Kupang: Social Adaptability and Vulnerability across an urban rural continuum in West Timor

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Declaration of Originality

This thesis is the original work of the author

Except where due reference is made in the text of the thesis

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For Selfi and Keyvin

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Abstract

To date, research on the vulnerability of human systems has tended to focus on the physical impacts of climate change and variability, rather than on social impacts. Emphasis has also been directed to these impacts at the national, regional or sectoral level, rather than at the community level. While these valuable contributions have provided useful assessments of the impacts of climate change, they have provided only a limited understanding of how societies or communities are susceptible to climate change. Such research also fails to take into account the forces contributing to the vulnerability of human systems other than the bio-physical.

This research addresses an apparent gap by examining social adaptability and vulnerability to the problems of climate variability in Indonesia. Taking two districts in East Nusa Tenggara Province in Indonesia as case studies, this research concludes that social vulnerability to climate variability and change in the study areas encompasses disruption to livelihoods and a decline in social entitlement, reflected in economic failure, food shortage and hunger. Such vulnerability is shaped by environmental degradation, poverty and access to key resources. Erratic rainfall, persistent drought, El Niño and La Niña episodes are the most common types of climate-induced events that pose significant risks in the research study sites. Disruption of livelihoods, in particular loss of crops and harvest failures, leading to food production decline, are the most common physical impacts of these events. These events have social consequences for human welfare, especially food insecurity and hunger (ordinary and extra ordinary), and manifest themselves in terms of a widespread uptake of coping strategies.

This thesis contributes to theory by advancing our understanding of vulnerability to climate change through shedding light on the present problems of climate variability and its significant social consequences. This study suggests that building adaptive capacity is imperative to address people's vulnerability to climate variability. However, the nuances of local vulnerability and capability must be understood clearly. Measures have to be put in place carefully if adaptation policies are to be effective. Another significant contribution of the study is through its use of an integrative approach that builds on an inter-disciplinary perspective; this is considered an appropriate approach to discover a wide range of determining factors that explain how local communities and individuals are vulnerable and how they cope with the impacts of climate variability and change. The main implications of the research findings for policy focus on the importance placed on directing the people's adaptive responses to the root causes of vulnerability rather than solely to the physical impacts of the climate induced events. It is only through responding to these causes that vulnerability can be addressed.

Keywords: Climate Variability and Change, Social Vulnerability, Adaptation and Livelihoods.

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List of Abbreviations and Acronyms

AusAID	:	Australian Agency for International Development
BI	:	*Bahasa Indonesia* (Indonesian language)
BPS	:	*Badan Pusat Statistik* (Central Bureau of Statistics)
BRI	:	*Bank Rakyat Indonesia* (The People's Bank of Indonesia)
BOS	:	*Bantuan Operasional Sekolah* (School Operational Budget)
BPD/Bank NTT	:	*Bank Pembangunan Daerah* (NTT Regional Development Bank)
BPS	:	*Badan Pusat Statistik (*Central Statistics Bureau)
BMK	:	*Badan Meteorologi dan Klimatology* (Climatology and Meteorology Agency)
BNI	:	*Bank Nasional Indonesia* (the National Bank of Indonesia)
DPRD	:	*Dewan Perwakilan Rakyat Daerah;* Regional People's Representative Council
ENSO	:	El Niño Southern Oscillation
FAO	:	Food and Agriculture Organization of the United Nations
FGD	:	Focus Group Discussion
GDI	:	Gender Development Index
GDP	:	Gross Domestic Product
GRDP	:	Gross Regional Domestic Product
HDI	:	Human Development Index
HPI	:	Human Poverty Index
IDR	:	Indonesian Rupiah
IK	:	Indigenous Knowledge
IPCC	:	Intergovernmental Panel on Climate Change
INGO	:	International Non-government Organization
Jamkesmas	:	*Jaminan Kesehatan Masyarakat* (Public Health Insurance)
KMA	:	Kupang Meteorological Agency
Masl	:	Metres above sea level
NGO	:	Non-government Organization
NTB	:	*Nusa Tenggara Barat* (West Nusa Tenggara Province)
NTT	:	*Nusa Tenggara Timor* (East Nusa Tenggara Province)
PERDA	:	*Peraturan Daerah* (Regional/local regulation)
PKH	:	*Program Keluarga Harapan* (The Family of Hope Program)

PNPM	:	*Program Nasional Pemberdayaan Masyarakat* (National Programme for Community Empowerment)
PPL	:	(*Petugas Penyuluh Lapangan*) field officers of the local government
PRONA	:	*Program Nasional Agrarian*
Raskin	:	*Beras Miskin* (Rice for the poor)
Rp.	:	Abbreviation for 'rupiah'
RTSM	:	*Rumah Tangga Sanggat Miskin* (Very poor households)
SLR	:	Sea level rise
SUSENAS	:	*Sensus Ekonomi Nasional* (the National Socio-economic Survey)
SOI	:	Southern Oscillation Index
SST	:	Sea Surface Temperature
TBC	:	Tuberculosis (communicable disease)
UNDP	:	United Nations Development Program
UUPA	:	*Undang-undang Pokok Agraria* (Basic Agrarian Law)
WMO	:	World Meteorological Organization

Glossary

Adat	:	Custom, tradition
Amaf	:	Title of traditional power holder (head of clan among the *Atoni*)
Anai-anai	:	Adult winged termites
Atoni	:	See Meto
Atukus	:	Cattle herders
Atupas	:	Ritual lord
Ampupu	:	Eucalyptus tree, *Eucalyptus platyphylla* Auct.
Arisan	:	Rotating savings and loan groups
Bali cattle	:	*Bos sondaicus*
Bah' lele	:	Fence
Bebak	:	Palm leaf stacks of the *Corypha* palm
Bupati	:	Regent; head of administrative district called *kabupaten*
Belis	:	Bridewealth
Belukar	:	Secondary growth
Beringin	:	Tree – *Ficus benjamina*
Camat	:	Head of administrative sub-district called *kecamatan*
Cacing tanah	:	Earthworms
Capung	:	Dragonflies
Cendana	:	Indonesian name for sandalwood – *Santalum album L.*
Dae nggeok	:	Black clayey soil /dark soils
Dae mea	:	Reddish soils / medium-texture soil
Dae fulak	:	Light coloured or textured soil
Dawan	:	See Meto
Desa	:	Village in district (*kabupaten*)
Doulasi	:	Birds – forest cuckoo
Dusun	:	Village hamlet
District	:	Level of region with autonomous regional government and refers to both regencies (*kabupaten*)
Fatu	:	Rock; (Uab Meto (qv)).
Fettor	:	Head of administrative sub-district called *kefettoran*
Fufuk	:	loss of maize seed due to the weevil *Sitophilus zeamais*
Gebang palm	:	*Corypha utan* Lamk. (*gebanga* Bl.)
Gula air	:	*Lontar* syrup made by boiling *lontar* . (qv): juice

Gula lempeng	:	Solid brown palm sugar
Gunung	:	Mountain
Hau meni	:	Fragrant wood – Dawan name for *Santalum album* L.
Hectare	:	2.47 acres
Hetis	:	Cattle with no branding
Huë	:	Tree – *Eucalyptus alba* Reinw. (Dawan language)
Ijon	:	The sale of produce before it has been harvested
Ikat	:	Weaving technique whereby the pattern is established through dyeing the yarn before weaving
Jagung	:	Maize – *Zea mays* L.
Jukung	:	Dugout boat
Kabesak	:	Tree – *Acacia leucophloea* Willd.
Kabupaten	:	Regency/district, one of the two types of autonomous regions within a province
Kapok	:	Kapok*, Ceiba petandra*
Kayu merah	:	Tree – *Pterocarpus indicus* Willd*.*
Kebun	:	Dry-land plots (fields)
Kecamatan	:	Administrative sub-district
Keffetoran	:	Sub-district
Kepala desa	:	government appointed village head
Kelurahan	:	The territory of regional government under a *Kecamatan* that replaces an autonomous *desa* when an area becomes urbanized
Kesambi	:	Ceylon oak – *Schleichera oleosa (*Lour.*)* Merr.
Kintal	:	Home yards
Kumbang	:	Beetles
Kota	:	City when referring to autonomous region, but also a general term for city or town
Ladang	:	Home gardens or fields (*ladang*).
Lamtoro	:	*Leucaena leucocephala*– small tree used for *belukar* restoration
Lantana	:	Shrub – *Lantana camara L.*
Lapar biasa	:	Usual occurring hunger
Lapar luar biasa	:	Extraordinary hunger
Lontar	:	Native palm (*Borassis flabellifer* L.), a multipurpose tree
Loteng	:	Attic (crawl space between ceiling and roof); in a Timorese round house it is where grain is stored

Lalunuk	:	Fallow land - leaving the cropland uncultivated for some years
Lutu	:	Fence (Rotenese language)
Mamar	:	Agro-forestry plot / Permanent gardens with perennial crops; plots of land located close to water sources
Masyarakat Adat	:	Indigenous people
Meo	:	Traditional warriors of Meto clans *(*in Uab Meto language).
Meto	:	Most populous ethnic group in West Timor; the largest indigenous ethnic group in West Timor occupying almost two thirds of the region; also called Dawanese and Atoni
Mamar	:	Agro-forestry plot
nain metan	:	Black clayey soil /dark soils
nain me	:	Reddish soils / medium-texture soil
nain muti	:	Light coloured or textured soil
Nira	:	Fresh juice tapped from lontar palm
Nitas	:	Large tree – *Sterculia foetida* L. – with oil bearing seeds
Natoni	:	Contextually unique educational materials
Ojek	:	Motor bikes that serve as taxis
Padi	:	Rice – *Oryza sativa* L.
Pagar	:	Fence (Bahasa Indonesia)
Pah Meto	:	Dry land (Uab Meto)
Pah Tuaf	:	Guardian of the soil, first settler of a territory (Uab Meto)
Paronisasi	:	Cattle fattening program
Pena	:	Maize
Pemerintah Pusat	:	Central (national) government
Pemerintah Daerah	:	Local government
Perahu papan	:	Plank built boat (non-power boat)
Putak	:	Sago prepared from the pith of the stem of *Corypha utan*
Raja	:	King
Rencah	:	Trample the soft muddy soil of wet-land plots (*sawah*)
Rupiah	:	Indonesian currency; (IDR)
Rentenirs	:	Informal moneylenders
Sawah	:	Wet-land plots / paddy fields
Sawah tadah hujan	:	Rain-fed paddy fields
Sapi	:	Cattle
Suku	:	Clan or ethnic group / Kinship unit

Soni	:	Repeat sowing – plant the second batch of seed
Tanah merah	:	Reddish soils
Tanah putih	:	Light coloured soils
Temukung	:	Title of traditional power holder at a village level
Tonda / tatus	:	The practice of borrowing in-kinds from neighbours
Tofa	:	Hand-weeding
Tjemara	:	Indonesian pine tree – Mountain cemara – *Casuarina junghuhniana* Miq.
Tua-tua adat	:	Traditional elders
Turi	:	*Sesbania grandiflora* Pers. Used for *belukar* restoration
Turis	:	Pigeon pea – *Cajanus cajan*
Uab Meto	:	Meto language
Ume Bubu	:	Round House (Uab Meto language)
Usi/Usif	:	Ruler, king (Uab Meto language)

Currency Conversion

In this thesis the values of the Indonesian Rupiah (IDR) and the Australian Dollar (AUD) are calculated at a rate of AUD 1 = IDR 8,700, while the American Dollar is calculated at a rate of USD 1 = IDR 8,650, the rate current during the main period of fieldwork in 2011.

Chapter 1 Introduction

1.1 The Problem Statement

1.1.1 Climate Change, Vulnerability and Social Impacts

Climate change is already taking place. The IPCC Report (2007) clearly shows that the warming of the global climate system is obvious and undeniable and that global average temperature rose by 0.74°C during the 20th century, and could increase by up to 6.4°C this century, along with a sea level rise of up to 0.59 metres. The IPCC cautions that this trend of temperature variation and global warming is likely to result in changes in precipitation, wind patterns and extreme events. Climate change is nowadays mostly perceived as a threat to economic development and prosperity, rather than as 'just' an environmental problem (Stern, 2007; Garnaut, 2008). The Stern Report (2007) emphasized that access to the basic elements of life for people around the world (water, food, health, and use of land and the environment) is under serious threat due to climate change.

It has been argued that these predicted impacts of climate change on social-ecological systems through changes in global temperature and annual precipitation but also through increased occurrence and intensity of floods, droughts, and cyclones, and epidemics will pose serious risks to human security (McCarthy et al. 2001; Barnett & Adger, 2007)). Climate variability and extreme weather events are already established as resulting in significant mortality and widespread human misery. They disproportionately affect, as Lee (2002) points out, people of colour, tribal communities and those from low socio-economic backgrounds, especially the poor in developing countries (see also FAO, 2007).

1.1.2 Impacts in Indonesia

Like other countries in the world, Indonesia is no exception to the impacts of climate change. For the past three decades, agricultural production in Indonesia has been heavily damaged by changes in precipitation and cycles of droughts and floods triggered by both the Australasia monsoon and the El Niño Southern Oscillation (ENSO), and resulting in economic loss in terms of rural incomes, food prices, and food security (Naylor et al. 2007; Boer 2010). ENSO was the main reason for rice production decline from 1970 to 2000 (Naylor, Falcon et al. 2001; Naylor, Battisti.et al. 2007). Only six out of 43 drought events during the period of 1844 – 1998 were not associated with ENSO (Quinn, et al. 1978; Boer & Subbiah, 2005). The 1994 and 1997 droughts in Indonesia were arguably the worst cases during the twentieth century, when the national rice production fell significantly. The 1994 drought caused a productivity decline on about 500 million hectares of agricultural land, and harvest failure on 150 million hectares (Sutardi, 2006), while the 1997/1998 El Niño-related drought exemplified how the agricultural sector will suffer much from a hotter climate and disrupted hydrological cycle. Most regions in Sumatera, Kalimantan, Java and eastern Indonesia experienced unseasonably dry conditions for several months during the period and suffered significant crop losses.

Thus, the impacts of climate change are evident on agricultural production in Indonesia, especially food crops. The direct impacts can be clearly seen from the decreased agricultural productivity caused by increased air temperature and precipitation changes, while indirect impacts include changes in irrigation water availability as a result of changes in crop evaporative demands and runoff as well as shifts in the types of pests and diseases affecting food crops and livestock. Boer (2010) found that global warming and climate change in tropical regions can reduce corn yields by more than 40 percent and rice yields by 20 percent if temperature increases by 5°C. Rice yields are sensitive to a rise in minimum temperatures in the dry season; experiments conducted by the International Rice Research Institute in the Philippines have shown that yields could decrease 10 percent for every 1°C increase in minimum temperature (Peng et al. 2004).

Sea level rise (SLR) is another important threat to the economy of Indonesia through flooding, an increase storm surges, and the increased salinization of coastal aquifers. This is due to the fact that Indonesia has extensive coastal areas in comparison to its total land mass. Various economic activities take place on the approximately 81,000 kilometers (km) of the Indonesian coastline, contributing about a quarter of the national gross domestic product (Dahuri & Dutton, 2002). Coastal areas contain vast areas of agricultural land, many human settlements, and about 400,000 fish ponds. It is estimated that a sea-level rise of 0.56 meters would cause the loss of 30,000 square kilometers of land in Indonesia (Susandi, Firdaus, & Herlianti, 2008). A 1992 study estimated that SLR may reduce the local rice supply in Karawang and Subang districts (West Java) by about 300,000 tons. Similarly, maize output could be reduced by 10,000 tons, about half of this due to inundation (Boer, 2010). In addition, coastal aquaculture will suffer, and the coastal groundwater would have increased salinization, with potentially devastating results.

