a spicy flavour to the dish. The adoption of *valangur* into Dagua meant migrants are not passive, rather are able introduce and adopt crops that can potentially meet their food needs, in their context where land access is limited.

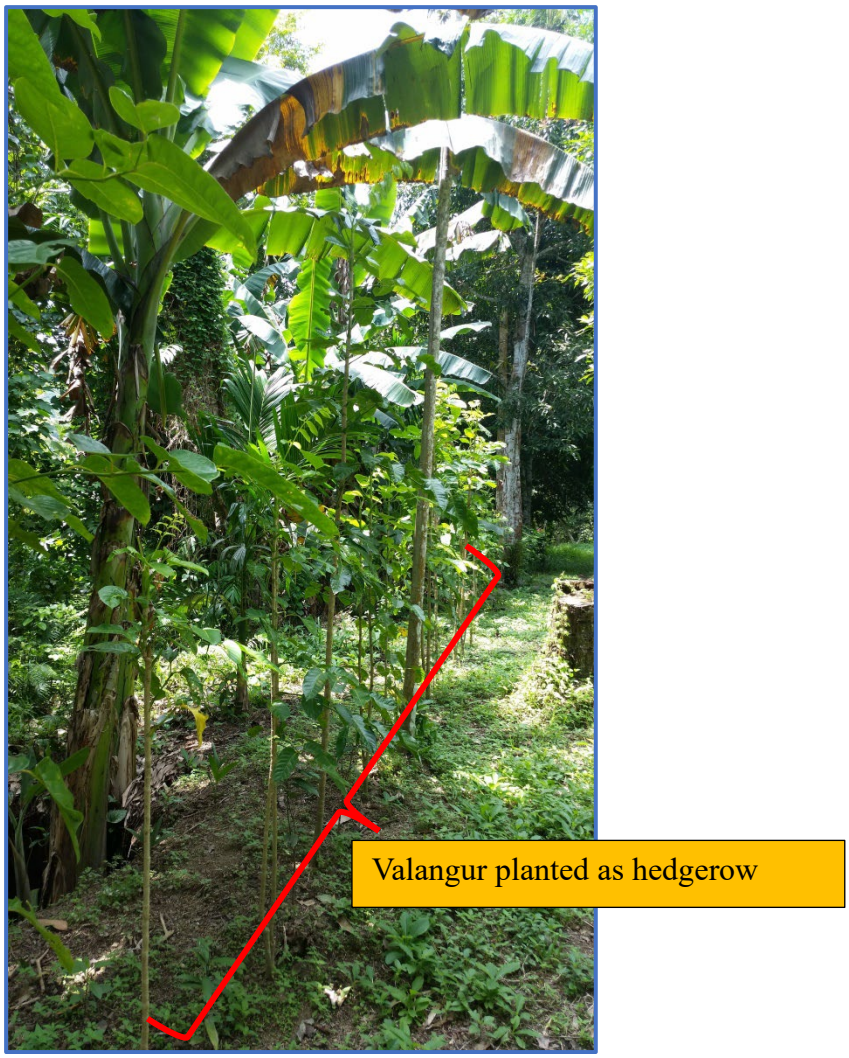

Plate 8.10: Valangur (*Polyscias verticillata)*

Other crops such as *aupa,* kangkong and pumpkin (*Cucurbita moschata)* are popular in Dagua; however, cultivation of these crops was hampered by the El Niño. Generally migrants have introduced new varieties or have increased their cultivation of particular existing varieties. These crops are maintained with very little external inputs. Labor input is minimal, and there is little to no use of fertilizers or pesticides applied in the gardens. This is because people did not have money to pay for the chemicals. However, kitchen waste and fallen tree leaves are often deposited in house gardens.

Agricultural extensification

While limited land availability has compelled most migrants to adopt a strategy of intensification, ready access to land has meant most landowners have taken an extensification approach, where more land is brought into cultivation, primarily to expand subsistence production. Fallowed land or portions of the forest are cleared, burnt and land prepared for planting (Plate 8.13). These gardens are planted with mixed crops as well as crops that are

important to ascertain ownership to land, crop with social significance and those that provide building materials (Plates 8.11, 8.12 and 8.13). The extensification strategy is also characterized by low inputs including chemical fertilizers and labour.

Plate 8.11: A landowner's subsistence food garden showing mixed cropping.

Plate 8.12: A landowner's abandoned rice farm.

Plate 8.13: A landowner's garden showing aibika intercropped with banana, and cleared site for garden expansion on the slope.

Landowners have more land-based livelihood options open to them than migrants because they have access to more land and land-based resources such as timber, sago palms, canes, wild leafy vegetables and fruit trees. They utilized secondary forest, some of which was very old, to expand production (Plate 8.13). Migrants, on the other hand, are much more constrained to the limited land they had and were not able to expand cultivation into new areas, also limiting the types of crops they can plant.

Increased use of underutilized land-based resources

Landowners' diversification strategies also led them to explore underutilized land-based resources. For example, when clearing the forest for gardens, trees are felled and left to dry before being chopped, bundled and taken home for firewood. Also during the clearing of the forest, people harvest wild varieties of leafy vegetables that are available. These are added to their diet, and if there is surplus sold at the local market.

Sewing of sago leaves for roofing in traditional houses is a common practice amongst few landowners (Plate 8.14). Although the activity is not regular, it provides an example of landowners' ability to access an array of land-based resources to earn money, beyond the cultivation of food gardens. This activity is not common for migrants because migrants do not have access to large groves of sago palms. Furthermore, thatched-sago leaves, require cane and bamboo strips, which have to be accessed from the forest which migrants do not have harvesting rights to. Only landowners were sewing and selling thatched-sago leaves.

Plate 8.14: Landowners sewing sago leaves for thatching roofing.

Increased consumption of wild caught foods

Seafood is rarely harvested by Daguans. This was observed by Mead early in the 1930s (Mead, 1938:226). When migrants moved to Dagua, they did not have access to the sea resources because sea resources belonged to the landowners. A few migrants, however, attempted to buy dried fish from the Sepik River sellers and resold them at Dagua. There was, however, a regular fishing for freshwater fish. This was particularly done by landowners who lived next to the rivers. Prawns, eels and freshwater fish added to people's diets. Because migrants did not have access to the rivers, it was impossible to make consumption of these protein sources regular.

Bush meat often hunted by landowners included bandicoots, flying foxes, wild pigs, cassowaries, and possums. Sago grubs were also gathered. After the incursion of CPB some landowners who owned land on the mountains began setting up flying fox traps by chopping trees and constructing narrow flight paths through the trees to catch flying foxes (Plate 8.16). A net is then erected across the flight path to capture the flying foxes. This activity became regular after the CPB incursion, but only amongst landowners. Migrants do not have access to

the forest and hunting grounds and were therefore more dependent on home-raised livestock such as chickens or ducks.

Plate 8.15: Part of the forest owned by landowners.

Plate 8.16: Flying fox flight paths constructed by a landowner.

Increased rearing of semi-domesticated and domesticated livestock

Many landowners have semi-domesticated pigs. These pigs freely forage through the village and in the bush during the day and return to the village in the evening to be fed. And so the cost of feeding a pig is considerably lower if it is able to forage for a high proportion of its food. Migrants do not have rights to the forest and other areas where there are no gardens so it is much more difficult and costly for them to raise pigs. Moreover, damage caused by pigs in food gardens caused migrants to pay compensation, which placed additional financial burden on them. The sale of pig meat was a non-regular activity that increased for some landowners during the CPB period. Pig farmers indicated that a whole pig was highly valued and so sold for K600-K800 depending on size. However, because consumers only occasionally bought a whole pig, pigs were more frequently slaughtered and cut into pieces and sold at affordable prices ranging from K3 to K10 a piece depending on the part sold. For example, quality cuts of pork would fetch the seller K5-K7, while pieces with less meat received a lower price. This strategy earns the seller less than if they had sold the pig whole, however, the aim was to get the meat sold. Farmers also sold piglets for K30. Wild pigs are sold in a similar manner to the domesticated pigs. The benefit of this activity to pig farmers motivated farmers to increase their effort.

A small number of migrants were able to raise local chickens and ducks around their homes. The animals are small and easier for migrants to look after than pigs. It also provided the household with a good source of protein. Having animals reared closer to homes meant migrants had access to protein sources which they were able to consume and sell for cash.

The section above discussed land-based activities pursued by migrants and landowners in response to the financial shock caused by the CPB epidemic. I argue that land access is the key determinant in people's adaptive capacities. Migrants' limited access to land meant there were a range of activities that they were either excluded from entirely, or were less able to participate in. The next section discusses people's increased reliance on non-farm or non-land based activities.

Increased reliance on non-farm/non-land-based activities for income generation

Engagement in non-land-based activities was important in generating incomes amongst both migrants and landowners. Migrants often had little choice but to diversify into non-land based activities as their land-based resources did not provide them with sufficient food and income. Landowners, on the other hand, had greater choice in whether to diversify into activities not

reliant on land because generally their land-based resources were sufficient to provide a living. Similar is evident amongst settlers in the oil palm areas of West New Britain Province (Koczberski *et al*., 2009:77). According to Koczberski and colleagues, smallholders adapted to economic and population pressure by diversifying into non-oil palm activities such as running PMVs and trade stores, selling phone credits, kerosene, cigarettes, candies, snacks to generate income to support livelihood (Bue, 2013:142; Koczberski *et al*., 2009:75-77).

Increase in remittances

Both migrant and landowner households reported an increased dependency on remittances. Remittances came mostly from their relatives living in Kimbe and occasionally in other PNG towns, or from relatives living or studying overseas. Remittances are significant because they contribute to the social bonds and economic status of communities (Rempel & Lobdell 1978; Curry & Koczberski, 1999; Dalsgaard, 2013). Although landowners reported receiving remittances, remittances were not as critical to sustaining their livelihoods as they were for migrants. For landowners, remittances tended to be used for social activities such as mortuary expenses, compensation and school fees. Although migrants also used remittances for these purposes, their need to maintain food consumption meant remittances were often used for immediate household food supply. This brings to light the struggle to maintain food security in migrants' homes during the CPB crisis.