Climate change also poses serious risks to human health. Changes in the hydrological cycle will increase the spread of infectious diseases such as diarrhea, and vector-borne diseases such as malaria and dengue (McMichael, Woodruff, & Hales, 2006). During the 1997/1998 drought, malaria spread to high elevations, and for the first time was detected at altitudes above 2,000 meters in the highlands of West Papua (Epstein, Diaz, & Elias, 1998).

It is, thus, confirmed that Indonesia faces serious impacts from climate change, ranging from changes in precipitation and the increasingly frequent occurrence of drought and floods, to sea level rise, as well as greater pressures on public health. However, the poor are inevitably the most vulnerable group to suffer from climate changes. Prolonged drought produces a longer lean season. Delays in the onset of rain, together with increasing frequencies of extreme events, will affect the poor, those living on less than US$2 per day in Indonesia. A longer hungry season usually causes price increases, which in turn causes more people to fall below the poverty line. Poor farmers who spend more than 50 percent of their household income on food purchases find it very difficult to deal with price instability. Likewise, the impacts on health will also be greatest among the poor who have the least protection. The poor are most likely to be living in environments vulnerable to flooding and water-borne diseases.

1.1.3 **Research Niche and Scope**

Vulnerability to climate change has become a prominent topic on the international global change agenda. While it is important to continue research on climate change, *more attention should be given to the present problems caused by climate variability*. These are problems that may worsen under conditions of climate change. Unlike the impacts of climate change, the impacts of climate variability have already been highlighted by events such as droughts and floods: the impacts of climate variability (e.g. reduced crop yields, livestock losses, water shortages, hunger) are not hyphotetical, but are already real and known (Ribot, 1996). Vulnerability assessments could be more helpful in providing useful and reliable data, which will assist in understanding climate variability and its impacts on human welfare (Kasperson & Kasperson, 2001). The advantage of focusing on vulnerability to climate variability is that it reduces dependence on the uncertain results of climate models and at the same time points to the many potential ways to reduce the impacts of climate variations both today and in future (Liverman, 1999; 2001; Liverman, Yarnal, & Turner II, 2004).

While serious economic and environmental consequences of global climate changes are widely recognised, climate change discourses have *largely ignored the significance of the social impacts*. To date, research on the vulnerability of human systems has tended to focus on the physical impacts of climate change and variability, *rather than on the social impacts*, and on the impacts at the national, regional or sectoral level, rather than at community level. The contribution of such studies lies more in their assessment of the impacts of climate change *but less in helping us understand how societies or communities are susceptible to climate change.* Such research also *fails to take into account forces other than the bio-physical contributing to the vulnerability of human systems*. The consequences of failing to incorporate social impacts can further disadvantage those people with the least capacity to cope with the changes and unavoidable climate extreme impacts**.** That means that vulnerable people or groups are potentially misguided in adaptation policies and measures that could otherwise help them to enhance their adaptive capacity in dealing with the physical impacts of climate change and variability.

This research will address this apparent gap by examining social adaptability and vulnerability in the Province of East Nusa Tenggara, Indonesia. This province has a high rate of poverty, and is one of the poorest regions in the country. Heavily reliant on agriculture as the main source of livelihood, the province has often suffered from unreliable rainfall, tropical cyclones, floods and other climate related hazards, especially El Niño-related drought. Harvest failures leading to ordinary and 'extra - ordinary' food shortages are the most common problems in the region.

Two districts or regions were selected as the case studies for this thesis because these regions represent different agro-ecological settings: Kota Kupang is semi urban, while the other (Kabupaten Kupang) is a rural district. These districts provide illuminating case studies which show how the people have responded to extreme climate events.

Moreover the author has lived and worked in the area most of his life, and hence has a good understanding of local issues.

A vulnerability approach will be employed in this study to identify and explain the multiple political, socio-economic and environmental forces that influence the way in which people are exposed to and are sensitive to climate, and their capacity to adapt to changing conditions. By relying on participatory, bottom-up methods, factors contributing to vulnerability are not assumed a priori, but will be identified on the basis of peoples' experiences, allowing for differentiated vulnerability within the community.

The use of vulnerability analysis is important to bridge the gap between impact analysis and policy formulation by directing policy intentions to the root causes of vulnerability rather than its symptom – the negative outcomes and impacts that follow triggering events such as droughts (Ribot, 1996).

1.2 **Research Objective and Questions**

The main objective of this study is to assess people's vulnerability and the configuration of forces that shape people's ability to cope and adapt to climate variability and change in semi-urban and rural Kupang, in the East Nusa Tenggara province of Indonesia.

This objective will be carried out by exploring the following three research questions:

1. *How has such climate variability and change affected social vulnerability in the research areas?*
2. *How have households and community groups coped with and adapted to the risks?*
3. *What are the root causes of social vulnerability in West Timor, Indonesia?*

The main objective of Question 1 is to examine how people in the research areas are vulnerable to current climate variability and change. In addressing this question, it is important to study the main characteristics of the environment in the research regions. This is addressed in Chapter 3. Another important issue centres on the occurrence of climate variability and how such variability affects local communities in the regions. This is covered in Chapter 4. The aim of Question 2 is to study household and community groups' responses in addressing the climate related risks that affect their livelihoods. This is covered within two chapters: Chapter 5 discusses strategies adopted by local communities in dealing with inherently poor soil quality, unreliable rainfall, and drought, while Chapter 6 focuses on livelihood diversification strategies across individuals, community groups (ethnicity) and agro-ecological settings. Question 3 seeks to explain the underlying factors that shape people's vulnerability in the research regions. Based on an integrated vulnerability approach, Chapter 7 offers three main roots of social vulnerability and adaptability in the research areas.

1.3 **Overview and Thesis Structure**

The thesis consists of eight chapters. Following the introduction, Chapter 2 focuses on the theoretical and research frameworks employed to study social vulnerability and adaptability in the studied regions. Various theories on climate and weather are discussed. The concept of vulnerability and its relevant elements including entitlement, coping and adaptation is critically analysed as a theoretical approach through which the impacts of climate variability and change have been studied in the past. An integrated vulnerability approach for this study is then presented. Case studies are justified as an appropriate methodology for studying social vulnerability to climate variability. Kota Kupang and Kabupaten Kupang in East Nusa Tenggara Province are selected as case study sites. The modes of selection of villages and households, and the sources of data are detailed. Finally, ethical considerations are discussed.

Chapter 3 examines the main characteristics of the environment in the research regions. First, the bio-physical environment covering geography, the climate, the soils, natural vegetation and bio-physical hazards is discussed. The economic environment is described, highlighting the agriculture sector as the mainstay of the local economy; the local market system, land tenure and access to credit are also described. Socio-cultural and governmental environments are examined. These characteristics are the predetermining factors in shaping social adaptability and vulnerability in the research regions.

Chapter 4 discusses how bio-physical hazards manifest themselves in livelihood vulnerability in both regions. The general characteristics of the climate in the research regions are described. Climate related risks, namely unreliable rainfall, droughts, floods and El Niño and La Niña events are presented to highlight their importance in affecting people livelihoods. The impacts on crop production, human health and food security are discussed.

In Chapter 5 a wide range of coping and adaptation strategies are considered. Water and soil conservation strategies derived from local knowledge are described. Seed selection and storage methods employed by subsistence farmers to ensure the availability of seed stocks and the household's food supply are also presented. Predicting the rain through local knowledge is also examined. The chapter also examines the pattern of coping strategies, with regard to variation in time and between households, in dealing with droughts.

Chapter 6 examines livelihood diversification strategies adopted by individuals and the different ethnic community groups to eke out a living. Consideration is given in particular to crop production and livestock rearing which constitute the main livelihoods in the research regions. Other important livelihood activities including cattle fattening, *lontar* (*Borassis flabellifer L.*), palm tapping and manganese collection are described. Livelihood diversification strategies are compared according to geographical areas, wealth group, ethnicity and gender.

Chapter 7 discuss three determining factors that are related and reinforce each other to shape social adaptability and vulnerability in the regions. First of these is the environmental degradation manifested in forest depletion, land degradation, soil erosion and water shortages. Next, poverty is described as an important barrier to adaptive capacity in the research regions. Finally, access to key resources (land, livestock, labour, credit, markets and social networks), mediated through formal and social institutions, is investigated.

In Chapter 8, the major findings of the research objective are summarised. The implications of these findings for addressing local vulnerability to climate variability and change and future research in the context of this study are briefly discussed.

Chapter 2 Theoretical and Research Framework for Studying Social Vulnerability and Responses to Climate Variability and Change

2.1 **Introduction**

The main objective of this chapter is to identify theoretical approaches that provide a framework for analysing social adaptability and vulnerability to climate variability and change, the issue central to this thesis. In doing so, this chapter will review some theoretical debates on (1) agricultural livelihood vulnerability to climate-related hazards especially El Niño-related droughts and rainfall variability, (2) how affected households/individuals cope with such hazards, and (3) how they adapt their livelihoods to environmental change and climate variability.

The chapter first reviews theories on climate and weather. From there, it will discuss previous work on vulnerability and related concepts such as exposure, capacity, entitlement and coping. Studying agricultural household strategies to mitigate risk will also be reviewed as an important approach to understand the processes that determine household vulnerability and the manifestation of environmental changes at the household level. The theoretical debates over relevant issues such as land degradation and livelihood diversification will not be covered in this chapter. Instead, they will be linked where relevant to my findings in the empirical chapters.

The final part of this chapter will cover the research framework that guides this study. Methological issues are also presented, in particular the justification of the case study approach, the selection of research sites, methods of data collection and analysis, and ethical considerations.

2.2 **Climate Variability and Change**

Climate variability makes it difficult for anyone to accurately predict what the next season will be like. For farmers as well as input suppliers and marketers but also governments, it is imperative for decision-making to have some idea of seasonal patterns. This problem of uncertainty poses risks for farmers and has fuelled the need to study a range of climate phenomena in order to generate predictions for the agriculture sector and for the economic system in general. The large body of studies that have examined and reviewed the potential impact of climate variability and extreme weather events has clearly indicated that climate variability can have serious impacts on both human and natural systems. In relation to the agricultural economy, it is argued that climate variability is associated with changes in soil moisture availability and that the increased occurrence of climate fluctuation and extreme weather events contributes to crop diseases and can bring about a significant reduction in agricultural yields. These conditions, in turn, lead to the serious problem of food shortages.

The World Meteorological Organization defines climate as the average state of the atmosphere, usually measured over a 30-year period (WMO, 2000). Two crucial variables that determine the climate of an area are temperature and precipitation (Miller, 1996). Climate variability refers to changes in one or more climatic variables such as temperature, precipitation and wind over a specified time (Ribot, 1996). In addition, the IPCC (2001) defines climate variability as the variations in a mean state using other statistics (such as standard deviations or the occurrence of extremes) of the climate on all temporal and spatial scales beyond that of individual weather events. These conditions could be driven either by internal variability – natural internal processes within the climate system or/and by external variability – variation in natural or anthropogenic external forcing. In addition to climate variation, a climate extreme is defined as an event that is rare within its statistical reference distribution at a particular place (Gray, 2004). In this view, its characteristics vary from place to place. It is further argued that a climate extreme is an event that exceeds the average of a number of weather events over a certain period of time (for example, rainfall over a season, a prolong drought and so forth).

Current concern for climate variability has arisen due to the unprecedented pace and the extent to which unexpected changes in climate affect human and environmental systems (Ribot, 1996). Climate variability affects countries in one-way or another. Some countries may experience climate variability in terms of rainfall, while others may have problems with snow pack and varying evaporation rates.

2.2.1 **Droughts**

Drought – as a recurrent feature of climate – is considered as a ‘creeping’ phenomenon that affects regions, causing crucial damage to human lives and economic bases for survival. Despite its hazardous causes, drought carries quite different characteristics from other natural hazards since its potential impacts accumulate very slowly over a considerable period of time, extend over a large area and may last for years after the termination of the event which makes it very difficult to determine its onset and ending (Tallaksen & van Lanen, 2004). Apart from its uncommon characteristic, another crucial problem is the difficulty to establish a precise and objective definition of drought (Yevjevich, 1967;). Drought, is therefore, a *relative* rather than an absolute condition that should be defined for each region. Each drought differs in intensity, duration and spatial extent. In general, drought is regarded as a persistent occurrence of natural water availability deficit over a certain period in a certain region, resulting in extensive damage to crops and to loss of yield (Beran & Rodier, 1985).

Wilhite and Glantz (1985) classify drought into three types based on physically measurable indicators. In the order of appearance and increasing complexity, the types are (1) meteorological drought; (2) agricultural drought; and (3) hydrological drought. A deficit of precipitation over an extended period in a certain region is considered a primary cause for a *meteorological* drought. This view is solely based on the degree of dryness compared to normal conditions (average amount and duration of dryness), or specifically based on the departure of actual precipitation from the average amount over monthly and seasonal time scales. The analysis of meteorological droughts is arguably easy as compared to other types of drought since it is mainly defined in statistical terms (Mortimore, 1989). *Agricultural* drought points to the lack of water or soil moisture over a particular time for crop development. In this respect, agricultural drought occurs when crops lack sufficient water to fully grow and develop. The availability of soil moisture falls below the normal range of variability for a prolonged period of time and crop failure results. Due to different crops requiring different soil moisture in different stages of their growth, it is quite difficult to define the occurrence of agricultural drought in a given area, especially where a wide variety of crops is grown. *Hydrological* drought is closely associated with the effects of the periods of rainfall shortfalls on the water levels of rivers, reservoirs and lakes and aquifers. This type of drought is usually noticed after meteorological drought. Hydrological drought is usually linked with the effects of a precipitation deficit over an extended period on surface or subsurface water supply.

Despite its various definitions, most droughts are associated with *precipitation deficiencies*. The lack of precipitation over a period of time leads to meteorological drought. The shortage of water propagates through the hydrological cycle and, coupled with high evaporation resulting in insufficient moisture in the topsoil, may cause an agricultural drought, which in turn leads to hydrological drought when a reduction of groundwater and stream flow exists. These various types of drought are significantly influenced by each other through the natural hydrological cycle. Thus, the hydrological drought is generally considered as the final phase in a cycle starting with meteorological and agricultural droughts (Wilhite and Glantz, 1985). My research is mainly related to the former two types (*meteorological and agricultural*) of drought and their impacts on society.

2.2.2 **Rainfall Variability**

What makes an area prone to drought is not due to the low average rainfall. As Kemp (1994) argues, inter-annual variability of rainfall is the prime cause of dry years. Kemp then makes a clear difference between aridity and drought. A low average level of precipitation is associated with aridity which is also a permanent feature of a region's climate, while drought occurs when a region faces a temporary lack of precipitation significantly less than the normal or expected rainfall level in a given month, season, or year (Kemp, 1994). When a higher rainfall variability is evident in a region, the chance of receiving rainfall significantly below the average amount is also higher; consequently, the risk of meteorological drought that leads to agricultural drought is higher as well. Therefore, we need to be more precise, as far as rainfall variability is concerned.

In general, rainfall variability is differentiated into spatial variability, inter-annual variability and intra-annual variability or seasonal concentration (Schaik van & Reitsma, 1992). *Spatial variability* refers to the differences in rainfall amount received between neighbouring sites or villages, either structurally or proximately (in a given year). Spatial variability is high when two nearby sites receive quite different rainfall amounts. Structural differences in rainfall level are often found between sites that are separated by a mountain range and thus high spatial variability. The village on the lee side will be receiving less rainfall than the village on the weather side. Without a mountain range, it is still possible to find great differences in precipitation over short distances. This may cause different annual drought risks within a small site.

Inter-annual variability refers to the difference in precipitation between years. The assessment of inter-annual variability is mainly restricted to a comparison of total annual amounts of precipitation in different years, while the year-to-year variation in the rainfall distribution is often overlooked (Schaik van & Reitsma, 1992). In fact, what matters most is the year-to-year variation in rainfall distribution which exposes subsistence farmers to a high degree of uncertainty and risk. Therefore, in addition to the amounts of rainfall, the distribution of rainfall needs to be included in the assessment of inter-annual variability. A higher average level of precipitation does not neccesarily mean that inter-annual variability in total amounts of rainfall is lower (see Schaik and Reitsma, 1992). In the assessment of agricultural drought risk, inter-annual rainfall variability is more critical than average rainfall conditions (Kemp, 1994).

Intra-annual variability or seasonal concentration is the distribution of rainfall within a year. If the amount of rainfall remains at exactly the same level within months or whichever time unit is used in the analysis, the intra-annual variability would be zero (Foeken, 1988). The rainfall pattern in East Nusa Tenggara Province and the research regions is unimodal; it is concentrated in one rainy season in which the rainfed farming activities take place, leaving the dry season for other activities (see Ormeling 1956). This means that a harvest occurs only once a year. Therefore, the risk is concentrated in one harvest time and the rainfed farmers find it very difficult to bridge the period between two harvests. The granary remains empty during the months prior to the harvest; consequently, household consumption has to be reduced while the agricultural work is quite demanding. Thus, the seasonal concentration of precipitation has significant impacts on people's lives, in particular the seasonality in the agricultural cycle, in labour demands, food availability, and food prices.

2.2.3 **Climate Classifications**

According to Boerema (1941), the climate of Indonesia can be differentiated into three distinct types: (1) a monsoonal type which features one peak of monthly rainfall, influenced by the Asian winter monsoon; (2) a double equatorial rainy season type which has two peaks of monthly rainfall and is influenced by the passage of the sun across the equator twice a year; and (3) a local type being characterized by one peak influenced by the Australian winter monsoon.

These three rainfall types specifically characterize the following rainfall regions of Indonesia: a relatively high annual rainfall ranging from 2,500 and 4,000 mm is found in Kalimantan, Sumatra except for the northern coastal strip, West Papua except the south-eastern region, the central parts of Sulawesi, Halmahera and Aru islands of Maluku, and south-western Java. The remaining regions of Indonesia feature either a semi-arid or a monsoonal climate; the driest part is found in Nusa Tenggara (NTT and NTB) with an annual rainfall of between 700 mm and more than 1000 mm. However, most Indonesian regions have an annual rainfall of more than 2000 mm with a national annual average of about 2600 mm. These relatively high levels of humidity and rainfall play an important role in inhibiting any climate change hazards.

While this rainfall pattern holds generally true for the entire Indonesian archipelago, due to its more southern position (roughly between 8 and 10 degrees south of the Equator), what makes the climate of Timor (the research regions) differ significantly from that of other parts of archipelago is its proximity to Australia and its relief features. Within the context of tropical Southeast Asia, Timor is one of the driest parts, displaying extremely pronounced climatic differences. In this respect the island occupies a transitional position between humid Southeast Asia and dry central Australia (Metzner, 1977).

2.3 Vulnerability to Climate Variability and Change

Having discussed climate and weather, I now discuss the link between climate and people, that is, between the natural environment and human society. Rainfall variability causes high risks of production failure and has the potential to cause disasters. For many years, it was argued that natural disasters among human populations were mainly caused by natural hazards, which are, in most cases, climate and weather related. It is now widely held that natural hazards do not necessarily bring about disasters (Bohle et al.1990; Cannon, 1990; Blaikie et al. 1994). An agricultural drought in a given year does not necessarily lead to hunger and famine, for example. A natural hazard can only lead to a disaster when vulnerable people are affected (Cannon, 1994). In this respect, a natural hazard is mostly considered as a trigger event that causes a disaster. However, the underlying causes are to be found in people's vulneraility. These causes are more related to social and cultural issues, in addition to economic and political factors. Having argued that, the concept of vulnerability has evolved from the the focus on bio-physical hazards to take into account the human dimension which helps to characterize the nature of vulnerability. The following section will review the evolution of the notion of vulnerability in the study of climate change and variability.

2.3.1 The Physical Dimension of Vulnerability

The concept of vulnerability varies among bodies of literature and contexts. Natural hazards are defined as extreme natural events that pose a threat to people, property and possessions (McGuire et al. 2002). The literature examines how people and societies respond to natural events, what factors influence response choices and how risks are managed (Cutter, 1996; Hewitt, 1997). In natural hazards scholarship, vulnerability has been referred to as the "degree of loss resulting from the occurrence of natural phenomena to a given element or set of elements" (United Nations Disaster Relief Organization, 1982, p.12). Attention is focused on the characteristics of hazards such as magnitude, duration, frequency and rapidly of onset (Burton et al. 1993). From this perspective, vulnerability is explained in terms of physical stimuli and their impacts.

Building on the natural hazards scholarship, research on climate change impacts often uses exposure to biophysical conditions to define vulnerability (Liverman, 1994; Smith & Lazo, 2001). In this context vulnerability is concerned with the impacts of a hazard and the resultant damage by a system (Brooks, 2003). Vulnerability is characterised by the distribution of a hazardous condition, the human occupancy of a hazardous zone (unstable slope, seismic zone, coastal area) and the degree of loss (of life, property) associated with the occurrence of a particular event (landslide, earthquake, tsunami) (Cutter, 1996). Populations are treated as being vulnerable based on their presence in a hazardous location and the nature of the hazardous event (frequency, severity).

Impact asssessments have also been used in the field of climate change studies. The assessments begin with selecting a particular hazard or environment stress of concern and seek to identify its most important consequences for a variety of social or ecosystem properties. These types of assessments in the climate change field have been referred to as the standard approach (Burton et al. 2002), conventional and/or traditional approaches (Carter et al. 1994) with the goal of identifying impacts of climate change and the resultant vulnerability of a system. Impact assessments in the climate change field typically rely on scenarios derived from Global Circulation Models (GCM) to identify possible problematic future conditions (Carter & La

Rovere, 2001). The assessment begins with a stimulus specified by a scenario (for example an increase/decrease in average temperature/precipitation, sea level rise) and then predicts probable environmental and social implications over a vast area. Although its use has been instrumental in creating awareness of the potential impacts of climate change, its focus tends to be on the physical dimension and vulnerability is addressed at the end of the assessment. It is a *top-down* approach where vulnerability is described as the resulting impact of climate change or as a residual impact of following adapation strategies (Smit & Wandel, 2006).

Most research on climate change impacts in the 1980s and 1990s linked climate scenarios with bio-physical impacts or studying responses of individual systems to selected climatic threats. Few studies captured the dynamism of local vulnerable groups, current exposures to stresses, relationship of various scales and the responses to climate variability and extremes that define future vulnerability to climate change (Downing, 2003). Climate change impact studies assess vulnerability at the end of the analysis which rests on numerous accumulated estimates, uncertainties and asumptions of potential impacts (Kelly & Adger, 2000). Turner et al. (2003, p.8074) argue that this approach does not address:

> … the ways in which the systems in question amplify or attenuate the impacts of the hazard, the distinctions among the exposed subsystems and components that lead to significant variations in the consequences of the hazards and the role of political economy, especially social structures and institutions in shapping differential exposure and consequences”.

The ability of a population to modify the hazardous event is greatly downplayed as the focus is predominantly on the event and its impacts. These studies underemphasize the processes by which society can increase the possible impacts associated with a hazard or enact adaptations strategies designed to reduce the possible impact.

2.3.2 **Social Approach: Human dimensions of vulnerability**

The human-dimension of vulnerability emerged from the recognition that exposure to environmental stress alone was not the only component creating vulnerable conditions (Liverman, 1994). Although hazards, disasters, climate change and variability cause tremendous susceptibility to harm of human communities, they are also influenced by the surrounding social conditions. Attention paid to the human dimension addresses the social attributes of vulnerability. For example, attributes that can increase or decrease a system's vulnerability include marginalization, inequity, presence and strength of institutions, food and resource entitlements, economics and politics (Adger & Kelly, 1999; Adger, 2000; O'Brien & Leichenko, 2000; Pelling, 2002).

The conceptual evolution of emphazing the human dimension in relation to the physical dimension of vulnerability has been well developed in the fields of food security (Sen, 1981; Chambers, 1989; Chen, 1991; Bohle et al. 1994), political ecology (Blaikie & Brookfield, 1987; Bryant & Bailey, 1997; Pelling, 1999; Mustafa, 2002; Paulson et al. 2003) and more recently climate change (Handmer et al. 1999; Leichenko & O'Brien, 2002; Adger, 2003; Ford & Smit, 2004). An examination of vulnerability inclusive of the human dimension includes an understanding of the human use of and access to resources, which in turn determines the ability of an individual or society to cope and adapt to change (Wisner et al. 2004). For example, vulnerability has been referred to as "the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard, an extreme natural event, or process" (Wisner et al. 2004, p.34). What follows is a review of some important contributions to the concept of social vulnerability.

2.3.3 Entitlement Approach: Basis of understanding vulnerability

The entitlement approach, first developed by Sen (1987), is still very influential in the study of vulnerability. It seeks to explain how and why an individual fails to secure a livelihood, and in particular how his/her entitlement to food declines. As argued by Sen, food production decline is not the only cause of hunger and famines. In addition to production failure, people often go hungry due to an exchange failure or entitlement failure. Entitlement in this respect is a broader concept that incorporates income with all the resources available to a person including assets and social exchanges (Adger, 1996).

An individual's entitlement is defined as the set of different commodity bundles (including food) over which s/he can establish command and choose to consume. A person is vulnerable when s/he fails to hold command over commodities, resulting in a consumption decline. This type of entitlement failure causes famines and hunger to occur (Sen, 1987). Entitlement is related to endowment and exchange. Endowment refers to an individual's initial bundle of ownership including land, labour and other assets. These endowments can be exchanged or used to generate various alternative bundles of entitlements such as through social claims based on informal rights and social networks (Swift, 1989; Bohle et al. 1994). For instance, rural households often sell their labour to buy or produce food (Drèze & Sen, 1989). Likewise, households may choose to deplete assets such as selling small animals to buy food when the granary is about to empty. Households owning an adequate commodity bundle are relatively secure.

A decline in endowments and/or exchange failure leads to entitlement failure, as argued by Sen (1981, p.4) "a person's ability to avoid starvation will depend both on his ownership and on the exchange entitlement mapping that he faces". In this respect, people become vulnerable when they encounter a high risk of entitlement deprivation. In early studies of entitlement, it was argued that food production decline caused entitlement failure especially for subsistence households who secure their entitlements from producing food; however, exchange entitlement failure as a result of skyrocketing food prices and the plummeting prices of assets is another important cause of entitlement failure. A study of the 1992/1993 drought in Zambia confirms that a decline in food availability did not cause a subsistence crisis since entitlement to food was shifted from production to market, transfer and credit (Devereux & Naeraa, 1996).

By emphasising temporary shifts in entitlements, this approach has been heavily criticized to have neglected the structural-historical processes that bring about the unequal distribution of entitlements to resources. Other criticisms are that the approach failed to explain what occurs *after* the period of a disaster, the so-called recovery process (Watts and Bohle 1993). Swift (1993) argues that the entitlement approach focuses on exchange failures and/or entitlement failure, while food production failures are neglected. By arguing that food availability decline does not cause famines, they dismiss the fact that crop and/or production failures do not have the potential to create serious food stress among cultivators (directly, as a production failure) and/or market-dependent households due to skyrocketing food prices (indirectly, as an exchange failure). In line with this view, Leach et al. (1999) argue that an excessive distinction between the availability of and command over food are unnecessary since the two phenomena are often inter-connected in practice. More recent entitlement research, or extended entitlement research (for example. Davies, 1996) has incorporated these criticisms.

A very simple model was developed by Swift (1989) who identifies four determinant factors of short-term vulnerability (see Figure 2.1). In this model, other underlying factors are included in explaining structural vulnerability; production (failures) and consumption are mediated by exchange (failures) and by *assets*. While 'exchange' relates to a household's position and participation in labour and commodity markets, assets include investments, stores and claims. Assets play an important role in creating a buffer between production, exchange and consumption. For this reason, assets, which are created in times of surplus in production and exchange, can be converted into productive inputs or into food for consumption through selling, buying, exchange and/or inter-household transfers in times of shortage.

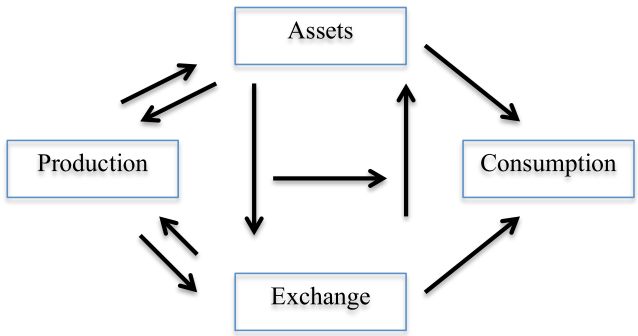


Figure 2.1 The role of assets and exchange as a buffer between production and consumption.
(Source: Adapted from Swift,1989, p.11)

2.3.4 **'The Causal Structure of Vulnerability'**[1]

The theoretical approach in vulnerability studies has not been well developed in its empirical analysis especially at household level. As argued by Watts and Bohle (1993), vulnerability as a concept lacks well-established indicators or methods of measurement. In response to this theoretical gap in vulnerability analysis, researchers have endeavoured to bring together different approaches to make a greater contribution to the theoretical debate on vulnerability (Ribot, 1996). However, their studies have

[1] The title of this section was taken from Watts & Bohle (1993).

still failed to provide methods of measurement especially in empirical analysis at household level.

In an article, entitled 'The space of vulnerability: a causal structure of hunger and famine', Watts and Bohle (1993) reviewed three different but complementary approaches to vulnerability: the entitlement approach, the empowerment approach and the political economy approach. Taken together these three approaches make an 'analytical triangle' (see Figure 2.2). While the entitlement approach refers to what has been discussed in the preceding section, the empowerment approach highlights three political domains, namely the domestic domain (intra-household politics), the domain of work (production politics) and the public-civil sphere (state politics), that affect rights and power in command over food (Watts and Bohle, 1993). Political economy approach offers an historical explanation of the structural processes of entitlement and empowerment in a society. The processes are commercialization, proletarianisation and marginalisation that cause inequality and vulnerability to increase through the appropriation of surplus from direct producers (1993 p. 51-52). Despite the overlap among the approaches, each has its own causation. Vulnerability is a result, respectively, of: (1) the failure of entitlement or command over food in the economic space of vulnerability; (2) the lack of power in the political space of vulnerability and (3) appropriation and exploitation in the structural-historical space of vulnerability.