Increase in marketing of store goods and other items at roadside markets

Selling of manufactured goods at roadside markets was important for some migrants (Plate 8.17). Store goods such as soap, sugar, salt, biscuits, lollies, cigarettes, and cigarette lighters are common items sold to commuters. Migrant women who were able to sew clothes and weave bilums sold their products at roadside markets. Migrants also produced *karamap* – small quantity of pure or mixed food wrapped with leaves and boiled or cooked in coconut cream – for sale. A popular *karamap* is sago mixed with ripe sweet banana wrapped with leaves and cooked in coconut cream. This is served as small parcels.

Betel nut, betel pepper, and lime, bought from Wewak market, were also sold at village markets. For migrants, it was convenient as many of them lived next to the highway. According to the migrant councillor, migrants initiated the roadside market activity prior to CPB to earn additional income to support their livelihood. This activity was scaled up considerably after the arrival of CPB with along with the sale of store goods. A few landowners also attempted marketing at the roadside markets; however, the push to do so was

less compared to migrants as they were able to secure food from their food gardens and other land-based resources. The migrants also lived closer to the main road than most landowners and so were better positioned to trade on the roadside.

Plate 8.17: Migrants selling items home-sewn clothes, bilums, store items and betel nut at roadside market.

Opportunities for contract work

Churches, schools and the hospital in the community also provided opportunities for people in Dagua to engage in contract work. Usually there is no favouritism in awarding contracts; however, given the type of contract and the availability of resources, landowners' assets often better positioned them to be offered the contract than migrants. This is because the contract work often needed land-based resources such as building materials or sand for mixing concrete to which the landowners had better access due to their control of forest resources and the shoreline.

Increase in home-brewed alcohol selling

Existing demand within Dagua and in Wewak town area provided a market for home-brewed alcohol, and a small number of households produced alcohol for sale. Home-brewed alcohol was also an important source of income for a few households. Since people had limited incomes and could not afford commercially produced beer, many consumers bought beer from

local brewers. The home-brewed alcohol is sold cheaply making it accessible to consumers. All those doing home brewing were landowners. They had better access, than migrants, to *kulau* or fruits such as ripe bananas and pineapples that are used to ferment alcohol. A youth stated: *'there is no other way for me to earn an income, so I brew and sell alcohol. The sale is fast because it is cheap, and I make money - so I am happy' (SH #77, 14/04/2016).* Migrants, with the limited coconuts and fruit trees rarely brew alcohol. Migrants were also wary of drinking as if they got into trouble after drinking, they faced the burden of paying fees, which would impact already stretched household incomes.

Conclusion

In response to the loss of their most important income source due to the arrival of CPB, the people of Dagua adapted their livelihoods to support their income and food security. Livelihoods in both communities centered on land, and degree of land access was the key factor that determined the type of livelihood activity migrants and landowners engaged in to earn income and to provide food. In some respects, the responses of migrants and landowners were similar. Both groups made use of existing resources that were underutilized, including betel nut, coconuts and firewood. But in other ways the two groups adopted very different strategies.

The key response by landowners was agricultural extensification where they brought more land into cultivation. They diversified ttheir livelihoods by engaging in more land-based activities such as cultivating fresh food, harvesting sago, increasing betel nut and coconut plantings, raising livestock and hunting wild animals. These strategies were possible because the landowners had access to plenty of land as well as the vast forest resources.

In marked contrast, the key response by migrants was adopting agricultural intensification practices. This they did by increasing intercropping and adopting crops with characteristics such as a tolerance to high-density planting, tolerance to poor soils or to a range of soil types, shade tolerance. They also adopted fast-maturing crops. Migrants' limited access to land constrained their ability to expand food gardens, and plantings of betel nut palms and sago, to raise livestock and hunt. And so, even though they diversified into alternative income-generating sources, the number of activities they engaged in was less diverse than for landowners. The motivation for migrants and landowners to pursue a certain activity also differed. For example, migrants cultivated tobacco and betel nut not only because the crops earned them cash, but also because the crops required less space. Landowners also cultivated tobacco, though primarily due to its high value rather than any consideration of the land area required to cultivate it.

Table 8.1: Key differences between income activities of migrants and landowner households during CPB period

Area of difference	Migrants	Landowners
General livelihood approach		
Diversification of livelihood activities	More emphasis on non-land based activities High participation rate in a limited range of activities Engaged in limited land-based activities.	More focus on land-based activities High participation rate in a broad range of activities Engaged in more diverse land-based activities.
Mode of agricultural expansion	Intensification with particular focus on adoption of crops of high value, tolerance to poor soils, shade and high planting density, vigorous growth, and fast-maturing characteristics. Very short to almost non-existent	Extensification with particular focus on bringing more land into cultivation. No pressure to adopt crops with special characteristics. Fallow of less than 10 years
Land-based		
Fresh garden produce	Very few diversified into producing garden food. Intercropping was significant to maintain crops on small piece of land. Less variety of fresh produce. Difficult to expand on their current production.	Many expanded on gardening and cultivation of various types of garden produce. More variety of garden produce.
Firewood	Rarely sold due to limited access rights to forest.	Access to forest made it possible to collect and sell.
Sago	Unchanged. Limited land access prevented expansion.	Increased during the CPB period.
Livestock	Less evident. Only few farmers raised broiler chickens.	Raising of small livestock was evident.
Tobacco	Up-scaled production. Cultivated around homes.	Up-scaled production and cultivated next to food gardens in forest.
Coconut	Sold dry coconuts or *kulau* at roadside markets but in small quantities. No access to additional land to expand cultivation coconuts as long term adaptation strategy.	Regular selling of dry coconuts and *kulau* at roadside markets and local markets in Wewak.
Bush meat	Not regularly consumed.	Regular hunting and consumption.
Non-land-based		
Remittances	Increased reliance on remittances including maintaining household food supply.	Remittances more focussed on meeting social obligations than maintaining household food supply.
Contract work	Less likely to engage in work involving harvest and use of land-based resources. Unable to supply more labour for group tasks as population size is small.	More likely to be engaged in work involving harvest and use of land-based resources. Bigger pool of labour to draw from to implement group tasks.
Non-food items sales	Regular at roadside stalls	Not regularly sold at roadside stalls.

Similarly, although remittances were received by households in both groups, migrants were more likely than landowners to use this money to maintain household food supply. Landowners who were receiving remittances during the CPB period used the cash mainly for social obligations. It is evident that migrants' range of adaptive responses to the financial stress is significantly reduced because of limited land access. It also highlights possible implications on future vulnerability for landowners and migrants. For example, there exists no training in sustainable use of forest lands for gardening. The need for knowledge on sustainable land use is evident as overuse of land through extensification process may result in uneven use of soil nutrients and soil degradation. With the increasing population, intensification of land use will lead to soil fertility risks (Bourke 2019:160). Moreover, intensification by migrants may lead to soil degradation forcing them into further vulnerability. They may also be limited in their options for intensification in the future, and these may place them in vulnerable state to future shocks. Because of this it is important for migrants develop innovative strategies that utilize resources accessible to them to help manage the short and long-term impacts of shocks and stressors.

Chapter 8 discussed differences in the short to long-term livelihood strategies migrants and landowners employed in response to the financial decline caused by Cocoa Pod Borer. The chapter has argued that people's adaptation responses have been primarily shaped by their different livelihood assets (see Chapter 5). These assets were also critical in shaping people's initial coping strategies (Chapter 6), and their block management practices (Chapter 7). In Chapter 9, I draw on the conclusions of Chapters 5, 6, 7 and 8 to summarize the key differences between migrants and landowners, and how this has shaped their resilience, vulnerability and adaptive capacities.

CHAPTER 9

CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Introduction

In this thesis, I have compared and contrasted how two groups of people – migrants and landowners –within an agricultural-based community were impacted by, and have responded to, the livelihood shocks and stresses caused by a serious agricultural pest, the Cocoa Pod Borer. I then compare and contrast the impacts and the key coping and adaptation responses by the two groups. I proceed to suggest implications for policy development, and lastly provide suggestions on areas for future research.

People's vulnerability to shocks and stress are context-specific and determined by the type of shock or stressor, exposure and their adaptive capacity. This thesis contributes to the literature on people's adaptive and coping strategies in response to unexpected calamities, specifically, comparing different groups of people within a community. It does this by focusing on smallholder migrants and landowners in Dagua, PNG. Over the years, the smallholder farmers in PNG continue to face challenges while participating in the modern market economy. Evidence from different locations around the country suggests that these communities coped and adapted to various catastrophes including financial shocks, limited land access, lack of credit and decline in general livelihoods conditions (Curry *et al*., 2011; Sitapai, 2012; Numbasa & Koczberski, 2012; Sengere, 2016). Their adaptive capacity is key to their responses to such calamities. Studies in different parts of the country show that shifting land-use practices and utilizing social networks are vital for sustaining livelihoods during perturbations. Farmers diversify livelihood activities, intensify land-use or engage in non-farm activities to generate incomes (Bue, 2013; Curry *et al*., 2011; Koczberski & Curry, 2005). This situation is, however, far more critical for groups of people who are settling under informal land agreements (see, for example, Numbasa & Koczberski, 2012). Unlike those living on land settlement schemes who are able to renew their tenancy agreements to the land, smallholders who have informal land agreements continuously face the risk of being displaced. Using the case of migrants and landowners in Dagua, East Sepik Province, this study examined the differences in the coping and adaptive strategies the two communities pursued in response to the unexpected decline in household income caused by Cocoa Pod Borer.

Vulnerability contexts of migrants and landowners

Engaging in the cash economy in the rural areas of PNG is challenging because key government services are often difficult to access. This becomes more difficult during time of disasters. The landowners and the migrant groups in Dagua are no exception. The migrant community in Dagua have an added stress – land access. A community is vulnerable when it possesses characteristics that are weak, making it susceptible to disaster. Land access is the dividing factor between the migrants and landowners. Migrants, as outsiders, have limited access to land and land-based resources. They are also not allowed to access the large forest lands in Dagua to extract building materials, hunt for wild animals or fish in rivers. They are at the mercy of the landowners because the agreement to settle in Dagua in the late 1940s was informal. Migrants are engaged in the cultivation of Robusta coffee, peanuts, rice, coconut and cocoa. Their livelihoods are centred on these crops as well as cultivating the small portions of land allocated to them for food gardens and building homes. Part of the migrant population moved to work on the oil palm plantations in West New Britain Province (WNBP). The division of families between these two new sites is important as it provides safety nets during periods of shocks and stress, such as the drop in copra prices. With limited land, migrants adopted agricultural intensification practices to maintain household food supply as well as to earn income. Social networks in Dagua are important. As outsiders, migrants' social connections with the landowners are critical as they help maintain land security and access to resources in times of need. Friendships developed through affiliations to groups, such as the school and the church or through cultural obligations and intermarriages, are vital strategies in maintaining relationships with landowners. In local politics, migrants have limited influence because landowners are more numerous and occupy most of the local level government positions.