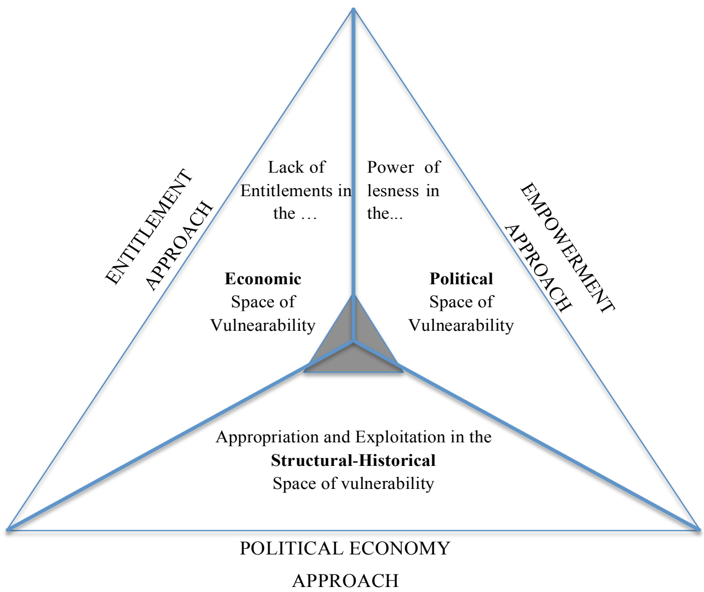


Figure 2.2 The causal structure of vulnerability,

Source: Adapted from Watts and Bohle (1993, p.53-54)

The space of vulnerability occurs at the intersection of these three causalities, which affect the exposure to risk, the capacity to cope and the process of recovery. They are not mutually exclusive but occur simultaneously and reinforce each other. Their relative causes can explain the unequal distribution of food security between regions and community groups. Among the vulnerable regions are the marginal, the dependent and the crisis - one regions, while the vulnerable groups include the resource - poor and those vulnerable to market disturbances, the powerless and the exploited (Watts and Bohle, 1993).

Based on five case studies from Asia and Africa, Watts and Bohle (1993) apply their model to explain the *empirical* differences in the space of vulnerability. Their differentiation is based on class, livelihood system and gender; they trace changes to explain the type and degree of vulnerability in different years and seasons. Such an approach offers a very interesting understanding of vulnerability among different community groups over time. However, the study was drawn from secondary sources: those studies were not deliberately designed to study vulnerability empirically. As a consequence, community groups are assigned different types and degrees of vulnerability in different epochs, based on interpretations of historical processes. Given that, this study offers no improvement with regard to methods of measurement.

Empirical analysis of vulnerability is quite different between the political and structural-historical spaces of vulnerability, and the economic space of vulnerability concerning entitlements to food and livelihoods. Adger (1996) argues that the difficulty in measuring entitlements to resources is due to their temporal and seasonal dimensions, and intra-household transactions. Adger, in his study of vulnerability to climate variability and change in Vietnam, relies on poverty as a proxy to measuring entitlement to resources. Davies (1996) points out that a careful dis-aggregation of poverty is required in vulnerability analysis including the ways in which people access food, both in normal years and in stress years. In contrast to Adger, Davies does not take a proxy measurement such as poverty for vulnerability analysis. Powerlessness and exploitation in the political and structural-historical space have indirect effects on vulnerability. Direct food and livelihood vulnerability occurs due to the fact that people have a limited set of entitlements. The three spaces of vulnerability do not occur at the same time to cause vulnerability; while immediate vulnerability is due to the limited set of entitlements and is easily measured, the underlying causes are associated with two spaces that can only be recognised and described.

2.3.5 **Social Vulnerability to Unreliable Rainfall and Climate Variability**

In this section, the discussion on vulnerability will focus more on people's vulnerability to irregular rainfall behaviour, climate variability and climate change. Of course, there are still more sources of risks that agricultural households face in making ends meet. The emphasis lies, however, in unreliable rainfall and climate variability; the main objective of this study is to assess people's vulnerability and responses to climate variability in order to identify policy interventions for enhancing people's adaptive capacity. Moreover, unreliable rainfall and climate extreme events are identified as among the major sources of risks for the predominantly rain-fed agricultural sector in my research regions. As a *hazard*, an irregular rainfall regime and climate extreme events can result in either *insufficient* rainfall or *over-abundant* rainfall. Such a hazard will in turn lead to a decline in agricultural production and food and the destruction of livelihoods, affecting the majority of the population but especially the vulnerable people. Thus, these climate phenomena and other natural characteristics in the research region like low soil fertility are among the *structural causes* of vulnerability.

In the earlier section on vulnerability, it is stated that natural hazards do not *cause* disaster. An event only becomes a disaster when vulnerable people are affected. In this sense, hazards serve as trigger events. Bearing in mind, natural factors do not come to the fore in the vulnerability theory, as outlined in 'the causal structure of vulnerability'. It is rather social, economic and political factors that reinforce each other to constrain people's entitlements, which, in turn, lead to vulnerability. This notion is contrary to the physical determinism position strongly held in studying disasters (Ribot, 1996). The notion, however, offers other features of social or political-economic determinism (see Blaikie *et al*. 1994) that undermines the significance of the natural environment for agricultural livelihoods.

In saying that, natural factors are not merely identified as trigger events. In the agricultural sector, natural factors play a significant role in people's livelihoods in 'normal' years in the sense that they affect the prospects for production surplus and the ability to accumulate assets, which are crucial in reducing people's vulnerability. In rural areas, household production still constitutes the major source of livelihood, despite a rapid change associated with the rise of livelihood diversification and de-agrarianisation (Bryceson, 1997). Agricultural households living in geographical areas that are bestowed with a favourable climate and high quality natural resources have more secure sources of entitlements as compared to their counterparts in risky environments with unfavourable climate, poor soils and a limited endowment of natural resources. All in all, natural factors serve not only as trigger events but also as the causes of vulnerability. Therefore, in assessing the vulnerability of people living in areas with low quality natural resources, it is essential to take into account these underlying factors in the social, political-economic and cultural domain.

Ribot (1996) argues that the social framework of vulnerability should include climate variability and change. Incorporating natural or environmental variables in the causal analysis of vulnerability requires a clear distinction be made between natural factors that cause vulnerability, and natural factors that trigger events. Examples of this include land degradation and ‘normal’ climate variability in semi-arid regions. Neither acts as a trigger event. In fact, they are natural factors that cause people or regions to become more vulnerable as they put a structural restriction on people’s productive entitlements and their capacity for asset accumulation.

In an article on social vulnerability and climate change, an adjusted causal structure of vulnerability is developed by Bohle et al. (1994) (see Figure 2.3). Taking into account Dreze and Sen’s (1989) inclusion of the ‘totality of rights’ in the entitlement approach, the ‘empowerment’ and the ‘entitlement’ approaches are gathered together under ‘expanded entitlements’. Thus the ‘human ecology’ approach to vulnerability is now added to the analytical triangle. Human ecology points to the causal link between *nature* and *society.* The main concern is with two issues: (1) the risk environment that the vulnerable face; and (2) the quality of their resource endowments. This newly adjusted approach is more appropriate to study household vulnerability to climate variability including unreliable rainfall than the one presented before.

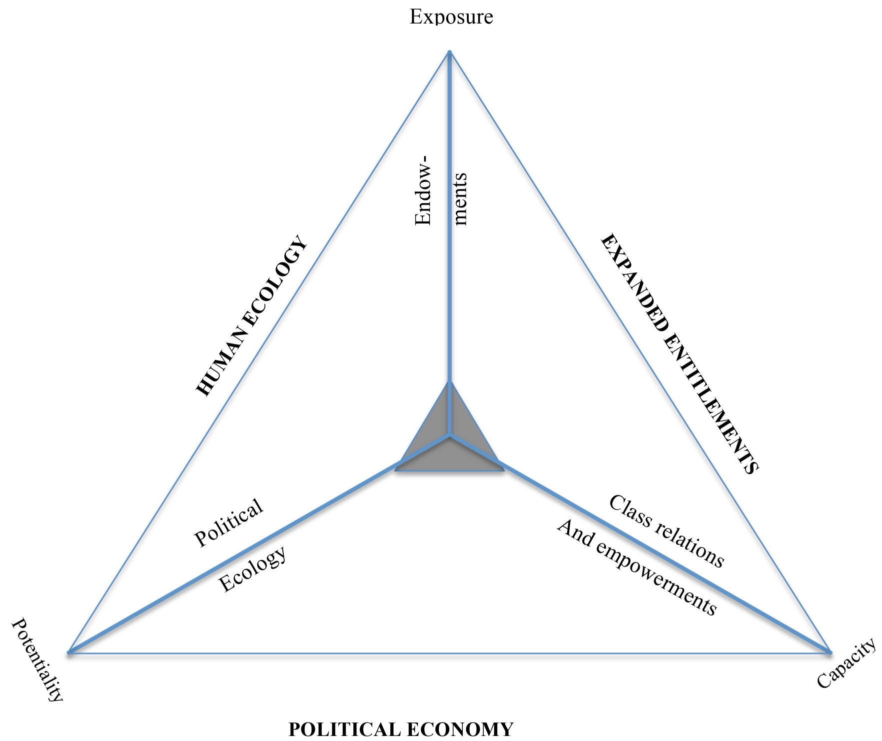


Figure 2.3 The causal structure of vulnerability after integration of the 'human ecology' approach,

Source: Bohle et al. (1994, p.39)

In their model, Bohle et al. (1994) differentiate vulnerable livelihood groups based on the three causal powers that shape vulnerability. One type of vulnerability includes *refugees, cultivators, pastoralists, urban poor and wage labourers*, while *subsistence farmers* are placed in the human ecology space of vulnerability for the reason that their vulnerability is due to climate perturbations and that their livelihoods rely heavily on natural resources. Environmental degradation and/or poor natural resource endowments increase farmers' vulnerability. Their vulnerability to a decline in food entitlements is caused by the low productivity of their livelihood system, instead of exploitation or powerlessness. Amongst livelihood groups, certain social groups such as women, the elderly and refugees are often more vulnerable due to limited rights and powerlessness (Bohle et al. 1994).

An empirical study of vulnerability to climate variability and change was conducted by Adger (1999) in coastal Vietnam. Two types of vulnerability are assessed in his study, namely individual and collective vulnerability. While the former is measured through "access to resources and diversity of income sources, as well as through social status of individuals or households", the latter is measured by "institutional and market structures, such as the prevalence of informal and formal social security and insurance, and by infrastructure and income" (Adger, 1999, p.251). An additional feature of collective vulnerability is high inequality in access to resources. In Adger's study, individual vulnerability is measured through quantitative indicators of poverty indices and the proportion of income dependent on risky (climate-related) resources, while collective vulnerability is measured by GDP per capita and income inequality as quantitative indicators (proxies).

Adger's study revealed that vulnerability in coastal Vietnam increased due to some changes in the macro-economic and institutional environments in terms of liberalisation and an increase in income equality. In addition, the rolling back of the state had two contradictory effects on vulnerability. While it reduced individual vulnerability with the rise of incomes from commercial crops, collective vulnerability increased because it had weakened prevalent institutional security-nets (Adger, 1999).

The distinction in analysis between individual and collective vulnerability in Adger's study is very valuable since it separates two different variables, namely *internal* variables, referring to household-related variables and *external* variables, pointing to area-related or community-related variables. For comparative vulnerability analysis, taking an example of differences between agro-ecological zones, the distinction between individual and collective vulnerability is equally important. Collective vulnerability is generally higher in risk-prone environments than in relatively secure environments. In politically marginalised areas with poor soil quality and lack of alternative income opportunities, people are *collectively* vulnerable because everybody is affected by these characteristics of the local environment. It is worth saying, however, that not everyone shares equal vulnerability in that area. The degree of exposure to risk in the period of hazard definitely varies, depending on the individual capacity to cope, which is defined as individual vulnerability. While some individuals/households in a region or community are affected in times of stress, some people may even benefit from the vulnerabilities of others. Obviously, there is a differential distribution of individual, household and livelihood system vulnerability *within* the area.

2.4 **Vulnerability and Coping**

2.4.1 **Coping: Concepts and Characteristics**

Coping strategies in the study of climate-related vulnerability refers to how the affected households and community groups secure livelihoods in times of environmental distress. Coping is often regarded as an array of short-term strategies pursued in response to distress and includes the wide variety of entitlements to which households rely on to secure subsistence. Studies on coping, as discussed below, describe constraints that individuals and households encounter in adapting to environmental change. Household options in coping strategies occur within the structures of both political economy and human ecology.

Davies (1993) refers to coping strategies as “a short term response to an immediate and unhabitual decline in access to food” (Davies, 1993, p. 60). While Sen argues that famine is an inevitable result from the failure of exchange entitlements, the literature on coping highlights that the way in which entitlements are obtained is differentiated across time and between households. Households and/or individuals are active as they respond to a crisis in strategic ways. They deliberately weigh up the costs and consequences related to various coping strategies (Adam, Cekan, & Sauerborn, 1998). The term ‘household coping strategies’ suggests thorough forward planning (Corbett, 1988).

It has been argued that coping strategies adopted by rural households follow a general patterned sequence, as a result of decreasing reversibility and the growing commitment of household resource bases. “Coping strategies have a discernible sequence which corresponds to increasing levels of distress” (Adams et al. 1998, p. 268). Based on a review of studies on the sequencing of coping strategies, Corbett (1988) identifies three main stages of coping. The stage one is *insurance mechanisms*. Typical examples include the disposal of non-productive assets such as small livestock, adjustments in cropping and planting practices, collection of wild foods, dependence on inter-household transfers and migration in search of employment. According to Corbett, this first stage of coping is often employed to cope with predictable and non-severe risks that do not affect future sources of food and livelihood. Stage two of coping strategies is *the disposal of productive assets*: the sale of livestock and agricultural tools; sale/mortgage of land; obtaining credit from merchants and money lenders; reduction of consumption levels. The third and last stage of coping strategies is *distress migration*.

This sequence in household coping strategies reflects the trade-off between current consumption and future income. Stage one, according to Corbett, does not affect future sources of food and livelihood. However, when the crisis increases and the available options are exhausted, households may take up the next stage of the coping sequence that has the potential to damage future livelihoods in order to secure subsistence. Early stage coping may be insufficient to cope with the intensified, prolonged distress. Many households taking up petty production, for instance, can cause reduced prices in the market. Likewise, inter-household transfers of money, food and labour have been found to increase in the initial stages of household coping strategies, and decline as the crisis intensifies. One study in China confirmed that horizontal relationships weakened during crisis, but vertical relationships endured at least to some stage (Chen, 1991). Another study in Zambia found that social networks were important resources in dealing with hunger (Pottier, 1988). One important implication of the household coping sequence is that some coping strategies at later stages involve high costs for households themselves such as disposal of productive assets.

2.4.2 **Social Variation in Household Coping**

The sequencing pattern of coping strategies seems to overlook the fact that there is considerable variation between households in employing coping strategies. Some studies on household coping strategies reveal that these strategies are quite varied between community groups depending on gender, age and ethnicity (Winchester, 1990). Little attention has been paid to the contesting choices and purposes that households juggle in the process of coping (Adam et al. 1998). Moreover, intra-household dynamics that affect the type and consequence of coping strategies have also been largely ignored.

While coping seeks to lessen the intensity and duration of crisis by utilizing the limited resources, the capacity of households to mobilize and manage resources varies and as does the ability to cope. Watts (1983) uncovered considerable differences in the ability to cope according to household income groups. During times of environmental shock, the rich may even gain from stocking food and hiring labour at relatively lower prices, which is in contrast to the poor who have exhausted their food stocks early. A study of coping strategies in Tanzania and Ethiopia found that possessing particular skills or endowments of labour is one determining factor in income diversification (Dercon & Krishnan, 1996). Possessing skills and showing diligence in agricultural livelihood activities especially farming are cited as the main explanations for differences in success of coping with environmental pressures. Anderson and Woodrow (1991) confirm that people's ability to work together, combined with associated skills and knowledge caused droughts to have socially differentiated impacts. Moreover, the capacity to respond to a drought at a community level depends on social and organizational capacities, such as in decision-making, in addition to attitudinal and motivational capacities, such as shared belief systems (Blaikie et al.1994).

Vestal (1991), examining vulnerability at household level, argued that successful coping is defined by the ability of households to summon adequate resources to deal with adversity without threatening long-term objectives, in particular livelihood security. Failure to cope causes forfeiting of both short and long-term objectives. Typical examples are disposal of key productive assets, reducing food intake, and reliance on wild foods instead of cereals. The most vulnerable are households having the least capacity to cope, having low productive capacity and limited asset reserves (Adam et al. 1998).

Coping strategies aim at fulfilling numerous objectives, including to "maintain the various objectives of the household, including livelihood security, consumption, health and status, thus ensuring individual and/or collective well-being" (Adam et al. 1998, p. 264). Household coping strategies comprise trading off between these objectives. However, such objectives vary between households and even between household members. This is due to the fact that households and individuals are driven by a diversity of needs and objectives, and this affects coping. Individual objectives may be forgone in the trade-off between these objectives. For example, a case study from Cameroon by Swift (1993) showed that exchange and market based strategies were particularly important for men, while reducing consumption was mostly pursued by women at an earlier stage than men. The pattern of a general sequence, thus, may not be applied by most households due to the variety of objectives and also since the same options are not available to all households at all times (Longhurst, 1986). The demographic structure of households, as well as their socio-economic status, is among household-specific factors that affect the ability and coping capacity of households, indicating a political economic process that can explain the social differentiation in household coping strategies.

2.4.3 **Coping Strategies and Adaptation**

Coping and adaptation in the study of vulnerability are two inter-connected terms. Despite being vulnerable to climate stressors, individual households and community groups are not entirely helpless victims; they may, at least at some points, maintain the ability either to act in response to such hazards or to adapt to the changed environment or conditions. In this respect, the main concerns when hazards or disasters occur are usually about who is affected and their capacity to respond, withstand, and recover from the impacts, rather than the severity of the hazards (Hewitt, 1995).

Even though the aim of both coping and adaptation strategies is to reduce vulnerability, the two terms differ to somewhat in definition. While coping measures are temporary adjustments or *short-term responses* to mitigate immediate danger, adaptation involves *long-term adjustment* to changes in the environment and/or continuous or permanent threats (Fankhauser et al. 1999). Coping refers to the manner in which individuals and/or communities pursue goals within existing resources and the range of potential in a given context to achieve various ends (Blaikie et al. 1994). Adaptation, on the other hand, is defined as adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities (Intergovermental Panel on Climate Change, 2001). Hungry season strategies used for part of most years are considered as 'normal' activities, while strategies to survive especially in bad years represent 'abnormal' activities and coping (Corbett, 1988; Davies, 1993). Coping strategies becoming a more permanent phenomenon, however, implies a change in livelihood systems. Coping strategies hence become part of a process of adaptation of the food production system.

Several uncertainties in differentiating between coping and adaptation arise when these two concepts are examined in more detail. Owing to variations between households and community groups, it is difficult to differentiate between coping mechanisms that are temporary and those that are already permanent and considered as part of an adaptation process. Not all activities and behavior taken up by households and community groups can be viewed as a coping strategy to cope with food stress. For example, most Sahelian communities habitually rely on wild foods (Davies, 1993). Likewise, Chen observes that coping strategies are in some cases "as deeply engrained in local livelihood systems as seasonal adjustment strategies" (Chen, 1991, p.222). Coping strategies do not necessarily indicate adverse conditions which require immediate adjustments to be made, as some community groups use these activities all the time. The reasons for undertaking a particular coping strategy really depend on the availability of options.

Another perspective holds that coping strategies may end up by increasing long-term vulnerability (Frankenberg and Goldstein, 1990; Adger, 1996), or the arrival of another state of vulnerability (Adger, 2000). This view refers to the undertaking of actions that merely satisfy short-term needs, but does not take into account the consequences of these actions such as asset depletion during a drought period (Corbett, 1988). Some coping strategies can also result in damage to the environment especially in the long term such as depletion of natural resources, or provoke other problems that have the potential to cause adverse impacts of hazards (Frankenberg & Goldstein, 1990), or be detrimental for development in the long-run (Davies, 1996). In addition, the social networks which are crucial for survival in times of food stress may eventually break down as conditions worsen (Frankenberg & Goldstein, 1990). Examples of such coping strategies include seasonal migration, taking credit from merchants and moneylenders, relying on food relief programmes, and household break-up (Corbett, 1988). Obviously, in circumstances where more permanent changes occur, undertaking coping strategies with short term views is not effective, and among such options mentioned, various adverse potential consequences are apparent. Consequently, Davies (1993) highlights the importance of timescale and sustainability to differentiate coping strategies from adaptation.

Adaptation and coping imply a nexus between household vulnerability and government policies because social and economic settings affect the ability of households to engage in coping mechanisms in certain circumstances. It is important to examine coping in adaptation since much adaptation is often implicit rather than planned. As pointed out by Watson et al. (1996) adaptation can be either spontaneous or planned, and is often pursued as a response to or as anticipative measures to changes in conditions. Moreover, Adger (1996) argues that in regard to social responses, adaptation can take place in two forms: spontaneous household behavior in the face of climate variability, or planned adaptation policy that happens over a longer time period and as collective action.

2.5 Theoretical Implications for Research

Several implications can be drawn from the discussion so far which are salient for assessing social vulnerability to climate variability and change in the research regions. First, both physical and social aspects of human - environment interaction are equally important, and, thus, should be incorporated in assessing vulnerability to climate variability and change. Second, the concept of vulnerability involves the recognition of exposure to an event, and the capacity to cope with and/or adapt to that event. Not only the natural event per se, but individual or household ability to secure a livelihood is also central to understanding vulnerability. Third, exposure and capacity in this study are linked through examining a particular climate variability event such as El Niño related droughts and rainfall variability. Vulnerability is operationalized at the local level in terms of the coping strategies that the affected individuals and households employ during that particular event. Fourth, coping strategies demonstrate a way of securing entitlements and vary across time and space due to certain environmental and social factors. Examining such variation between households over time is important to identify underlying causes or processes that affect a household's ability to secure a livelihood in times of environmental change or climate distress. Fifth, the sequencing of coping strategies is an important characteristic in the dynamism of coping. As Corbett (1988) argues, household/individual coping attempts to balance current consumption with future livelihoods. As adversity increases, households' coping strategies tend to compromise future livelihoods, indicating poor sustainability that implies increased vulnerability and poor adaptation.

In the following sections, the research framework and methodology for analysing social vulnerability and responses to climate variability and change are presented.

2.6 Research Framework: An Integrated Vulnerability Approach

The framework of this study draws on 'the integrated vulnerability approach' (Figure 2.4). This approach recognizes that inherent susceptibilities and resiliencies of both the biophysical and social environments are a function of the interrelated and inter-dependent human-environment system. This is in line with recent discourse in the field of climate change research that suggests vulnerability be considered as the starting point, rather than the end point as with impacts-driven assessments (Kelly & Adger, 2000; Smith & Pilifosova, 2003). Adaptive capacity is characterised by the ability of the system to respond and adapt, rather than in terms of what may or may not happen in the future.

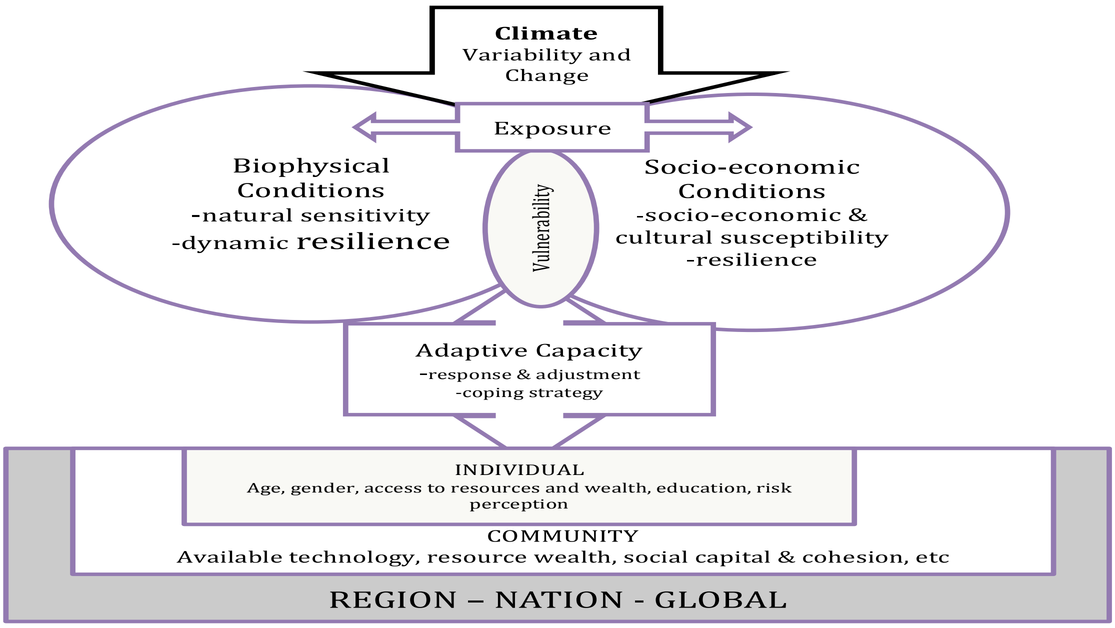


Figure 2.4 Integrated vulnerability framework

Source: Adapted from Dolan & Walker, 2004

As the impacts of climate variability and change are unevenly distributed among and within countries, regions, community groups including different ethnic groups and individuals because of different exposures and vulnerabilities, the integrated vulnerability approach highlights determinants of adaptive capacity at the local scales and situates them within larger regional and national settings. Determinants of individual adaptive capacity include age, gender, access to resources and wealth, human capital (education), while those of community level adaptive capacity include social capital, ethnic identity, clan membership, property rights, access to technology, resources, wealth and information.

This research framework provides a methodological starting point that, as a community based or 'bottom-up' approach, yields important insights into local responses to climate variability and change. Current adaptive capacities and potential for managing change are then linked to existing decision processes to provide a more locally relevant, community-based approach. This moves away from identifying and evaluating specific adaptation options towards promoting capacity building within communities to respond and adapt to climate variability and change.

2.7 The Methodology

2.7.1 Case Study Approach

This study undertakes two broad case studies in East Nusa Tenggara province, namely Kupang district and Kupang city (see Figure 2.5), two neighbouring districts affected by climatic variability and drought (see Chapter 4 and Chapter 5 for more details). A case study refers to "an empirical enquiry that investigates a contemporary phenomenon within its real-life context" (Yin, 1994, p. 13). The case study approach examines the impact of a phenomenon within a geographic and temporal situation. The significance of the case study approach rests on its ability to formulate general conditions under which different outcomes of a phenomenon occur, allowing for the development of policy-relevant theory (George, 1979). Case studies have one limitation as they deal with only one community at one particular time (Whyte, 1984). Not surprisingly, a different case at a different time may bring about completely different conclusions. Whyte confirms that different researchers coming up with contradictory conclusions is often due to the fact that they examine the same phenomenon in different communities. George (1979) deals with this disadvantage by maintaining that case studies are generalizable to theoretical propositions, but not to populations or a universe. Rather than enumerating frequencies, the objective of case studies is for theoretical generalisation and development through comparing the empirical outcome of the case study.

Place-specific case studies are important to the vulnerability approach to climate change research (Ford et al. 2007; Ford et al. 2008, Ford et al. 2010) because vulnerability varies between nations, regions, communities, and even within communities, due to differential exposure to climate change impacts and differential adaptive capacity (Turner et al. 2003, O'Brien et al. 2004; O'Brien et al. 2004). Thus, understanding the dynamic interactions between humans and the environment requires case studies situated in particular places and cultures (Ford et al., 2007). Place-based studies can illuminate how different factors – at different scales – can interact and affect the ability of different households and even different individuals within households to cope and adapt (Eriksen et al. 2005; Noor, 2008). Therefore, the case study approach (Yin, 1994; Stake, 1995) provides an appropriate means of exploring coping and vulnerability (Eriksen et al. 2005), in particular the way that local adjustments to change are shaped by interacting processes (Eriksen & Lind, 2009). Moran (1995 in Eakin et al. 2006) argued that case studies allow for the in-depth capture of ethnographic detail that is often essential for understanding why and how changes are occurring (see also Noor 2008; Baxter & Jack, 2008).

2.7.2 **Selection of the Villages in the Study Site**

Three villages in Kupang district and two villages in Kupang city were selected as suitable case study sites for the purpose of assessing local and/or individual responses to climate variability and change. The location of the sites is shown in Figure 2.5; they take into account a variety of bio-physical, socio-cultural, and economic conditions.

Figure 2.5 Map showing villages studied in both regions of Kupang City and Kupang District

Bio-physical conditions are closely related to agro-ecological conditions in the research regions; these are largely determined by altitude and rainfall that dictate erosion, temperature, and other climate risks. Socio-cultural factors refer to ethnic identity and affiliation as well as clan membership and determine community norms, social relations, and customary laws, especially as they relate to access to resources. Economic factors relate to farming and other livelihood activities that follow from the ecological and socio-cultural factors.

The method of village selection was aimed at providing good study cases that would show how different bio-physical conditions and socio-cultural backgrounds determine household capacity and responses to climate variability including access to livelihoods and resources such as land, labour and social networks. More importantly, a rich analysis of the variation in social vulnerability can be drawn based on socio-economic and biophysical indicators (see Table 2.1).