Landowners access the same government facilities as migrants; however, they have an advantage over the migrants – land access. They own the land in Dagua and have access to large land-based resources. They have used their land in the cultivation of peanuts, rice, coffee, coconut and now cocoa. Land has sustained them over the years providing them with food, water, building materials and bush medicine. During disasters, such as El Niño, they rely on land as a safety net. Landowners also have extensive social networks with neighbouring villages. It is through these networks that support for customary obligations such as payments for bride prices, mortuary expenses or building homes are obtained.

Although they have similar problems accessing government services as the migrants, they are not as vulnerable as the migrants.

Prior to the intrusion of CPB, people in Dagua depended heavily on cocoa to provide income for food, school fees, health care, travel, bride price and compensation payments, funeral expenses, fundraising, and other household and personal needs. The drastic fall in income caused by the CPB had a greater impact on migrants, as they were more dependent on cocoa for their livelihoods. This study has shown how migrants were under pressure to respond to the impact of CPB because they were heavily dependent on cocoa income to sustain their livelihood. The sharp decline in cocoa income meant they had to quickly switch to alternative sources of income. This was not easy as they did not have land to make the livelihood adjustments quickly. While responding to the financial shock, they also had to ensure the coping and adaptation strategies pursued did not conflict with the risk of losing their land user right privileges they have with landowners. It demanded them to maintain positive social relationships with landowners.

The impact of shock and stress on livelihoods

Vulnerable points in a process or system are easily impacted upon during a disaster (Singh *et al*., 2014). There may be more than one vulnerable point in a community. For example, migrants limited social connections, lack of political voice, constrained access to additional land-based resources, and no land rights are weak points that already placed them in a vulnerable position. The intrusion of CPB was therefore an added stress on their already reduced adaptive capacity. Specifically, the CPB attack and the subsequent financial losses resulted in the decline in block maintenance, reduced harvests and loss of income, inadequate access to government services, decline in consumption of manufactured goods, reduced earnings for local businesses, and reduced contributions to social and customary obligations. For both groups, the broader impact of the epidemic on cocoa farmers for both groups was similar in that both experienced drastic income shortfalls which disrupted their livelihoods. These impacts were also similar to those reported in other recent studies in ESP, and ENB (Curry *et al*., 2011; Keane *et al*., 2021). However, in Dagua, the shock and stress were more intense for migrants than landowners because they had other inherent points of vulnerability.

Lack of block maintenance led to reduced harvests and resultant income losses. Cocoa harvests declined from the usual fortnightly harvests prior to CPB to almost once per month after the incursion of the pest. With an average of three healthy pods per tree, farmers

attempted using some beans from diseased pods to make up the weight. Although landowners had bigger blocks and were earning, on average, more per harvest than the migrants prior to the epidemic (*landowners* K222.2; *migrants*, K170.8), after the onset of CPB both communities were earning less than K20.00 per harvest. This impacted on other aspects of their lives. For example, limited funds also prevented people from accessing better treatment from health services outside of Dagua or ESP, and this contributed to some deaths in the communities. It also led to an increase in people accessing natural remedies through bush doctors. Community members also reported a lack of money to meet village court costs with most opting to settle disputes with payment of compensation in kind or to undertake community service instead of making monetary payments.

Both migrants and landowners found it difficult to pay school fees, project fees and to provide lunch money for school children. Teachers reported that some students had to spend less on lunch or forfeit lunch altogether. Lower incomes also led to a decline in the number of people who paid full fees for medical treatment. Low incomes also reduced people's mobility. Prior to CPB, people travelled frequently into town for shopping, marketing, accessing hospital, visiting friends and relatives or for other business activities. After the incursion of CPB and the fall in income, people travelled to Wewak less frequently.

Household businesses experience reduced earnings due to the shock experienced. The arrival of CPB also impacted local businesses. Cocoa drying businesses were not able to meet the cost of maintaining the dryers. At the time of the study, all operating cocoa driers were owned by landowners. The number of bags produced fell after the CPB intrusion because the dryers' owners were not generating enough cash; they were also not able to buy wet beans from farmers. Buyers were subject to world cocoa prices and the prices being paid by local exporters which were limited by their own financial capacities. This impacted on the buying rates and the entire operation of the dryers.

Village trade stores in both the landowner and migrant villages also struggled to sustain operations during the CPB incursion. The impact included, a slow turnover rate, with popular food items such as rice, coffee, milk, tinned meat and flour remaining on the shelves for longer periods of time. Customers who bought items on credit also took much longer to repay their debt affecting the cash flow of the businesses. This also contributed to store owners not restocking frequently. The expectations that store owners would make substantial contributions to social demands such as paying for relative's school fees and medical

expenses or contributing to clan activities placed additional stress on the operation of trade stores. These challenges were particularly significant for the owners of trade stores within the migrant communities who depended on the stores for most of their income. PMV businesses also faced a reduced number of passengers. With fewer passengers travelling into town, especially from the landowner group, the incomes of PMV businesses declined. Owners of cocoa dryers also hired vehicles less often. Passengers from the landowner groups were also not paying full fares, thereby, generating conflict with the crew members and the drivers who were usually from the migrant group. The impact of income losses from CPB was also felt when PMV owners were not able to fully cover the cost of vehicle maintenance.

The decline in incomes also reduced people's contributions to social relationships and activities such as fundraising activities, compensation payments, church activities as well as assistance to extended families. Although individual households varied in their capacity to help others, most households in both migrant and landowner groups reduced their contributions to social and customary obligations following the arrival of CPB.

Coping and adaptation responses by migrants and landowners

Coping and adapting to livelihood disasters require modifying livelihood practices to lessen the impact of the shock or stress. Coping and adaptation strategies of migrants and landowners to loss of incomes varied. Migrants' responses were more than just responding to income shortfalls. They adopted approaches that helped them both cope with the impact of CPB, and also adopted strategies to cope with their land insecurity. A vital approach to adaptation is to reduce dependency on one particular livelihood activity (Adger *et al*., 2003). With limited access to land-based resources it was crucial that their focus was shifted to other assets that had the potential to generate cash.

Although most farmers were in the initial stage of abandoning their blocks, the study showed that migrant households were more likely than landowners to have reduced the time spent maintaining their blocks, including activities such as regular harvesting, pruning, weeding, grass slashing and pod burial (Chapter 7). Block maintenance was generally poor. Cocoa blocks were not completely abandoned, with most households from both groups continuing to forage from their blocks out of desperation to earn some cash. A few landowners were replanting their blocks with other crops or even chopping down their cocoa trees. Migrants did not do this. Instead, they foraged through the cocoa trees for healthy pods, and also attended to other crops intercropped with cocoa in their blocks for incomes and to maintain

food supply. Migrants reduced their time spent on cocoa maintenance because it allowed them to have time to experiment with alternative income sources such as attending to *haus* gardens or raising meat chickens.

A decline in the consumption of manufactured goods was one of the most noticeable responses to the impacts of the loss of income. Prior to CPB, most households from both groups reported that store foods including rice, flour, oil, noodles, tinned fish, tinned meat, biscuits, sugar, coffee, and milk were a regular part of their daily diet. After the CPB incursion, people bought these foods less often. Households were also not able to afford goods like clothing, hand tools, cooking utensils, household lighting and other basic household items. People's reduced incomes meant that they had to make decisions about how to spend their limited finances, and so forewent certain items and concentrated on household necessities. People shifted to consuming more garden foods, sago and wild foods from the forest and rivers to maintain their daily diet.

The primary priority for migrants was to develop and maintain healthy social relationships with landowners (Table 9.1). They had been doing this for many years, however, the incursion of CPB and the financial crisis meant social events and obligations where cash is contributed were disrupted. This meant extra effort was required to generate income to contribute to such activities. Contributing to these activities is important in maintaining a harmonious relationship with landowners. Maintaining good relationships with landowners ensure trust and that friendship is not destroyed. Migrants, for example, attempted full payment of school fees, medical bills, or transport fares. This helped to avoid confrontations with the school or hospital board. They avoided land disputes with landowners, and conflicts were resolved amicably. Debts with landowners were also paid quickly. These responses by migrants were crucial during the period of CPB because it ensured they were not placed in a more vulnerable position.

Within their migrant group, families reduced financial support rendered to relatives and friends including to various fundraising events. This, however, did not mean that these bonds weakened; rather, people understood that everyone else was going through difficult times and so accepted any small amount families and friends gave. Although migrants were still helping relatives and contributing finances towards social events, they were more selective of the type of activity to which they contributed. This avoided unnecessary spending and enabled saving

for other activities. Landowners, under less pressure, were less selective in the social obligations to which they would contribute.

Investing in education continued to be a key strategy for migrants. Studies conducted in other parts of the world demonstrate that migrants are better educated than the inhabitants of their host country (Nawrotzki *et al*., 2012: 4). The Dagua experience also highlights this scenario. Migrants, more so than the landowners, prioritized their children's education. This is also shown in their attitude in making full payments of school fees. Many migrants see the need for education because of the condition they now live, and the desire for their children to have more opportunities and not to go through similar challenging experiences.

Livelihood diversification into agricultural and non-agricultural activities was significant for both groups. In PNG and the Pacific, diversifying livelihood activities is crucial in building resilience to livelihood shocks and stresses. By diversifying their livelihood activities people increase their adaptive capacities, and their ability to respond to disasters. This study shows that migrants and landowners differ in their level of adaptive capacity. For migrants, other pre-existing conditions had already weakened their ability to respond. The study shows that a group's ability to diversify also depends on the context of their adaptive capacity at that point in time. Landowners diversified by utilizing their land-based resources. Firewood, betel nut, coconut, sago, cultivating fresh food gardens and hunting were key activities landowners employed to raise income and maintain household food supply. Although migrants had similar resources, the quantity to sustain them was much more restricted because they had very limited access to land. Migrants therefore explored non-agricultural opportunities such as selling non-agricultural items at roadside markets.

A key response evident from the migrant group is agricultural intensification. Although landowners practised some intensification in their gardens, it was much more evident amongst migrants. This study showed that because migrants did not have access to land to expand food gardens, they diversified by adopting agricultural intensification practices. Migrants had already been intensifying for some time, however their intensification following CPB was a step up from their pre-existing intensification practices. It was a step up because they had to readjust the ecological and economic resources to respond to the added shock they were facing. An important aspect of this intensification process was to intercrop food crops in their cocoa blocks. Spaces between the cocoa trees in the blocks were planted with patches of food crops and betel nut (Table 9.1). Adopting of crops tolerant of poor soils and fast-maturing

crops such as banana, aibika, Japan cheera, cassava, karakap and *brus* were important in maintaining household food supply and to earn additional cash. These were grown in the blocks or at home in the house gardens where they are easily managed. Migrants demonstrated that they were proactive in responding to the shock by intensifying their agricultural practices. However, like the landowners, migrants were cultivating these crops using very little external inputs. This is likely to pose problems with the management of soil nutrients and it is unclear how long such intensification can be sustained without nutrient supplementation.

As noted, the adaptation strategies adopted by migrants were both economically motivated, focused on sustaining the household and replacing lost income, and socially motivated, focused on maintaining good relationships within their host community. The focus on good relationships with the host community was necessary to maintain their access to land. These are summarised in Table 9.1.

Table 9.1: Economically-motivated and socially-motivated strategies by migrants

Economically-motivated strategies	Socially-motivated strategies
Selective contribution to fundraising events. Reduce unnecessary support to others or reduce amounts given (Chapter 6). Continue planting, harvesting and selling crops intercropped with cocoa (Chapter 8). Maintain household income by increasing non-farm livelihood activities, including selling at roadside markets (Chapter 8). Spend less time on block maintenance activities to concentrate on other livelihood assets (Chapter 7). Plant perennials with multiple benefits in the cocoa block, such as, fruit trees, betel nut, breadfruit, coconut, rose apple, Okari nuts, black palm, bamboo, and sago to maintain incomes (Chapter 5).	Avoid confrontations with landowners. Incidents that would incite trouble are resolved quickly (Chapter 6). Generally, avoid criminal offences (Chapter 6). Ensure school fees and hospital bills are paid either fully or through instalments (Chapter 6). Occasional financial contributions to customary obligations and fundraising are important to maintain social relations (Chapter 6). Ensure money owed to landowners for store goods, services or transport is paid (Chapter 6). Encourage intermarriages with landowners as this helps maintain access to resources. Assist landowners financially with customary obligations. This is to maintain long-term relationships.

Landowners, in contrast, adopted agriculture extensification as a key adaptation strategy. Rather than using their land more intensively, as the migrants have done, they have responded primarily by bringing more land into cultivation. Although this approach is making it possible for families to have food, it remains a low input production system. With the potential threats from climate change, such as droughts and increases in pests and diseases, the production from these food gardens may fail creating food shortages as seen in other parts of the country. Furthermore, agriculture extensification has limits because the patrilineal practice of land inheritance means not all members of the landowning group have complete right to land ownership. So, with an increasing population, landowners may run short of land for gardening, hunting and the extraction of building materials. It therefore requires them to adopt prudent measures in utilizing their land. Population increases in the future would render families within the landowning group vulnerable to land poverty. To date, there is no significant pressure on land within the landowning groups, however, as population increases, there will be limits on the ability of landowners to expand; indeed, there are already reduced fallow periods, and this will impact people's adaptive capacity in the future.

Key contributions of this thesis

This research makes several important contributions to our understanding of livelihoods, adaptation, vulnerability and resilience in the Pacific:

1. I show that land access as a key determinant of adaptive capacities in PNG and the Pacific. It provides evidence that land access is vital in smallholder agricultural systems. Land access shaped responses by migrants and landowners. Migrants intensified their land use, and switched to non-land-based livelihood activities while landowners utilized their land-based resources and adopted agricultural extensification practices.

2. I also provide evidence that internal migrants with no formal land titles face land security issues. This affects their social relations with landowners. Hence, their responses to livelihood disasters, such as the Cocoa Pod Borer, not only tackle biophysical constraints in cocoa production but also the social approaches that are conducive to maintaining a healthy relationship with landowners.

3. In this study I contribute empirical evidence to understanding how different groups within a community, each with different livelihood assets have been impacted by a

shock and livelihood stress in different ways, and how they responded differently. The study does this by using Cocoa Pod Borer as a case study to understand migrants and landowner farmers' coping and adaptation responses to the shock and long-term stress on livelihoods caused by the pest. This supports the argument in the literature that vulnerability is context-specific, and that shocks and stress impact on people and communities differently. Moreover, their ability to respond is dependent on their adaptive capacity.

4. Numerous studies have been conducted on livelihood shocks and stresses and farmers' coping and adaptation strategies elsewhere. Less however is known of farmers' responses to long-term stressors in the Pacific Island Countries. In this study I fill that gap by presenting the coping and adaptation responses of cocoa smallholder farmers in a rural community as described in Chapter 8. I however, points out that in the light of current climate change conditions, farmers' responses in the long run may have negative implications on other aspects of their livelihoods.

5. I also show in this study that the socio-cultural contexts of people are vital in understanding their coping and adaptive measures in response to shocks and stress (Chapters 5, 6 and 8). This highlights that socio-cultural and relational economies between people and communities do determine smallholder farmers' participation in the modern market economy.

6. While similar studies were done in the PNG island provinces of East New Britain and Autonomous Region of Bougainville (ARoB), little is known from the mainland provinces where the environmental and socio-economic contexts are different. In this study I fill that gap by describing aspects of smallholder production in East Sepik Province on the mainland of PNG. I support the argument that people's livelihoods are different in different geographical, socio-cultural and economic contexts and these shape people's responses to livelihood disasters.

Vulnerability and adaptive capacity: Lessons from migrants and landowners

Smallholder farmers are active contributors to the modern cash economy. Not all of these farmers, however, have rights to the land they cultivate, and so, their contribution to the national economy is limited. In Dagua, differences in land ownership and access led to key

differences in the responses of migrants and landowners to the livelihood shock caused by CPB. Land is key to both groups' participation in cash crop production (Bue, 2013). Without land it was challenging for migrant farmers to expand cultivation to raise income and maintain household food supply. This created a condition of vulnerability and amplified the impact of the financial shock on farmers.

Depending on a single source of income increases the vulnerability of people and communities. It weakens people's adaptive capacity to cope when disaster strikes. Migrants and landowners of Dagua were over dependent on cocoa for income. From the cocoa income, personal, household and social expenses were met. This was more critical for migrants than for landowners because prior to CPB less effort was put into developing other sources of income. Although, the same could be said for landowners, it was easier for landowners to fall back to their land-based resources to sustain them. And so, the impact of CPB was more pronounced for those who relied totally on cocoa for livelihood sustenance.

Migrants' response to the financial shock was to diverge from cocoa production. Migrants' responses to the financial crisis indicated that there were other vulnerable points, such as sustaining household food supply, generating incomes, their limited garden land, or their tenure insecurity, must be considered. In this way they adjust their responses to different situations accordingly. Their responses demonstrate that in order to sustain their livelihoods, they had to reduce their engagement in cocoa production.

The CPB shock meant that the resulting livelihood coping and adaptation strategies were unplanned and ad hoc. These responses compromised people's adaptive capacity. In responding to the financial shock, farmers initially abandoned their blocks rather than adopt CPB management strategies recommended by CCIL. During the CPB period, farmers were still foraging from the blocks with no intention of conducting proper maintenance. With an overdependence on cocoa income, and no plans in place, farmers resorted to last minute emergency adaptation strategies which were likely to be costly given the time, effort and money used in establishing such activities (Smit & Pilifosova 2003:890). Moreover, changes in the climatic patterns have already presented challenges such as increasing temperatures, coastal inundation, drought, storms, and agricultural pests and diseases of agricultural crops (Bourke, 2019; Chung *et al*., 2015). Measures to manage these challenges should be factored into community livelihood training programs run by state and non-government organizations.

Social assets are significant during livelihood calamities. Connections built over time through intermarriage, friendship, or connections through sports or church groups, help people ease the impact of shocks and stresses through access to material and non-material resources. Intermarriage continues to be an effective approach in building bonds. Intermarriage with landowners is an important strategy for migrants to access resources. Not only was the bond advantageous for migrants, but also benefited landowners for whom it provides an avenue for landowners to gain support from the bride's family in WNB Province or other parts of PNG who have paid jobs. However, depending on family relations as a safety net may be problematic in the long run when more children are born into the households and finances are stretched thin. Also, multiple stressors such as the country's economic situation, natural disaster or social disorder impacting on people will constrain a family's financial capacity to help another. Although intermarriage has created close connections between the landowner and migrant communities, and it is possible that over time this may slowly erode the distinctions between the two groups, at present the two communities maintain distinct identities. The distinct migrant identity is reinforced, in part, by the migrant community living in a separate council ward (Ward 13 – Urip) to the landowner communities. The migrant community is also relatively small compared to the landowner group. Kinship relations between landowners and migrants are key to shaping vulnerability and resilience, and understanding these kinship relations in greater detail would be a valuable area of future study.

Migrants and settlers with no legal land rights are likely to face conditions of vulnerability in their host destinations. In PNG and other Pacific Island Countries, people are migrating into towns and cities in search of better living standards or paid employment. These people often end up in informal settlements with no formal tenure security (Numbasa & Koczberski, 2012). Their offspring may face even more vulnerable conditions where resources may be difficult to access. This will give rise to situations of unemployment and poverty. In addition, their living conditions and challenges in the urban centres have become problematic for town authorities and planners. Crime committed in the urban centres, such as Port Moresby and Lae in PNG, are routinely attributed, whether true or not, to settlement dwellers. Politicians have raised these concerns; however, no sustainable actions have been taken apart from reactive measures like burning down settlements in parts of the country. If the issues of internal migrants are not factored into the government's development plans, local social crises will likely get out of hand.

Although landowners were under less stress to sustain income and maintain household food supplies, their approach to extensification and relying on sago, firewood, betel nut and coconut may not prove sustainable in the long run. The extensification approach practised by landowners is to cultivate multiple gardens on fallowed land. However, the gardens are cultivated using very minimal external inputs. The yields are small and incidences of pests and diseases are evident. Presently there are no tangible plans in place to cope with the incursion of a new pest or decline in yield. This approach to farming is unsustainable under the present climatic trends. Furthermore, as argued by Bourke (2019), intensification practices will increase under population pressure. This will place stress on resource use and people's livelihoods are likely to become more vulnerable to future shocks and stresses.