Table 2.1 Characteristic of the selected village sites

District	**Kupang District**			**Kupang City**	
Sub-district	Takari	Fatuleu Barat	Amabi Oefeto	Maulafa	Maulafa
Village	**Kauniki**	**Poto**	**Raknamo**	**Fatukoa**	**Belo**
Agro-ecological zone	Highland	Lowland	Plateau - midland	Upland	Upland
Altitude (meters above sea level)	600 - 700	50 - 100	200 - 350	175 - 275	175 - 275
Number of household	627	623	427	578	751
Average household size	4	5	4	5	5
Total population (person)	2405	2529	1169	2869	3713
Population density (person/sq. km)	14	13	30	171	645
Major ethnic group	Predominantly the Atoni	The Atoni and Rotinese	Atoni, Rotinese and East Timorese	The Atoni	The Atoni
Major land use	dryland, rain-fed rice fields, grazing	dryland, rain-fed rice fields	dryland, rain-fed rice fields	dryland, rain-fed rice fields	dryland, rain-fed rice fields
Main economic activities	dry fields farming, animal husbandry	dry fields farming, paddy cultivation, animal husbandry	dry fields farming, paddy cultivation, animal husbandry, horticulture	dry fields farming, animal husbandry	dry fields farming, animal husbandry
Accessible	low	low	high	high	high
Distance to sub-district (km)	30	0	5	9	7
Distance to district centre (km)	98	81	43	13	11
Access to market	Weekly	Weekly	Weekly	daily	daily

2.7.3 Selection of Household Sample

Before the actual data collection was conducted, a pilot survey of 25 households was carried out to review the suitability of the questionnaire. The pilot survey revealed that the main problem was the length of the questionnaire and as a result the number of question for each household was reduced. After the pilot survey, the sample fraction of households chosen for the household questionnaire was 12% in each village. A stratified random sampling technique was applied, taking account of *dusun* (village hamlet), ethnic group and primary livelihood activities. The names of all household heads, by *dusun*, of each village were provided by the secretary of the village. Approximately 12% of each *dusun* was selected with the aid of a series of random numbers. The ethnic status of each household head was identified and the samples checked for adequacy in numbers of Timorese and Rotenese (the major ethnic groups), in addition to other ethnic minorities including the newly settled East Timorese. As can be seen from Table 2.2 approximately 11% selection was achieved for all the villages, with the response rate ranging from 87 to 95%. I found that the total number of households per village enabled me to go into adequate depth of analysis to address my research objectives and also proved to be a manageable number of households to collect information considering the time constraint and the logistic aspects of my research.

Table 2.2 Numbers and percentages of households sampled for each village in the survey

District / Village	Number	Percentage of total households	Response rate (%)
Kupang district:			
Kauniki	61	9.7	87
Poto	70	11.2	93
Raknamo	50	11.7	95
Kupang city :			
Fatukoa	62	10.7	91
Belo	78	10.4	92

2.7.4 **Well-being Classification**

The stratification of the household sample according to some kind of well-being differentiation is imperative to gaining a clear view of the range of livelihood activities and strategies and the different patterns of diversification in the research areas. But what indicators can be used? What is a relative wealth differentiation measure in the local context? To address these questions, a wealth ranking exercise was conducted to provide a framework for understanding the local perceptions of differentiation and categories of wealth.

Wealth is a complex concept incorporating many different aspects of household asset holding and income earning strategies. Through the community-based participatory exercises held in both districts, an historical comparison was evident with regard to wealth interpretation. Wealth in the *past* was closely associated with the presence of livestock (cattle). Cash income was not seen as so important. However, the key indicators of wealth *today* have clearly changed to incorporate more factors than simply wealth in cattle. A combination of livestock, a large amount of agricultural land (for example, two or more hectares of paddy field), productive assets (such as rice mills, tractors, motor cycles and trucks), having access to money, having educated children (especially in tertiary education) and a modern house (with tiled floor, masonry walls, and a zinc roof) are among the key indicators of wealth today. Money is now seen as increasingly important.

Four groups emerged from the ranking exercise that incorporated occupational, resource endowment and access considerations. The *'very poor'* were identified as those with no assets, often having no land, relying on begging or farm labouring, and with poor shelter conditions. The groups changed as access to resources and services increased. The '*poor'* and '*average'* groups had more flexibility in terms of social and economic factors – these groups were in general able to afford some basic services (health and education), and had sufficient land for farming practices with a subsistence level of production and limited sales. Those who belonged to the '*average'* group were also identified as having access to sufficient financial capital, being able to afford essential non-food household needs such as clothing and, in some cases, radios and motorbikes. The last group, the *'rich'* who were identified according to their access to assets that determined their occupations, were those with more than 1.5 ha of land, possessing *several* head of cattle, and/or having *business* activities either as shopkeepers or traders.

Based on this 'wealth' group ranking, the sample households were differentiated as follows:

Table 2.3 Wealth Group Ranking in the research sites

Wealth Group	Size of Landholding	Cattle Ownership	Physical Assets
The rich	More than 1.5 ha	more than 15	Tractors, rice mills
The average	0.75 ha – 1.5 ha	7 – 15	
The poor	0.2 ha - 0.75 ha	3 – 6	Hoe
The very poor	Landless households	0 – 2	Hoe

2.7.5 **Data Collection**

In order to obtain the qualitative and quantitative data required to shed light on the impacts of climate variability in the two districts under study and to identify factors and processes determining household vulnerability and coping in the studied villages, the collection of data included secondary and primary data.

2.7.5.1 Secondary data sources

Secondary data were obtained from a comprehensive review of existing published and non-published literature relevant to the study. Materials reviewed included the following:

1. Literature on famine, vulnerability to climate change and variability, coping with various climatic conditions (for example, from various books, journals, electronic articles).
2. Published and unpublished material on Indonesia's climatic conditions and the impact climate has had on the country and the research regions (for example, books, newspapers, and journals).
3. Local statistics concerning population, infrastructure, agricultural production and other details from the Central Bureau of Statistics (BPS).
4. Climatology data (daily and monthly rainfall, temperature, evaporation) from BMKG Kupang
5. Literature on the research study areas

The use of secondary data made a significant contribution to the overall quality of the research. The data provided a variety of background information for the research that enabled the construction of an historical profile and provided the baseline context for the study. The data enabled the researcher to see how particular theoretical and methodological approaches have been applied by other social scientists, the problems they have faced and the insights their approaches have provided. Data derived from all the above sources were used to compare and complement primary data.

2.7.5.2 Primary data sources

Primary data were obtained through (1) questionnaires, (2) participatory rural appraisal / focus group discussion, (3) face-to-face interviews and (4) direct observation. Each of these techniques is explained in more detail below.

Questionnaire

A questionnaire was intended to elicit household data. A wide range of questions was formulated to meet the study's objectives including: respondent characteristics such as ethnic background and household demographics, income sources, alternative livelihood activities (livelihood diversification), details on land and type of farming, household assets, agricultural production, coping mechanisms and adaptation strategies for climate variability related hazards.

Questionnaires are widely used due to their main advantages as an inexpensive data collection method in studies that deal with a large number of respondents (Marsh, 1982; Chadwick, 1984; Joliffe, 1986; Babbie, 1992; Moser & Kalton, 1993; Jackson, 1995). However, questionnaires are time consuming in practice and respondents may be impatient to complete the survey. Fortunately, respondents for this study were very cooperative as shown by the high response rate.

The questionnaires involved both open-ended and closed questions. Open-ended questions are designed to collect in-depth information and data from respondents. There were no pre-determined sets of responses, and the respondents were free to either answer or refuse. The advantages of having open-ended questions are to solicit subjective data and to obtain further clarification on issues that were raised during the survey. This is not to say that the open-ended questions do not have disadvantages. By its nature, open-ended questions are obviously time-consuming in tabulating and/or in performing statistical analysis (Chadwick, 1984; Babbie, 1992). This problem was encountered during analysis. However, with patience and passion, answers were individually reviewed, grouped according to categories or issues, then coded for statistical analysis. The difficulty in coding open-ended questions was minor in comparison to the comprehensive information offered by open-ended questions. Moreover, the questions allowed the study to gather and explore more information that was unexpected but relevant to the study.

Closed questions, in contrast, involved the form of multiple-choice questions. For this reason they were easy to respond to and were less time-consuming. Restricting the answer set was very helpful for coding for the purpose of statistical analysis over the whole group of respondents. Open-ended and closed questions complement each other: closed questions are less time consuming compared to relying on the open-ended questions.

Household surveys were undertaken over a period of five months (August to December 2010). With the help of research assistants, households that were selected for the interviews were informed. Households that did not mind being interviewed at the time they were being informed, were interviewed immediately. Appointments were made with those households who could not be interviewed immediately. The interviews went according to schedule and the respondents were cooperative. This was time-consuming but eventually the interviews were done.

Participatory Rural Appraisal

On completion of the household surveys, focus group discussions were scheduled. The method of participatory rural appraisal was applied. Participatory rural appraisal is a qualitative research method designed to allow local involvement in data collection and analysis undertaken by outside researchers (Ison & Ampt, 1992; Checkland, 1992; Chambers, 1994). This approach enables the researcher to explore the context in which a particular problem occurs. Participatory rural appraisal emerged in the late 1970s, as agricultural developers were looking for ways to interact more effectively with local rural people (Chambers, 1992). The value of this method was soon recognized as a way to uncover the richness and value of rural knowledge and culture within which development was taking place. Using this set of methods, the researcher is able to seek out local knowledge and interact with local people. Data collected using this method allows for development plans to take into consideration the knowledge and rights of the people they claim to help.

This study adopted participatory rural appraisal in the form of focus group discussions. Semi-structured questions regarding the information to be collected were pre-determined by the researcher in advance. The questions were designed to guide the interviews which were informal and relaxed discussions.

Before undertaking the interviews, the communities were informed through community leaders. The motives and intentions of the study and the researcher were made clear to mitigate mistrust and suspicion. As a result, attendance and cooperation were very good and the communities showed great interest in the study. Through focus group discussions, concerned individuals and communities were able to speak for themselves, as result providing knowledge that enhanced the researcher's capacity to understand the viewpoints of local people.

Focus group discussions were undertaken to gather information concerning climate hazards (droughts, El Niño) and their related risks, impacts, coping mechanisms and adaptation practices, local soil knowledge and conservation. The focus groups comprised participants from various age groups including elderly members of the community, and the most vulnerable groups in the communities. The focus groups included poor people, women, the elderly, the landless, and ethnic minorities; their inclusion allowed them to identify their particular challenges related to climate risks and coping strategies. Focus group discussions were carried out over a period of two months (February to March 2011).

Face-to-face interviews

Face-to-face interviews were the most important method for primary data collection for this study; they helped me to understand the ways households make decisions and assign meaning or value to different options, and to understand the lived experience of events or characteristic. In-depth semi-structured interviews with community members, farmers, village leaders, government officials and the local elite of the two selected districts were conducted to identify climate-related risks that local people and community groups have dealt with (past and current exposure); to provide insights into how these risks were experienced and managed (current coping strategies and adaptive capacity); to identify the processes and conditions which have determined the efficacy, availability, and success of past and present adaptations; and to characterise community adaptability to cope and adapt to climate related risks and environmental changes. Information obtained from the interviews was used to complement data collected from focus groups, households and secondary sources.

Direct Observation

Observation is often a primary source of data collection in qualitative research. Data collection using this method represents firsthand encounters with the phenomenon of interest. Data of naturally occurring behaviour seen or heard by the observer is recorded (Bogden and Biklen, 1982). Observation was employed to collect data about the state of the social and ecological environments and the behaviour of the people in them. In the five villages of the research areas, I participated in household and farm work including rice harvesting, fence erecting, collecting manganese ore and other activities. However, I remained a participating observer, as an 'outside' researcher who observed the situations of people's daily life from an outsider's perspective.

Upon the completion of data collection, the process of data analysis commenced. The process of data analysis is described in the next section.

2.7.6 **Data Interpretation and Analysis**

Interpretation and analysis of data were undertaken after I returned from the fieldwork. Information obtained from direct observation, face-to-face interviews, documents (newspapers, publications, climatology records) provided sufficient information for a comprehensive data interpretation and analysis.

Recorded interviews and notes from unrecorded and recorded interviews, from focus group discussions and meetings were translated to English and transcribed electronically. Field notes and relevant documents were recorded in electronic form.

Data collected through the questionnaires were compiled and coded. A codebook was developed as an outline to explain what each research question was, the labels associated with each question, and the numerical values assigned to them. Data management and statistical packages including Excel were used to process primary quantitative data collected from household surveys. Counts, percentages, means and charts were used for presenting summary research results.

2.8 **Ethical Considerations**

A wide range of ethical issues needs to be taken into consideration when conducting research that involves human subjects at any stages of the research process (Gray, 2004) including confidentiality, questions of privacy, anonymity and data ownership (Fowler, 2002). This research complies with ethical obligations as set out in the National Statement on Ethical Conduct in Research Involving Humans (NHMRC, 1999). My ethics application in conducting this research was approved by the Australian National University Human Ethics Committee (ANU HREC) on 13 May 2010 with the protocol number 2010/199.

The ethical issues and considerations were always explained to the participants before holding each interview including the main objectives of the research and how the information would be used. A formal endorsement letter from the Provincial Government of East Nusa Tenggara was provided to the relevant Local Government Units at the district and sub-district levels, including the heads of villages, farmers' groups and key informants at the village level, to explain the purpose of the research and ask for their permission and support to conduct field research and interviews with them and other respondents within their administrative areas. Participants were assured of confidentiality and privacy. It was made clear that participation in the research was entirely voluntary and they had the right to withdraw from the interview at any stage.

In the next chapters, results obtained using the theoretical and research framework described in this chapter are presented and discussed. Chapter 3 concerns the environmental settings that predetermine the vulnerability in the research regions, while Chapter 4 assesses the impacts of climate variability in the two districts of Kupang. Information gathered from studying local responses to climate variability is presented in Chapter 5 and Chapter 6, followed by a discussion of underlying causes of social vulnerability in Chapter 7.

Chapter 3 The Environment: The Space Of Vulnerability

3.1 Introduction

The conceptual framework of this thesis is based on an integrative approach that considers social vulnerability to be the result of a wide range of factors including both bio-physical and socio-political factors. This framework also considers that social vulnerability to climatic events such as droughts and floods as well as non-climatic events is determined by both individual factors and collective factors. Individual factors are mainly associated with the characteristics of a household which generate the differences in vulnerability between households, while collective factors are concerned with characteristics of the environment, which can be labelled 'the space of vulnerability' (derived from Watts & Bohle, 1993). According to this view, people's livelihood strategies and social adaptability are very much driven by changes in their environment. The changes can be gradual and long-term or sudden and short-term. The space of vulnerability, which consists of both the bio-physical environment and the economic and socio-cultural environment, can potentially affect people's behaviour and trigger change. Therefore, in order to clearly understand people's vulnerability and adaptability, one has to study their living space, their environment.

This chapter presents the main characteristics of the environment within which the people of West Timor have to derive their livelihoods. This chapter has two main objectives: it is intended to serve as an introduction to the research area and is also an attempt to fill in a part of the conceptual framework to explain how this living space may affect people's vulnerability and adaptability.