Finally, this study provides evidence that people and communities are proactive and have agency when confronted by livelihood calamities. They make decisions that suit them in the constrained conditions they are in. They draw from resources available to them within their specific contexts to sustain livelihoods. This supports literature on coping and adaptive capacities of people and communities in times of disaster.

Future prospects for migrants and landowners at Dagua

In this study I have examined how migrants and landowners have responded to a disaster by drawing on their natural resources including land-based and social connections. While creative and innovative actions were taken, as discussed in Chapters 6, 7 and 8, long-term risks of vulnerability remain. Migrants face several challenges. First, the increasing population may see migrants run out of land. If this occurs, migrants may have to return to their place of origin in the hinterlands of West Yangoru. There have been ongoing talks about returning for many years but migrants have not yet started to move. They may also seek proper settlement elsewhere in other parts of the country or make formal agreement with landowners to settle permanently in Dagua. Second, migrants who continue to reside in Dagua must have proper training in sustainable intensive livelihood activities. Without this, achieving maximum potential benefits from the land will continue to be a challenge. Although landowners are resource-rich, a majority have returned to subsistence-style farming, a key coping strategy to maintain household food supply and earn money. This becomes problematic because yields are less and incidences of pests and diseases are high. Furthermore, use of external inputs is minimal, thus, households are not able to participate fully in the cash economy. More training on advancing local crops is required for people to adopt promising livelihood strategies to attain better living standards. Land-short migrants

also need to be supported to expand their non-land based economic activities. This could be an emphasis in training on petty trading, for example, or as intermediaries in the value chains of fresh food produce. It may also require support for agricultural intensification such as intercropping cocoa with high value crops like vanilla.

Recommendations and policy implications

This study provides some policy considerations.

1. In this study I highlight a key factor in the migrant group that determined their responses to the CPB outbreak – *land access*. This case is similar to others who have moved during the colonial era to contribute to capitalistic markets (see, for example, Curry & Koczberski, 1998; Curry & Koczberski, 1999). The migrants in this study are not illegal settlers. They are economic migrants who settled in Dagua for economic and development reasons in the late 1950s. Their move was facilitated and negotiated by Sir Peter Simogun and the Dagua landowners back then. However, their stay in Dagua has now become an issue of concern. Due to population increase, land is scarce for this marginalised group. With no formal land tenure agreement, their status as outsiders places them in a disadvantaged position. Furthermore, the push for Incorporated Land Groups (ILG) throughout the country could displace this particular group of people because they do not have formal land tenure agreements on land they are settling on, which belongs to the customary landowners (Allen & Monson, 2014; Yala, 2010). While they respond to the calamities they face, their responses are limited to the land-based resources they possess. Appropriate policies should be developed to address the needs of present settlement dwellers in urban and rural sites who do not have legal rights to the land they occupy. The case in Solomon Islands where a 'land poor' generation is becoming a concern (Jansen *et al.,* 2006:16) should raise an alarm for PNG. Clan Land Usage Agreements (CLUAs) have been used successfully in WNB to give oil palm settlers on customary land some security over their oil palm blocks (Gemes, 2019). Although beyond the scope of this thesis, the use of CLUAs to give some land tenure security to Dagua migrants should be investigated.

2. I also indicate that institutional support for smallholder farmers was lacking. While CCIL, CBPNG and NDAL are stationed in Wewak, the capacity to facilitate training and awareness during periods of stress is limited in locations outside of Wewak. There is also a duplication of roles between these institutions as reported by extension

officers in this study as well as by farmers. According to DAL and CCIL officers at Wewak, resource constraints are the main reason for loss of quality extension (Sitapai, 2012). With the current support from government to introduce clones and nurseries into communities to boost production in East Sepik Province, the need to address these issues is inevitable. There is also the need to re-examine policies that can work with the reforms in the political, administrative and institutional domains.

3. Furthermore, I indicated that the majority of the farmers depended on traditional crops and emergency food crops during the periods of income stress. This is supported by other studies on livelihood stress (see, for example, Allen & Bourke, 2009: 64). This response by people is often short-term. Key policies on developing sustainable cultivation and maintenance of food crops should be developed to improve traditional crops such as betel nut, sago, coconuts and traditional leafy vegetables which are often neglected but become very useful in maintaining livelihoods during periods of shocks and stress. The current impacts of climate change mean actions must be taken to carefully utilize promising food and cash crops.

4. Finally, I highlighted farmers' capabilities to cope and adapt to stress. It was evident that farmers find accessing financial capital to respond to household livelihood crisis challenging. With no social support system in place, appropriate policies should be drafted to make financial assistance more accessible to farmers.

Areas for further research

Below I suggest possible areas for future study.

1. Further research should be conducted on migrants in other locations in PNG to understand how they respond to different types of shocks and stresses. This is important because smallholder migrant farmers play a vital role in the supply chain system of major commodity crops in the country, and because they are a vulnerable group.
2. Land and its impact on development is a concern for smallholder farmers who have insecure land tenure. Further research should be conducted in this area to examine different land-use strategies smallholders use to counter this challenge and for the benefit of developing appropriate policies that would address this challenge. In PNG this is significant because of the ongoing land reform challenges the country is facing,

especially with customary land (Yala, 2010), where migrant farmers can be easily displaced. Clan Land Usage Agreements (CLUAs) should be investigated as a potential strategy to improve land tenure security for migrants on customary land.

3. People's coping and adaptive responses to one particular stress are often aimed at serving multiple outcomes under multi-stress conditions. People's livelihood context is crucial in understanding how people cope with shocks and stress. For example, in the time of this study, the 2015-2016 drought impacted on people's behaviour forcing many to feed on wild foods available within their localities (Bourke *et al*., 2016). More studies should also be conducted to understand how different groups of people respond to multiple stressors acting upon them at one particular time.
4. This study has focussed on coping and adaptation strategies at the household level and has focussed on comparing and contrasting migrant and landowners' experiences and responses. There are, however, also important differences between men's and women's adaptive capacity and vulnerability. Further studies should be conducted to understand the differences between the responses of men and women to livelihood calamities.
5. Women are active participants in smallholder farming, and especially in sustaining household financial security (Bue, 2013). This study highlights some fundamental coping strategies women play in ensuring household financial stability. There is still a need to explore women's coping strategies and adaptive capacities in alleviating financial stress with other commodities and in other locations.
6. Coping and adaptive capacities between generations may differ because of the growing population and the need to access resources. It is important that studies be conducted to understand the changing trends of resource accessibility between generations.
7. Although literature exists for crops such as coffee, cocoa, oil palm and coconut, much of these studies have captured the biophysical aspects and not much on the current socioeconomics and the cultural components. There is a need for more studies to understand the socioeconomics and cultural aspects of these crops.
8. Future studies should also, consider challenges and opportunities for development, for smallholder migrant growers because they also contribute considerably to the national economy.

CODA

This thesis demonstrated the resilience of smallholder cocoa farmers in Dagua in the East Sepik Province of Papua New Guinea. Fieldwork was conducted between 2016 and 2017 when I lived with the Dagua people for over a year. Since then, I have travelled twice to Dagua to visit my host families and to glimpse how the community was doing after my period of fieldwork. My most recent trip was in 2021 where I visited Makopin, Maguer and Urip villages. During the trip I realized that generally not much had changed; however, it did seem, from the cocoa farmers I spoke with in Wewak, that cocoa was going to do well if Cocoa Pod Borer could be managed.

Since my fieldwork there has been increased training of cocoa farmers. Several training sessions were conducted on bud gardens and nursery management of cocoa seedlings. The Australian Centre for International Agricultural Research (ACIAR) had funded projects that helped train many cocoa farmers in East Sepik, Madang, New Ireland and Chimbu provinces. The training included work on budwood gardens, and management of clones including bud grafting of clones (Keane *et al*. 2021). Another important program was led by the Food and Agriculture Organization (FAO). This program was counter-funded by European Union for Support to Rural Entrepreneurship, Investment and Trade in Papua New Guinea (EU-STREIT PNG). An important focus of the EU-STREIT PNG program is on value chains for cocoa. Cocoa training particularly targeted marginalized groups such as women. Training programs were conducted by FAO in partnership with Cocoa Board officers in East Sepik Province (ESP) for eight districts of ESP and West Sepik Province (WSP).

The ACIAR project and the STREIT program also distributed planting material for hybrid clones and tools to assist farmers revamp their cocoa blocks. It was anticipated that from 2019 onwards cocoa farmers would be able to restore their cocoa blocks and produce more cocoa including in Dagua.

An increase in the price of cocoa has also had an impact on communities. Starting in 2020, cocoa prices have increased, including for cocoa farmers in ESP. In August 2023, farmers were earning K700 per bag: prior to that it was between K320 –K340. The *Post Courier* newspaper reported that as of 28th of March, 2024, the price for dried cocoa beans had reached around K1500 per bag (Wohi, 2024). Reports of the recent increase in cocoa prices has been publicized by the local newspapers and social media particularly Facebook. The East

Sepik governor, Honourable Allan Bird pleaded for people to make use of this opportunity to improve their living standards (Bird, 2024). It is, however, evident from the reporting that most farmers were selling wet beans and that there was a need to establish cocoa dryers.

PNG's cocoa farmers, including farmers in Dagua, are currently taking advantage of the strong prices caused by weather-induced short term production declines in other cocoa producing countries, and have increased their harvest effort, but it is not clear if these increased inputs will be sustained beyond the current period of high prices, or whether it has stimulated lasting change in production practices. When prices decline in the future, farmers will again have to decide where to invest their labour and whether they continue to invest labour in cocoa harvesting or switch to other livelihood activities. A future price fall may result in a repeat of history akin to the incursion of CPB where prices fell and people left with limited financial security.

In the Dagua community, land access is likely to be the key factor shaping migrant and landowners' responses to recent events. For landowners, the recent price hike is likely to tempt them to respond by bringing additional land into cultivation (extensification). Migrants with a much more limited supply of land, may be willing to invest more time and labour in their existing cocoa blocks (intensification), and would perhaps be more likely than landowners to adopt high yielding clones. Curry *et al*. (2007) reported that in the pre-CPB period, many smallholders in ENB were reluctant to adopt high yielding clones because they require much greater labour inputs in maintenance than the more robust 'traditional' varieties – they have a high mortality rate if not maintained adequately (Curry *et al*., 2007). However, it remains to be seen whether the adoption of new high yielding clones will be sustained when prices fall from their current high levels. We could speculate that land-poor migrants looking for opportunities to intensify production would be more likely than landowners to adopt hybrid clones and to maintain hybrid clones as prices return to their long-term norm.