3.2 The Bio-physical Environment: Kabupaten Kupang and Kota Kupang

3.2.1 Geography

My study was conducted in two administrative regions of East Nusa Tenggara Province, Kupang district (*Kabupaten* Kupang) and Kupang city (*Kota* Kupang), both of which are situated on the western tip of the Island of Timor. Geographically (Figure 3.1), these two regions are adjacent to each other. While Kupang city is an urban area, Kupang district is a remote and relatively rural region. Kupang city occupies 160.34 sq km of land. It is bordered by Kupang district to the south, west and east, and by

Kupang Bay on the north. As the provincial capital of East Nusa Tenggara, Kupang city is the seat of government and the location of offices of international aid agencies as well as the hub of trade and financial services in the region. Administratively, it has four sub-districts (*kecamatan*) and 49 villages (*kelurahan).* Most of these sub-districts and *kelurahan* are located along Kupang Bay. Kupang city has occupied a strategic location along the main transport routes since the pre-colonial era and includes the region's major seaport and, more recently, the region's main airport. Besides various traditional seaports where sea transport vessels dock regularly, Kota Kupang also has a port, Tenau, which is the province's largest seaport and is up to export standard. El Tari Kupang Airport is often used for international flights especially to Dili, East Timor and Darwin, Australia. Given this level of social and economic infrastructure, Kupang city is the fastest growing city in Nusa Tenggara Timor and so has the highest population density in the region.

Figure 3.1 Geographical location of Kota Kupang and Kabupaten Kupang within West Timor

In contrast to the geographical setting of Kupang city, Kupang district occupies a large area, covering 5,898.3 km2 with relatively poorer infrastructure conditions in comparison to Kupang city. It shares administrative boundaries with Timor Tengah Selatan district (South Central Timor) and East Timor (Ambeno Enclave) to the east, while the north, south and west of Kupang district is bounded by the Savu Sea. Kupang district includes 25 islands, of which only two are populated: Timor and Semau. Administratively, it has 24 sub-districts (*kecamatan*) and 240 villages (*desa / kelurahan*).

3.2.2 **The Climate**

Kupang district and Kupang city are subject to the typical West Timor climate, being located in one of the driest provinces in Indonesia. Its climate is characterised by low rainfall (less than 1000 mm per annum), high winds and intense solar radiation (Monk, Fretes, & Reksodiharjo-Lilley, 1997). Due to its position which is relatively close to the Australian mainland, the climate of West Timor is in many respects strongly influenced by the climatic conditions of Australia which make its climate quite distinct from other regions in Indonesia.

Unlike other regions which have a 6 – 7 month rainy season, West Timor experiences a short rainy season and a long hot, dry season. The short rainy season of 3 – 4 months begins with the arrival of the west monsoon between early November and late December. The rainfall during the rainy season is sporadic and is often very heavy and intense, resulting in serious soil erosion especially on unprotected soils. Interruptions can occur between individual rainfall events during the rainy season, which seriously hinder crop growth. By early April, the winds begin to shift. The arrival of the east monsoon, the south-easterly winds that blow from the Australian desert, marks the beginning of the long dry season. Between April and May and October and November, both regions receive relatively little rainfall.

Kupang district and Kupang city have a low and erratic rainfall. For the years between 2005 and 2008, for example, annual rainfall in the two regions ranged from 94 to 424 mm with total rainy days of between 89 and 101 per year (BMK Kupang, 2009). The effects of this erratic and unreliable rainfall are exacerbated by great annual rainfall variability in Kupang district and Kupang city where the annual rainfall levels fluctuate tremendously from one year to the next, and therefore are extremely unpredictable. For example, the highest rainfall level in 2005 occurred in the month of December, reaching 403 mm. For the next two years (2006 and 2007), however, the highest rainfall shifted to January (497 mm) and March (424 mm) respectively (BMK Kupang, 2009).

Another significant aspect of climate variability in these two regions of West Timor is the microclimatic diversity within particular areas. This diversity may be ascribed to what Ormeling (1956, p. 235) has termed the region's "capricious relief" which causes weather conditions to impact differently on closely adjacent sites. Usually coastal areas receive low rainfall, while mountain slopes have high rainfall (Fox, 2000).

Climate variation in the regions is also significantly influenced by the El Niño/La Niña- Southern Oscillation, which in El Niño years changes the timing and volume of rainfall. On average, El Niño periods occur every 3 to 4 years (Fox, 2006). During the El Niño events, the rainy season is often delayed by 2 to 3 months, significantly impacting the agriculture sector which provides the main livelihood support in the West Timor region. A prolonged dry season will generally delay crop planting. In addition to insufficient rainfall, planting delays and the loss of seed due to unsuccessful early planting can lead to a diminished planting area or even harvest failure. Excess rainfall during a La Niña cycle can also damage crops.

3.2.3 Soil and Soil Fertility

The literature suggests that among other factors, the low soil fertility may be partially due to inherent soil infertility but may also be a result of land degradation in which a decline of soil fertility, caused by intensive land use in conjunction with poor soil conservation measures, is a major factor. In this section, I will elaborate more on the low soil fertility and leave the issue of land degradation to be discussed in the following section.

"Soils are the joint product of rocks, climate and vegetation" (Boateng, 1966, p. 54). The parent material of soil is derived from rocks, whereas all important organic substances of the soil are provided from the vegetation, which causes the soil to have characteristics different from sand or rock waste. The climate itself is responsible for the processes to which the soil is exposed and the factors that generate the breaking up of the rock into small enough particles for soil formation (Boateng, 1966, p. 54).

Topography plays another crucial role in the formation and distribution of soils and also affects soil fertility. Despite similar geological and climatic conditions, soil characteristics of a given area show regular patterns of change, from the hill-tops through the valley sides to the valley themselves (Boateng, 1966, p. 54).

The soils in the research area are inherently fragile and poor with regard to material background, climatic conditions, vegetation and topography (Ormeling, 19560. The two regions belong to Timor Island which lacks the young volcanic ash deposits of the islands in Indonesia's Inner Arc (Ormeling, 1956, p. 48). Moreover, the climatic conditions of Timor produce a sharp variation between the long dry season and short rainy season and this results in the soils on Timor accumulating a considerable amount of soluble salts (Ormeling, 1956, p. 48). The accumulated salts in the topsoil move down in the wet season, and then during the dry season, salinization of the soil profile takes place driven by high evaporation associated with capillary uplift of the ground water. Poor soil fertility is also worsened by erosion, partially caused by the steep hilly topography (Ormeling, 1956, p. 48). Sudden rainfall following a long dry period can also decrease soil fertility by washing out humus and top soil.

Other studies also confirm the low inherent soil fertility. According to Fox (1988, p. 261) much of the material background of Timor's soil is made up of a soft, scaly clay, called 'Bobonaro'. This soil is grey or brown throughout the profile, highly calcareous and can strongly swell and shrink depending on the season. In the dry season, this clay is extremely hard, but becomes very sticky during the rainy season. Characteristics such as these of the soil on Timor, as argued by Fox (1998, p.261), are unfavourable for agriculture because they soak up rain and swell in the wet season while they dry, crack and develop fissures in the dry season.

In Kupang district, Bobonaro soil is mainly found in Naibonat and Camplong. In other parts of Kupang such as the plateau between Camplong and Takari, the Bobonaro soil is mixed with reef limestone and shallow soils which are mostly reddish with low swelling and shrinking capacity, but are slightly acid, causing rapid infiltration (Alderick & Anda, 1987) Around Kupang Bay and Oesau-Pariti plain are found heavy clay and limey loam soils (Ormeling, 1956, p. 51)

3.2.4 **Natural Vegetation**

In general, the local vegetation throughout Kupang consists of sparse monsoon forests and extensive savannas. The origin of the natural vegetation is the monsoon forest, which is quite different from the tropical rain forest in several respects. The monsoon forest is lower and less dense, while the trunks are mostly more curved, thicker and lower-branched (Ormeling, 1956, p. 56). Its composition also differs from that of the rain forest; its typical elements include *Acacia leucophloea (Roxb.)Willd, Eucalyptus* spp*., Cassia fistula L.,* and *Ziziphus mauritiana Lam.* (Ormeling, 1956, p. 56). This typical mixed monsoon forest has now been extensively replaced by savanna and grassland in the regions. Apart from long droughts hampering the growth of trees, the people and their activities of cultural burning and swidden cultivation have been linked to a major transformation of the anthropogenic vegetation in Kupang (Ormeling, 1956, pp. 56-61).

Remaining types of monsoon forest still found in the area now include the *kaju merah* (*Pterocarpus indicus Willd*). This non-fire resistant species, categorised as typical of primary monsoon forest, yields fine quality timber for cabinet-making, construction and bridge building. The original vegetation of Timor includes the valuable sandalwood (*Santalum album L.*), called *hau meni* in Uab Meto*,* which was the main commodity for trading centuries ago, since before the colonial period. Sandalwood is now depleted due to over-exploitation. A type of secondary forest that has grown to replace the monsoon forest due to fire and long drought is the *ampupu* (*Eucalyptus platyphylla Auct*) together with the mountain *tjemara* (*Casuarina Junghuhniana Miq.*), mostly found in areas such as Fatu Timau in Amfoang of Kupang district and its surroundings. What helps these two species survive in the harsh environment is their fire resistant quality, helping them to recover more quickly than other trees after fire. In addition, the mountain *tjemara* can grow on extremely poor and bare soil. From an economic point of view, the timber of *ampupu* is good for roofing of heavy constructions, whereas the mountain *tjemara* is mainly suitable for firewood and its wood ash is a valuable fertilizer.

In areas of savanna in the two regions, the dominant species differentiate them into several groups, namely palm savannas, eucalyptus savannas, acacia savannas and *tjemara* savannas. Kupang's palm savannas are dominated by the *gebang* palm (*Corypha utan* Lamk) and *lontar* palm (*Borassus flabellifer* L.) (See Figure 3.2.).

Many lowland and coastal areas in the regions have extensive stands of these species. Both these palms are able to cope not only with long, dry periods but they can also survive on regularly-burned land due to their fire-resistance. More importantly, they are valuable to the local economy in terms of the tapped palm juice and other products, including palm leaves and fronds which are used for containers, house building materials, clothing and household articles. Rotenese and Savunese rely on palm juice and palm syrup from tapping *lontar* palm especially in the period of 'ordinary hunger' (Ormeling, 1956; Fox, 2000;). Likewise, the mature *gebang* also offers sago gruel, locally known as *putak*, to feed livestock in the dry season and is often consumed by local communities during 'the extraordinary hunger' (Ormeling, 1956; Fox, 2000;). During normal times, this *putak* is frequently used as pig food. Besides food, the *lontar* and *gebang* palm offer raw materials for construction and for manufacturing common numerous articles for daily use.

Hue (*Eucalyptus alba* Reinw.) predominates in the Eucalyptus savannas, while the *kabesak* (*Acacia leucophloe* Willd.) is commonly found in the acacia savannas. Both tree species provide wood for fuel and construction of fences. However, comparing the two, the *kabesak* offers more comparative advantages than the *hue*. The former provides a source of feed for cattle especially in the dry season, while the latter is completely avoided by livestock due to its faintly aromatic leaves. Moreover, if the *hue* savannah consists mainly of Eucalyptus, the *kabesak* savanna is fairly well mixed with other trees and its contribution to the local economy is highly appreciated. Among others, the *kesambi* (*Schleichera oleosa Merr*.) is worthy of mention. In addition to the good quality of its wood, it is still an abundant source of fire wood and charcoal.

Figure 3.2 Extensive Stands of *Lontar* Palm (Top) and *Gebang* Palm (Bottom)

Source: Author's field survey (2011)

3.2.5 **Bio-physical hazards (tropical cyclones, flood, landslides)**

The two regions of Kupang are prone to various bio-physical hazards such as tropical cyclones, floods and landslides. Tropical cyclones occur mainly due to Timor's geographical location in a zone of cyclone activity, while the climatic and topographical conditions cause the region to experience frequent floods and landslides almost every year.

Due to its location between two main continents, Timor (both Kupang district and city) is greatly affected by changes and variation in temperature, atmospheric pressure and trade-winds between the two large land masses. Adjacent to the northern part of the Australian continent, and separated by the approximately 500 km wide Timor Sea, the region is susceptible to changes in climate conditions in Australia. Tropical cyclones, which are often accompanied by torrential rain and extreme winds, occur regularly in this region between November and April (Nicholls, 1985) as a result of disturbance in wind and pressure in the Australia continent (Fandry & Steedman, 1989; Gray, 1998). Timor is virtually the only part of Indonesia subjected to tropical cyclones (Ormeling, 1956).

Flooding and landslides often hit particular sub-districts such as Takari, Amarasi and Amfoang which receive more rainfall than other sub-districts in the Kupang district. During La Niña years or in those years with short but very intense rainfall events, flooding and landslides also hit other sub-districts. For example, intense rains in early 2011 resulted in heavy flooding and associated landslides in Takari and Amfoang, which affected 235 families and caused damage to 53 houses and 310 ha of rice paddy.

3.3 **Economic Environment**

3.3.1 **Primary Sector: the Main Source of Livelihood in West Timor**

Despite the unfavourable climate conditions, poor soils, steep slopes and low and erratic rainfall, the primary sector (agriculture, livestock and fishing) remains the main source of livelihood in the region and this has been the case for decades. Every year, this sector absorbs at least 75 per cent of total employment and contributes at least 40 per cent to the GRDP. In 2008, the primary sector accounted for 40.39% of the NTT's GRDP and about 80% of the working population was employed by the sector (BPS NTT, 2009). Likewise, 41.37% of Kupang district's GRDP came from the primary sector, absorbing 82% of total employment in 2008 (BPS Kabupaten Kupang, 2008). As the hub of trade and services in the province, Kupang city is the exception. A large proportion of its GRDP is generated by the other service sectors (especially government services), trade, hotels and restaurants, transport and communications.

The share of the primary sector of the GRDP is made up of three main sub-sectors: agriculture (food crops), livestock, and fisheries. The prominence of particular kinds of primary activities, however, differs between NTT and Kupang district. While the annual contribution of food crops – approximately 20% – is far greater than livestock (10%) and fisheries (4%) to the NTT's GRDP, the share of livestock is almost the same proportion as food crops, contributing about 17% each to the annual total of GRDP in Kupang district.

3.3.1.1 Agriculture Sub-Sector: Food Crops

The majority of the population in the West Timor region comprises subsistence farmers who rely mainly on dry land agriculture. The main food crops in the region are maize, paddy, cassava, pumpkin, sweet potato, soybean and groundnuts or peanuts**.** Among these staples, only pumpkin is not officially recorded, which causes some difficulty in figuring out its contribution to the local economy. Maize is the most abundant and accessible crop, making it the most important source of food supply in the West Timor region. Rice is the second most important food crop in the region as shown by total area of cultivation and total production. In 2008, 270,717 ha of land in NTT were cultivated with maize compared to only 187,907 ha for paddy cultivation, producing 673,003 tons of maize, and 332,714 tons of rice for the whole region (BPS NTT, 2009). The total area growing maize in Kupang district was also quite high (26,138 ha) in 2008 or almost double the total area devoted to paddy cultivation (13,775 ha), producing 64,979 tons of maize in comparison to 24,391 tonnes of rice (BPS Kabupaten Kupang, 2008).

The greater proportion of land devoted to grow maize relative to paddy reflects the topography of the region. In other words, the availability of land to cultivate maize is due to the mountainous and rugged hilly terrain in West Timor, suitable for growing maize instead of paddy which requires a relatively flat area to grow. The preference for growing maize on this land is not without problems. Given the topography of the cultivation area, maize is subjected to higher risks of flooding and soil erosion.

Apart from the availability of land and its rugged topography, climate variability, land degradation and the limited quality of the inputs also significantly affect the production of maize and rice in the region. Maize is vulnerable to drought and irregular rainfall because it is not irrigated and only relies on rainfall in the rainy season. The unpredictability of rainfall affects the timing of planting. Planting at the wrong time, either too early or too late, results in a number of consequences, such as wasted seeds, depletion of scarce seed stocks and harvest failure. Not surprisingly, considerable variation in crop production is often experienced by neighbouring farmers since determining the right time to plant is quite difficult.