There is little indication that migrants will return to their original homes in the mountains any time soon. Burial of prominent migrant leaders in the last few years at Urip suggests that migrants are slowly establishing long term residency status in Dagua. The increase in intermarriage also suggests the same. I believe, however, that it will take many more years before the boundaries between these two communities dissolve. In the meantime, migrants will have to be creative and innovative in how the manage their livelihoods.

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APPENDICES

APPENDICES

APPENDIX 1: HOUSEHOLD INTERVIEW GUIDE

Impact Study of Cocoa Pod Borer, October 2015
Interview Questionnaire
Changes to Livelihood Activities since CPB Incursion

Farmer ID: _____

_____

Demographic Information

Name of Farmer: _____Gender:_____Age:_____Church group: _____
Marital Status: [Single/Widow/Divorced/Married]
Highest Education level: _____
Village/Ward_____
Household size: _____
Interviewer name: _____ Interview Date: _____

1.1. Block History
1.1a. How old is your block? _____
1.1b. What is the approximate distance from your house to the block?_____
1.1c. What type of cocoa trees are you farming? _____
1.1d. How many trees do you have? _____
1.1e. Are you the sole owner of the farm? **Yes/No.** If no, who are the others? _____
1.1f. What pests/diseases did you have in your farm before CPB? _____
1.1g. Were you able to successfully control these pests and diseases? _____If so, how were you able to control them?
Pests: _____
Diseases: _____
1.1h. When did you first notice the presence of CPB on your block? _____

Additional Comments on block history

_____
_____
_____

2. Cocoa Harvest
2a. Before CPB incursion, how many pods were you able to harvest per tree? _____
2b. How many bags of wet bean do you fill from your block before CPB struck? _____
2c. How many harvest rounds do you do in one year before CPB struck? _____
2d. After CPB incursion, how many pods were you able to harvest per tree? _____

2e. How many bags of wet bean were you filling after CPB struck? ____
2f. How many harvest rounds have you been doing in a year after CPB struck?
2g. Have you dried any cocoa after CPB? **Yes/No**. What is the number of bags dried in a year? ____

3. Block Management Information and Assistance

3a. Have you received any information on how to manage a CPB block? **Yes/No.** If No, why? _____.If Yes, why? _____
3b. If Yes, who or what organization gave you this information? _____
3c. Were you satisfied with the information given to you? **Yes/No.** If yes, why? _____If No, why? _____
3d. Have you been confident in managing your block after the information given? **Yes/No**
3e. What would you have liked to be included in the CPB information given to you?
_____
3f. Do you receive block visits by an officer from the DPI or CCIL? **Yes/No**. If so, how often in a year?
_____

4. CPB Management Strategies?

4a. Do you practice centralized pod breaking? Yes/No. If No, why? _____
4b. Do you practice pod burial? Yes/No. If No, why? _____
4c. Do you practice weekly harvesting? Yes/No. If No, why? _____
4d. Do you use insecticides? Yes/No. If No, why? _____
4e. Do you remove all mature pods? Yes/No. If No, why? _____

5. Time and Labour

5a.Since the arrival of CPB are you spending less, the same or more time on the following cocoa activities:

ACTIVITY	**(circle correct answer)**		
Harvesting	Less time	Same amount of time	More time
Drying wet bean	Less time	Same amount of time	More time
Pruning	Less time	Same amount of time	More time
Shade control	Less time	Same amount of time	More time
Grass slashing	Less time	Same amount of time	More time
CPB management	Less time	Same amount of time	More time
Other pest & disease control	Less time	Same amount of time	More time

5b. If you have been spending less time on any of the above, what is your reason for that?
_____
5c. Do you plan to remove all or some of your cocoa holdings? Yes/No. If Yes, what do you plan to do with the land? (E.g. replace it with another cash crop, food crop or livestock?
_____

6. Primary Income Sources

6a. List the three top three income sources for **MEN** before and after CPB.

Before CPB		*After CPB*
(1)_____	(most important)	_____
(2)_____		_____
(3)_____	(least important)	_____

6b. List the top three main income sources for **WOMEN** before and after CPB.

Before CPB		*After CPB*
(1)_____	(most important)	_____
(2)_____		_____
(3)_____	(least important)	_____

7. Livelihood Activity and Change

	Tick (√) active income sources	**Regular income from activity (more than once a month)?**		**Change in Importance of Livelihood Activity since CPB Incursion. Tick (√) whichever is applicable**			
Livelihood activity	(√)	**Yes**	**No**	**Decreased**	**No Change**	**Increased**	**Started since CPB incursion**
Main Income Categories							
Food sales at local markets							
Tradestore							
Home-made bread							
Livestock (pigs chickens)							
Contract work							
Remittances							
Other (Name)							
Other Cash Crops							
Balsa							
Coffee							
Copra							
Vanilla							
Betelnut							
Spices							
Other (Name)							
Garden crops							
Greens							
Kaukau							

Taro							
Singapore							
Mami/yam							
Pitpit							
Peanut							
Brus							
Banana							
Pawpaw							
Pineapple							
Others							
Sago							
Other 2							
Other 3							
Processed foods							
Cooked pig meat							
Chicken							
Karamap							
Ice blocks							
Other 1							
Other 2							
Other 3							

8. Please describe the main impacts that CPB has had on your family and community

Food (store foods and garden foods):

_____
_____
_____

Travel (e.g., PMV trips to town):

_____
_____
_____

Education:

_____
_____
_____

Hospital/health care:

_____
_____
_____

Fund raising (church activities and kastom):

_____
_____
_____

Family relationships:

_____
_____
_____

Law and order:

Other:

APPENDIX 2: KEY INFORMANTS' INTERVIEW GUIDE

Informant ID: _____
Name of Informant: _____Gender:_____Age:____Home Province_____
Clan: _____Organization: _____
Position: _____Telephone/Mobile No._____

Area of Interest and informant	Objective	Guide Questions
Community *Village leaders and ward councillors of migrant and landowners' group.*	Evaluate the impact of CPB on the community	1. How long have you been serving the community? 2. What is the population size of the community? 3. How regularly do you meet with the people? 4. When was the first reported case of CPB in the community? 5. How has CPB affected production of cocoa in the community? 6. How has CPB affected incomes of cocoa farmers? 7. What were the reactions of farmers when faced with CPB? 8. What was the attitude of farmers towards cocoa production before and after CPB? 9. How has the government assisted smallholders manage their cocoa blocks? 10. Apart from the government who else provides assistance to smallholder farmers? 11. Have the farmers abandoned cocoa? If no why? If yes, what are they engaged in now to earn cash income?
Education *Primary school teachers (Head teachers in elementary, primary, and high school)*	Evaluate the impact of CPB on the functioning of the school.	1. How old is the school? 2. What is the size of the school population? 3. In what ways has CPB affected the general functioning of the school? 4. How has CPB affected the enrolment figures? 5. How has CPB affected the payment of school fees? 6. How has CPB impacted upon students learning at school? 7. How has CPB affected community's participation in school development programs? 8. Has the school been involved in CPB awareness programs? If so, in what ways?
Hospital	Examine the impact of	1. How old is the hospital?

Health officers *Hospital chairman and nursing officers.*	CPB on the delivery of health services	2. How many officers are there in the facility? 3. What is the average number of patients attended to daily? 4. How was the delivery of health services affected before and after CPB? 5. What are the common illness/diseases before and after CPB? 6. Did people's change in livelihoods have an impact on the delivery of services at the hospital? If yes, how?
Church *Church leaders from existing church groups.*	Examine the impact of CPB on the functions of the church.	1. How old is the church? 2. What is the size of the church population? 3. How has the church been affected before and after CPB intrusion? 4. How has CPB affected the social relationships of the church members? 5. How has the CPB affected the economic status of the church? 6. Has the church been involved in CPB awareness programs? If so, in what ways?
Law & Order *Community magistrate*	Assess the impact of CPB on Law & Order issues in the community	1. What is the structure of the law and order sector in the village like? 2. What are your basic roles in the village? 3. What law and order problems do you face frequently in the community? 4. What was the law and order like before and after CPB intrusion? 5. Were there any challenges brought about in the law and order sector as a result of people diversifying their livelihoods?
Transportation (PMV) *Two PMV owners, drivers and crews.*	Examine the impact of CPB on PMV business	1. How long has the PMV been in operation? 2. Who is the owner of the PMV? 3. Who are your main passengers? 4. What is the schedule of your PMV? 5. Where are your main pickup and drop off points? 6. How many passengers do you have per trip? 7. Do you provide hire? If so, for who and for what purpose? 8. How has your business been affected by CPB before and after? 9. How has people's change in livelihoods affected your business?
DPI/CCIL offices *DPI and CCIL officers*	Assess the overall CPB impact on the community	1. What is the number of cocoa smallholders in the village? 2. When was the first reported case of CPB in ESP? 3. What was the production levels before and

		after CPB intrusion? 4. How successful are farmers practising the recommended CPB management practices? 5. What areas of CPB management practices are farmers finding difficult to cope with? 6. At what rate were the farmers able to adopt the CPB control practices? 7. How many farmers are actively managing their blocks and how many are not? 8. What impact did CPB have on the community's livelihood practices? 9. How did farmers manage their livelihood activities while undergoing constraints by CPB? 10. How often do you visit the farmers? 11. Are there extension problems you face when doing your routines? If yes, what are they and how do you cope with these challenges?
Business *Village trade store owners*	Examine the impact of CPB on retail business.	1. How long has the business been in operation? 2. Who owns the business? 3. Who are your main customers? 4. What is the average amount spent by customers per day at the store? 5. What are the main goods sold in the store? 6. How has your business been affected by CPB before and after? 7. How has people's change in their livelihoods affected your business?
Cultural Perspectives *Village elders*	Examine the impact of CPB on cultural perspectives in the community	1. What was the cultural values like before and after CPB? 2. What are the beliefs of the people regarding CPB? 3. How has CPB affected the daily activities of the people? 4. How has CPB affected traditional ceremonies (bride price, compensation etc..?) 5. Was there a similar event in the past? If so, how did the people respond to it?
Local wet bean buyer	Examine the impact of CPB on buying of wet bean business	1. How long have you been buying beans? 2. Where are your buying points? 3. Who assists you with labour? 4. How much were you paying for a kilogram of wet bean before CPB? 5. How much are you paying per for a kilogram of wet bean after CPB? 6. How has CPB affected your operations?
Cocoa dryers	Examine the impact of	1. Who owns the dryer?

Cocoa dryer owners	CPB on cocoa drying business.	2. Is the dryer registered? 3. How long has it been operating? 4. Who assists you with labour? 5. Where do you obtain beans to dry? 6. How many bags were you able to pack before CPB? 7. How many bags were you able to pack after CPB? 8. How has CPB affected the dryer operations? 9. How has CPB affected labour? 10. What are the future plans of the dryer?

APPENDIX 3: BLOCK MANAGEMENT FORM

3a). Block management form

Farmer Name: _____Date:_____

1. Number of block you own apart from this one? _____

No. of trees planted/ block?	Type of trees planted/ block	Date of planting	No. of times block is visited before CPB	No. of times block is visited after CPB.	No. of Bags harvested	
					Wet	Dry
Block 1 __						
Block 2___						
Block 3___						
Block 4___						
Block 5___						
Block 6 ___						

2. Whose land is your block on?_____

3. Are the cocoa trees planted with other crops on your block?_____

4. Have you replanted your trees? Yes/No. If yes,
why?_____

5. Who planted the cocoa trees on this block?_____

6. Who is responsible for the trees on this block?_____

7. How often in a year do you visit the CCI or DPI officers for help regarding you cocoa?_____

8. How many trees have you lost so far after CPB struck? _____

9. What are other reasons for you losing your trees? _____

10. Who assists you with work on the block? _____

11. How did they assist you before CPB? _____

12. How do they assist you after CPB? _____

13. Have they been assisting you before CPB?_____

14. Do you have the tools to manage your block? Yes/No. _____

15. If No, where do you get tools to manage your block? _____

16. How do you plan to purchase tools for yourself? _____

17. Are you willing to spend more time on your block? Yes/No. If yes, why? If No,
why?_____

18. Why do you think it is difficult to control CPB in your block?_____

A*dditional comments by observation on general husbandry practices on the block*

3b). Tree inspection questions (x 10 trees)

Item	*T1*	*T2*	*T3*	*T4*	*T5*	*T6*	*T7*	*T8*	*T9*	*T10*
Total trees										
Height of tree (m)										
General health										
Cocoa type										
Shade type										
Tree flowering										
Degree of shading										
Pruning shade										
Pruning cocoa										
Weeding										
Herbicide usage										
Main pests										
Main diseases										
Healthy ripe pods										
Unhealthy pods										
Dry pods										
CPB infected pods										
Block pod control, sprayed fungicide?										
Removing CPB pods and black pods from trees										
Pod disposal										

APPENDIX 4: FOCUS GROUP GUIDE QUESTIONNAIRE

Description:
The guide included questions that were not captured in the household interview guide (Appendix 1).

Objective:
To investigate how women participated and benefited from cocoa production before and after CPB incursion.

Tok Pisin

1. I bin gat sampla trening ol sampla save lain o grup i kam ronim long dispela ples tu o nogat? Sopos igat, orait ol i ronim ol trening long wenem samting tru?
2. *a*. Bipo long sik CPB ikamap long ples, kakau i helpim yu na pemili olsem wenem? *b.* Bihain long sik i kamap, kaukau i helpim yu na pemili olsem wenem?
3. a. Bipo long sik CPB ikamap long ples, yu i save helpim man bilong yu long wokim ol wenem kain wok bilong kakau? *b*. Bihain long sik i kamap pinis, yu helpim long wenem wok bilong kakau?
4. Nau yupla lusim blok, na sopos kakau i sanap strong na pait long CPB, na ol nupla save i helpim wok bilong cocoa, bai yupla go bek long blok o nogat?
5. *a.* Insait long wan wik bipo long sik ikamap long ples, hamas aua insait long wanpela dei yu save putim igo long wok bilong kakau *b.* Bihain long CPB ikamap pinis long ples, hamas aua long wanpela dei yu save putim igo long wok bilong kakau
6. *a.* Bipo long sik ikam, yu na man bilong yu i save brukim moni olsem wenem? *b*. Yu hamamas long dispela pasin bilong brukim moni?

English

1. Was there any training conducted for women in this community over the years? If so, what were the trainings about?
2. *a*. How did you benefit from cocoa before CPB? *b.* How did you benefit from cocoa after CPB?
3. *a.* How did you assist your husband on cocoa work before the CPB intrusion? *b*. how did you assist after the CPB intrusion?
4. You have abandoned your block, however, if cocoa is able to withstand cocoa, or if new technologies assist farmers revive cocoa, will you return to your block?
5. *a*. Before CPB, how many hours in a day did you put into cocoa work? *b*. After CPB, how many hours in a day did you put into cocoa work?
6. *a*. How do you and your husband divide the money earned from cocoa? *b*. Are you satisfied with the way the money is being divided?

APPENDIX 5: GUIDE FOR TRANSECT WALK

Field Guide to Village Transect Walks

Description:
The guide comprises of a set of items that will assist the researcher to obtain physical settings and informative structures in the two villages under study.

Objective:
To identify, describe and map out communities' resource strengths, weaknesses, opportunities and challenges.

Items

	Item	**Comments**					
		Description.	Strengths	Weakness	Opportunities	Challenges	Possible Explanation
1	State the location of the village -GPS coordinates						
2	Describe the topography -mountainous/flat land						
3	Describe the surrounding vegetation -grassland/						
4	Draw a layout of the village -roads/rivers/structures						
5	Identify agricultural activities -crop types/livestock/quantity and their relative importance for subsistence & cash income						
6	Identify natural resources - types/locations/quantity						

	and whether or not they are accessible to everyone						
7	Identify economic activities - types/locations/quantity /process						
8	Identify government structures - types/locations/quantity /quality						
9	Identify social structures -types/process						

APPENDIX 6: KEY INFORMANTS' DETAILS

Key informants	Description of activity
CIC/DAL Officers	Institutions play an important role in agriculture development in PNG. The first key informants included a senior CIC officer, a senior DAL officer and the head of DAL. The two institutions were approached because farmers used to get assistance from DAL initially before PNGCCIL took over. The officers provided an overview of CPB impact on cocoa production, farmers' responses to CPB, farmers' attitude to improved technologies, institutional challenges in combating CPB and brief overview of other livelihood options available to farmers.
Ward councillors	Three ward councillors from Urip (Ward 13), Sibugen-Maguer (Ward 14) and Makopin (Ward 19) were selected. Ward councillors represent the government at the ward level. Wards are allocated according to population size or distance from nearest government outpost (Barcson, 2015). Since the study covered these three wards, the councillors were approached individually at their home on different days and interviewed freely. Information sought from the councillors included a brief the councillor's biography, history of the community, the demographic composition of the community, impact of CPB on households and community, law and order issues, government support and development progress in the community.
PMV owners	Only a small number of PMVs service the Dagua central communities. At the time of the research two 15 seater buses and 1 Hino truck served the villages. Interviews were conducted with the truck owner and driver, and the owners of one of the buses. The buses were mainly utilized by passengers that want a quick lift to town while the truck was used by passengers with heavy cargoes such as cocoa bags, coconuts, market vegetables and so on. The questions asked included impact of CPB on cocoa bean transportation to buyers in town before and during CPB incursion, number of passengers accessing and paying full fares before and after CPB, strategies utilized to make up for loss of income from passengers and future of the business.
Cocoa Dryer owner	Two cocoa dryer owners were interviewed. The research sought information on how the dryer was operating before and after the CPB incursion. Specific questions also included, how many bags were processed before and after CPB, dryer hire, government support and future plans of the dryer.
Local wet bean buyer	A local wet bean buyer was interviewed. The information collected from the buyer indicated how CPB affected the quantity of wet bean bags bought from farmers since its incursion. Amongst other questions were; how the buying power was affected, strategies used to alleviate the impact of CPB and what the future of the business was.
Store owners	Three store owners were approached at the store locations and interviewed. Since they also had other commitments it was difficult to contain all of them at the same time and so were interviewed based on time and day suitable to them. Store owners were important because they felt the pressure of CPB. The study sought information on how the business operated before and after CPB. This included cash flow, turnover rates, logistics and supply, strategies to counteract the impact of loss of buying power by customers, and the future of the business.

Appendix 6 continued

Key informants	Description of activity
Community magistrate	The magistrate has a significant role in maintaining law and order in the three wards. The study gave the opportunity to the magistrate to provide information on common law and order issues that were affecting the community before and after CPB. Since cocoa is the main livelihood of the communities, it's downfall from CPB gave resulted in villagers resorting to other illegal means on sustaining livelihoods. The illegal activities are often reported and are dealt with using the village court system.
Head teachers of elementary, primary and high schools	The head teachers of the schools were approached and interviewed also on different dates according to their convenience. The research aimed to collect information on how CPB affected the school and students' learning before and after CPB incursion. It also enquired on community support to school before and during CPB. Furthermore, it explored if enrolment figures were also explored. Finally it also enquired if state institutions utilized schools as a conduit to create awareness and teach basic CPB management skills.
Church elders	The church elders from the Roman Catholic, Church of Christ and Seventh Day Adventists were interviewed. The elders expressed opinions on the perspectives from their beliefs. The study aimed to explore the impact of CPB on the operations of the church. It also examined what the churches beliefs were in relation to such environmental stress.
Hospital chairman	Impact of CPB on health services was significant in Dagua. Since the CPB incursion there was a shift in the way health services were being offered. The study sought to explore how CPB intrusion could have impacted on service delivery. Among other questions were, what common ailments before and after CPB, how patients managed payment of fees before and after CPB, and government support in the functioning of the hospital.
Village elders	Four village elders were informally interviewed as a group. The aim of the interview was for them to provide as much information on the history of the communities, important historical events, perspectives on historical agriculture activities as compared to the current. Views, motivations and opinions on what current livelihood activities appeal to them.

MEMORANDUM

Curtin University

To:	Prof George Curry
	School of Built Environment
CC:	
From:	Dr Catherine Gangell, Manager Research Integrity
Subject	Ethics approval
	Approval number: RDHU-255-15
Date:	15-Dec-15

Office of Research and Development
Human Research Ethics Office

TELEPHONE 9266 2784
FACSIMILE 9266 3793
EMAIL hrec@curtin.edu.au

Thank you for your application submitted to the Human Research Ethics Office for the project: 5518

The Impact of Cocoa Pod Borer on the Livelihood Responses of Farmers in East Sepik Province, Papua New Guinea

Your application has been approved through the low risk ethics approvals process at Curtin University.

Please note the following conditions of approval:

1. Approval is granted for a period of four years from **15-Dec-15** to **15-Dec-19**
2. Research must be conducted as stated in the approved protocol.
3. Any amendments to the approved protocol must be approved by the Ethics Office.
4. An annual progress report must be submitted to the Ethics Office annually, on the anniversary of approval.
5. All adverse events must be reported to the Ethics Office.
6. A completion report must be submitted to the Ethics Office on completion of the project.
7. Data must be stored in accordance with WAUSDA and Curtin University policy.
8. The Ethics Office may conduct a randomly identified audit of a proportion of research projects approved by the HREC.

Should you have any queries about the consideration of your project please contact the Ethics Support Officer for your faculty, or the Ethics Office at hrec@curtin.edu.au or on 9266 2784. All human research ethics forms and guidelines are available on the ethics website.

Yours sincerely,

Dr Catherine Gangell
Manager, Research Integrity

CONSENT FORM

HREC Project Number:	
Project Title:	The CPB Impact on Livelihood Responses of Farmers in ESP, PNG
Principal Investigator:	Professor George Curry, Supervisor
Student researcher:	Alois Ndrewou
Version Number:	1
Version Date:	03/012/2015

Declaration by Participant

- I have read, *{or had read to me in my first language)* the information statement version listed above and I understand its contents.
- I believe I understand the purpose, extent and possible risks of my involvement in this project.
- I voluntarily consent to take part in this research project.
- I have had an opportunity to ask questions and I am satisfied with the answers I have received.
- I understand that this project has been approved by Curtin University Human Research Ethics Committee and will be carried out in line with the National Statement on Ethical Conduct in Human Research (2007) – updated March 2014.
- I understand I will receive a copy of this Information Statement and Consent Form.

Participant Name	
Participant Signature	
Date	___/__/2016

Declaration by researcher: I have supplied an Information Letter and Consent Form to the participant who has signed above, and believe that they understand the purpose, extent and possible risks of their involvement in this project.

Researcher Name	Alois Ndrewou
Researcher Signature	
Date	___/__/2016

PARTICIPANT INFORMATION SHEET

HREC Project Number:	
Project Title:	The Impact of Cocoa Pod Borer on the Livelihood Responses of Farmers in East Sepik Province, Papua New Guinea
Principal Investigator:	Professor George Curry, Supervisor
Student researcher:	Alois Ndrewou
Version Number:	1
Version Date:	03/012/2015

What is this project about?

Cocoa Pod Borer (CPB) is a serious economic pest that has been reducing cocoa yields and reducing incomes of cocoa farmers in Papua New Guinea. Some studies have been done to find ways to lessen the impact of this pest on cocoa yields and livelihood of farmers, however these studies have so far been conducted in other provinces and not in East Sepik Province (ESP). This project therefore aims to investigate these issues in ESP by documenting farmers' response to CPB. A total of 150 cocoa farmers will be invited to participate in this study. This project will build on the efforts by Department of Primary Industries, and Cocoa Coconut Institute to investigate Cocoa Pod Borer (CPB) and how it has been affecting the farmers in ESP.

Who is doing the Research?

This research is being conducted by Alois Ndrewou who is currently a student in the Faculty of Humanities at Curtin University. This research is supervised by Professor George Curry of Curtin University. The project is partly funded by the Australian Awards and Curtin University. The results of this research project will be used by Alois Ndrewou to obtain a Doctor of Philosophy at Curtin University.

Why am I being asked to take part and what will I have to do?

You have been asked to take part in this study because we believe you have some experience with CPB and how it is affecting the members of the community.

How will I participate in this study?

Your participation in this study will be engaging in a one-on-one interview and possibly participating in a focus group discussion if chosen.

One-on-one interview

Participating in a one-on-one interview with me will include a visit to your cocoa block during the interview. You will be asked some questions about your views of CPB issues affecting yourself, your block management, your family and the community. The questions will include how the pest has affected your business, food gardens, use of natural resources, spiritual lives and relationships with other community members.

I will be recording you as you speak but if you decide not to be recorded then I shall only take notes. Interviews will take approximately 1 hour. If you decide to withdraw from the interview and not take part again, your request will be respected.

Focus group discussion

You may be asked to participate in a focus group discussion. Focus group participation will be limited to 8 members of the community who have certain background that the researcher is interested in. For example; small trade store owners. You may be asked to participate in a focus group discussion to further clarify your views with others who share the same background as you. If you find that a question discussed is offensive or causing distress to you then indicate to us so we can move to other questions. Questions will be asked about how CPB is affecting your daily operations given your particular background. The time for the focus group discussion will be approximately an hour.

Question types

All the questions are straight-forward and you have all the time to answer them at your own pace. Your interview time will be approximately 40 minutes. You will be respected if you do not want to answer any questions. You will not be forced to answer questions and if you do not feel like continuing on with the interview, the interview will cease.

I will ask you questions relating to how CPB has affected your daily living; how you are managing your cocoa block, the challenges you face, and the opportunities you are experiencing. Your in-depth experience with CPB and how it is affecting the community will be the key issue in the questions being asked.

Benefit to participants and community

There may not be a direct benefit that you will receive from this study, however, I plan to highlight some of the things you mention to me to the relevant authorities in your district and province for possible strategies to combat the impact of CPB.

Are there any risks, side-effects, discomforts or inconveniences from being in the research project?

There are no foreseeable risks in this research. There are no personal questions in this research and I will not be asking you questions that will make you feel uncomfortable or distressed. You should not answer any question that you are uncomfortable with.

The schedule for the interview will take place at your cocoa block or your home at a time convenient to you. If you are participating in a focus group, the location will be at the community hall at an appropriate time for all members to attend. Only your time and participation is needed: apart from this, this research does not possess any risk to you.

Who will have access to my information?

The information collected in this research will be identifiable. This means that any information we collect that can identify you will stay on the information we collect and it will be treated as confidential and used only in the project unless otherwise stated. We can let others know this information only if you say so or if the law says we need to. All information will be stored securely in R drive at the Curtin University.

The following people will have access to the information we collect: the research team and the Curtin University Ethics Committee.

All electronic information collected will be stored in a password-protected computer. Information we collect from this study will be kept secured in the R drive at the Curtin University for up to 7 years before they are destroyed.

Will you tell me the results of the research?

Results will not be sent to individual participants but will be made known to relevant authorities. The overall outcome of this study will be discussed with the office of Cocoa Coconut Institute Limited (CCIL) and Provincial Department of Agriculture and Livestock (PDAL) after the publication of the thesis.

Do I have to take part I the research project?

Taking part in this research project is voluntary. It is your choice to take part or not. You do not have to agree to take part if you do not want to. If you decide to take part and then change your mind it is okay, you can withdraw from the project. You do not have to give us a reason; just tell us that you want to stop. Please let us know you want to stop so we can make sure you are aware of anything that needs to be done so you can withdraw safely. If you chose not to take part or start and then stop the study, it will not affect your relationship with us.

If you chose to leave the study we will use any information collected unless you tell us not to.

What happens next and who can I contract about the research?

If you decide to take part in this research we will ask you to sign the consent form. By signing it is telling us that you understand what you have read and what has been discussed. Signing the consent indicates that you agree to participate in this study. Please take your time and ask any questions you have before you decide what to do.

Further Information

If you have any questions or further information regarding this study, please feel free to contact us on the contact-information given below.

Professor George Curry
(Supervisor)
Curtin University
Faculty of Humanities
Phone: (08) 92663310
Fax: (08) 92662711
Email: g.curry@curtin.edu.au

Alois Ndrewou
(Student Researcher)
Curtin University
Faculty of Humanities
Phone: (08) 92663400
Email: alois.ndrewou@postgrad.curtin.edu.au

Curtin University Human Research Ethics Committee (HREC) has approved this study (HREC number ___/_____). Should you wish to discuss the study with someone not directly involved, in particular, any matters concerning the conduct of the study or your rights as a participant, or you wish to make a confidential complaint, you may contact the Ethics Officer on (08) 9266 9223 or the Manager, Research Integrity on (08) 9266 7093 or email hrec@curtin.edu.au.

__/__/2016

Dear Madam/Sir

Invitation to participate in a research project focusing on Cocoa Pod Borer (CPB)

I am Alois Ndrewou and am currently a research student in the Faculty of Humanities at Curtin University in Western Australia. I am being supervised by Professor George Curry of Curtin University.

We are conducting a research on understanding how CPB is affecting livelihoods of smallholder cocoa farmers in the community. This study and others that have been conducted will give us better ideas to develop strategies that we can adopt to reduce the impact of CPB.

You are invited to participate because firstly you are part of this cocoa farming community, and secondly, you receive assistance from either Cocoa Coconut Institute Limited (CCIL) or Provincial Department of Agriculture and Livestock (PDAL) with whom we are working closely with in this project. We therefore believe your experiences will be very informative and educational in this study.

You will participate by being interviewed and being part of a group discussion. The interview and the group discussion will take approximately an hour and done at different times suitable to you.

Participation in this project is voluntary and you will not be paid for your involvement.

If you are willing to participate let me know as soon as possible so that we can send you the information and other details regarding the study.

Thank you and we look forward to your response.

……
Alois Ndrewou
(Student Researcher)
Curtin University
Faculty of Humanities
Phone: (08) 92663400
Email: alois.ndrewou@postgrad.curtin.edu.au

……
Professor George Curry
(Supervisor)
Curtin University
Faculty of Humanities
Phone: (08) 92663310
Fax: (08) 92662711
Email: g.curry@curtin.edu.au

Sign-in Sheet for Focus group discussions

Impact Study of Cocoa Pod Borer, October 2015

Instruction: Participants please fill in your particulars below.

	Name	Gender (M/F)	Age	Clan name	Occupation	Phone Number
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Research assistant to fill information below:

Village: _____Venue:_____Group Number: ____Time:_____Date:_____