Climate variation also affects the production of rice. Most sub-districts in Kupang district only produce one single crop every year, because they are subject to such low rainfall. During a drought year or a period of limited rainfall, poor water storage and damaged irrigation infrastructure can result in insufficient water being available to irrigate crops. Excess rainfall, on the other hand, also reduces crop yields due to heavy flooding. Increased temperatures may result in increased evaporation of water from paddy fields, which also leads to low crop production.

The most profound effect of climate variability on crop production is related to the recurrent droughts and El Niño events which, according to Fox (2000), have occurred one year in every three or four years, on average, over the past century. Recurrent droughts result in significant loss of crop production, causing the West Timor region to suffer from annual food shortages. The crop yield of many farmers' fails to meet the consumption needs for the whole year. As a result, one or two months before the corn harvest, farmers suffer from ordinary hunger (*lapar biasa*) (Fox 2000). In the El Niño years, when prolonged drought occurs and there is a significantly reduced crop harvest, the period of ordinary hunger extends to a period of extraordinary hunger (*lapar luar biasa*) (Fox 2000). The most severe El Niño event in West Timor in recent years occurred in 1997-1998 with an estimated loss of 7 % of the rice crop and of more than 50% of the corn crop (Fox 2000).

3.3.1.2 Livestock Sub-Sector

The livestock sub-sector is a major source of income but is secondary to the food crops sub-sector in NTT and in Kupang district. It contributes almost 10 per cent of NTT's income and about 20 per cent of Kupang district's income annually. Apart from economic reasons (cash income), livestock are also critical for social and traditional reasons. A study of cattle production in three sub-districts of Kupang district confirms that in addition to providing cash income from sales, cattle are also a form of wealth, often used on traditional and cultural occasions (Ataupah, 1983). The cash income is used by farmers to fulfil their daily consumption needs, build a brick house and send their children to school. Some farmers also make use of this income to accumulate assets such as buying new farm land and conducting other small business activities. For traditional purposes, cattle are predominantly used as bridewealth (*belis*) in marriages and often consumed on special festive occasions (particularly at weddings and funerals). They serve as a sign of wealth and status.

Large Animals: Cattle

Bali cattle are considered to be the most popular animal in NTT as reflected in the high numbers of cattle relative to other large animals in the region. Kupang district is the main producer of cattle in West Timor, and accounts for almost 25% of the cattle production in the region since 2002 – 2007, the number of cattle has continued to increase, from almost 131,000 to 145,000.

Table 3.1 Population of large animals in West Timor districts of NTT, 2008

Districts/City	Cattle	Buffalo	Horse
Kupang district	144,674	7,519	12,922
TTS	126,158	540	5,091
TTU	61,839	768	2,445
Belu	100,374	2,689	4,031
Kupang city	3,581	34	55
NTT	566,464	147,754	103,601

Source: BPS NTT, 2009

The growth of cattle numbers in West Timor was triggered by the introduction of Bali cattle (*Bos sondaicus*) under the Dutch administration in 1912. The breed can survive the harsh environmental conditions found in West Timor. Compared to other breeds, Bali cattle are also superior in fertility and conception rate (Oka & Darmadja, 1996) and in their adaptation to harsh environments; they are highly efficient in utilising low quality feed (Darmadja, 1980; Darmadja & Oka, 1980; Martojo, 1995). Within West Timor, Bali cattle thrive better than the Sumba Ongole breed of cattle in terms of the sustainability of annual production under poor environmental conditions and the recovery of body weight after exposure to poor nutritional conditions (Toelihere, Jelantik, Kune, & Yusuf, 1990). Such advantageous characteristics of the breed have made it the preferred beef cattle in West Timor. To date, the cattle population in West Timor is predominantly Bali cattle.

Bali cattle are reared under a wide range of different environmental and management conditions, ranging from grazing on open land to intensive cut-and-carry management with animals kept in separated individual pens or in communal corrals. The majority of farmers in the sub-districts of Amarasi and Kupang Tengah manage their cattle in two ways: animals are kept in pens or tied to a tree not far away from their house, while most farmers in Kupang Barat leave their cattle to graze freely in open grassland with little attention (Ataupah, 1983). Whether free-grazing or hand-fed, cattle production in Kupang district relies mainly on native grasslands and natural vegetation. Farmers collect grazing forage from grasslands and estate cropping, and also gather cut-and-carry forage from on and off the farm, including crop residues such as rice straw, peanut and maize stalks.

Hand-feeding is the most common method of feeding, but this is not the only method for fattening. In other cases, farmers prefer hand-feeding during the dry season to meet the cattle's needs for water and forage. In the rainy season, hand-feeding is also preferred to prevent animals from entering crop fields (*ladangs)*.

The production of cattle is greatly hampered by shortages of feed, both quantitative and qualitative, especially in the dry season. One study in West Timor confirms that native grass production was reduced from 2 t DM/ha in the wet season to less than 500 kg DM/ha in the dry season (Bamualim, Saleh, Fernandez, & Liem, 1994). As a result, the carrying capacity was reduced significantly: from around three head/ha during the wet season to just 0.3 head/ha in the dry season. Lack of water during the dry season also exacerbates the problems of cattle production. It is reported that cattle suffer from the poor nutritional value of the forage, causing a great loss (20%) of live-weight (Bamualim, 1991).

Lack of knowledge about livestock and grazing management systems, or watering systems and improved pastures are all factors that are likely to have a profound effect on the performance of cattle in Kupang district. In addition, physical infrastructure and external factors — such as markets and marketing facilities, ports and harbours, transport and other communication infrastructures — all have a significant impact on livestock production and development (Ormeling, 1956).

Farmers in some regions such as Amarasi adopt a semi-intensive livestock production system which is known as *paron* or cattle fattening. Under this system, cattle do not roam freely and are kept in a pen. Young male cattle are frequently selected from the grazing herds. They are aged 1.0 to 1.5 years with a weight of approximately 100 kg. They are then fattened on a labour-intensive cut-and-carry system, which mostly uses *lamtoro* (*Leuceana leucocephala*). The system was originally introduced in Amarasi in the 1930s to reduce land degradation. Nowadays, the *paronisasi* has also been adopted in other sub-districts such as Amfoang and Kupang Tengah. The growth rate of cattle under this system is faster than with the traditional one.

Small Animals: Pigs, Goats, Sheep and Local Chicken

In addition to the raising of large animals, Kupang district has the potential for the rearing of small animals such as pigs, goats, sheep, local chicken and ducks. In fact, Kupang district is one of the main producers of small animals in the region (see Table 3.2). Kupang city, in contrast, contributes little to the total population of small animals in the region. Among all these animals, sheep are predominantly found in Rote Ndao district. There is a strong association between sheep herding and the Rotenese populations in these districts. However, sheep are symptomless carriers of a virus that can be fatal to Bali cattle. Hence the government has had to segregate cattle from sheep.

Table 3.2 Population of small animals in West Timor districts of NTT, 2008

Districts/City	Pig	Goat	Sheep	Local Chickens	Duck
Kab Kupang	108,797	85,813	41	1,988,171	18,963
TTS	286,957	37,682	-	808,225	10,219
TTU	68,944	18,143	36	144,353	9,553
Belu	111,977	14,124	23	788,693	21,346
Kota Kupang	22,648	4,645	41	25,350	2,689
Rote Ndao	67,746	33,550	20,286	114,366	292
NTT	1,533,072	527,103	20,427	9,944,822	256,987

Source: BPS NTT, 2009

The striking differences in small animal production between Kupang district and Kupang city can be partly explained by the availability of land of appropriate size and the strategic location of Kupang district. Rapid population growth in Kupang city puts pressure on the use of local resources including land. As more land has been converted to build houses, infrastructure and trade sector development, the land available for small animal rearing is diminishing in Kupang city. On the other hand, Kupang district still has sufficient resources for small animal production. Take the example of pig production. There are many sources of forage that can be found in Kupang district to support pig fattening such as maize, banana stems, *corypha* palm sago, vegetable leaves, left-over food and the by-products of milling.

Small animal production in Kupang district offers high economic return for the farmers. The small animal production in the region is expected to continue to respond to the high demand for small animals in Kota Kupang because of population growth and the increased awareness of nutrition needs by educated city dwellers. Due to its strategic location surrounding the densely populated city of Kupang, Kupang district has the potential to become the major supplier to Kupang city market with regard to the production of small animal meat.

Small animal rearing is not just regarded as an income generating activity but also fulfils household demands for meat and traditional ceremonies. Small animals are a significant source of meat at times of harvest failure or food shortage. Traditional ceremonies such as marriages and funerals also require small animals either as bridewealth *(belis)* payments or to feed those who attend a ceremony. For this reason, almost every household in Kupang district keeps small animals such as goats, pigs and local chickens.

Several factors constrain the growth of small animal production: unfavourable climate conditions, lack of knowledge and skills, lack of marketing knowledge and poor government services. Some animals have low resistance to the local climate. For example, every year, many chickens die from epizootic diseases, and farmers often rely on traditional remedies to treat such diseases. Most farmers are poorly educated, which limits their capability to adopt innovations. Small animal rearing is based on traditional methods, some of which inhibit the quantity and quality of production.

Continuation of guidance, advice and mentoring by PPL (field officers of the local government) is necessary to provide assistance for poor farmers.

3.3.1.3 Marine Sub-sector

The marine sub-sector is another important source of livelihood in the West Timor region. With its estimated coastline of 492 km2 and total sea area of 4,063 km2, coastal communities in Kupang district have open access to coastal and sea resources. Fishery comes third to food crops and livestock within the agricultural sector. Compared to other sub-sectors (food crops and livestock), the performance of the fishery sub-sector has remained relatively unchanged over the period 2002 to 2007, contributing approximately 8% to the agriculture sector.

Fishing serves as a subsidiary occupation, as reflected in the high number of people engaged in fishing activities as a secondary occupation. In 2007, more than 4,000 people were reported to have taken up fishing as a secondary occupation (BPS Kabupaten Kupang, 2008). Since 2002, the number of those involved in fishing as secondary occupation has almost doubled, showing that fishing as a non-farm agricultural livelihood activity has become more popular. Within Kupang city, fishing activities are mainly found in two sub-districts (Alak and Kelapa Lima). Local figures indicate about 3,000 people are classified as full-time fishers, while about one thousand people undertake fishing as a secondary occupation and fewer than 500 are reported to be involved in fishing as a casual occupation (BPS Kota Kupang, 2011). Much of this fishing activity is still carried out on a small scale with reliance on traditional artisanal fishing boats without engines. These activities require relatively small capital investment and rely on labour-intensive harvesting. Fishing is close to shore and caters to local consumption. Gill net and non-motorised canoes / boats are the most popular fishing equipment in Kupang district. Only a limited number of fishermen use modern techniques, which involve the use of outboard engines, improved fishing equipment and boats of fibreglass construction. Large vessels of 1-30 tonnes, which have considerable storage capacity, are only owned by people who have access to financial assistance either from banks or local government agencies; many of these are migrants from Sulawesi.

Table 3.3 Number of marine fishing boats by region and type, 2011

Region	Non-powered boat		Outboard motor (*Perahu Motor Tempel*)	Inboard motor (*Kapal Motor)*	
	Dugout boat (*Jukung*)	Plank built boat (*Perahu Papan*)		< 5 GT	> 5 GT
Kupang District	260	252	20	97	53
Kupang City	44	31	96	242	336

Source: BPS NTT, 2011

Table 3.4 Number of households with and without fishing boats by region and type, 2011

Region	Without Boat	Non-powered boat		Outboard motor (*Perahu Motor Tempel*)	Inboard motor (*Kapal Motor)*	
		Dugout boat *(Jukung*)	Plank built boat (*Perahu Papan*)		< 5 GT	> 5 GT
Kupang District	742	258	240	19	92	2
Kupang City	0	44	29	94	81	121

Source: BPS NTT, 2011

In addition to fishing activities, nowadays seaweed cultivation is becoming one of the most popular livelihood activities for coastal communities in Kupang district. Over the past decade, local communities have found that seaweed cultivation provides high returns, compared to farming activities. With a short period of cultivation, farmers enjoy large cash incomes. Seaweed is simple to cultivate, requires low initial capital investment and provides a rapid and high return on investment. Thus seaweed farming appears to be an attractive economic alternative to growing food crops and fishing. Despite its high return, seaweed is mainly grown in sub-districts of Kupang Barat, Semau and Semau Selatan (Table 3.5).

Table 3.5 Seaweed cultivation in Kupang district

Sub-district	No. of HH				Production (Tonne)			
	2002	2005	2008	2010	2002	2005	2008	2010
Semau	560	511	325	346	12	364	400	625
Semau Selatan	-	-	206	423	-	-	200	245
Kupang Barat	472	497	530	530	400	353	575	1,200
Nekamese	-	8	12	-	-	5	6	10
Amarasi Selatan	72	3	4	-	-	2	2	-
Sulamu	505	-	-	123	20	-	-	-
Total	1,609	1,019	1,077	1,422	432	724	1,183	2,080

Source: BPS Kupang (2003 - 2011)

In these sub-districts, seaweed cultivation has gender and age distribution implications among the labour force, absorbing not only adult males but also women as well as children. Moreover, women and children are involved in the drying of seaweed, and in the preparation of new lines and seaweed-propagules for the next crop. Wives work alongside husbands tending lines and harvesting seaweed, a task that some do from non-motorized boats.

3.3.2 **Local Market System**

There are two types of market in the region: one is a market which operates on a daily basis and the other is a market held once a week. There are four daily markets including one fish market in Kupang city, while Kupang district has one daily market in addition to 10 weekly markets. Weekly markets are mostly located in sub-district capitals and can be accessed by communities from several villages/*kelurahan*, both within and outside the respective sub-district. As the weekly markets operate on different days, traders from the city move from market to market, following the market schedules.

Weekly markets play only a limited role in the support and marketing of locally produced agricultural products, however. This is due to the fact that the types of goods sold in the weekly market are mainly clothes, foodstuff, kitchen utensils and electronic goods for local consumption. In general, such goods are sold by outsiders or traders from the city (Kota Kupang) who supply about 80% of the goods sold in the weekly market. Local people from the respective sub-district and neighbouring subdistricts supply the rest of the goods. Local products are generally sold for local consumption such as vegetables, fruits, sweet potato, cassava, corn, rice, peanuts, coconut oil, small livestock (pigs, goats and chickens) and various cooked foods. Only limited quantities of local produce are bought by traders; these are mainly bananas, vegetables, tubers, chicken and pigs, for sale in other (usually larger) markets or in small kiosks lining the main road.

The marketing of local produce in the region is characterised by the presence of many small producers with limited marketing power and a small number of intermediate traders at village, subdistrict and district levels. Even though local producers are free to choose buyers and sometimes compare the prices offered by more than one buyer, in many cases the farmers are ‘price takers’, rather than ‘price makers’. Various issues cause the farmers to be price takers. Lack of market information is one of the main problems. Usually farmers receive information on the price of their product at the point of sale, while intermediate traders always obtain their information beforehand and on a broader scale than the farmers. This condition allows the traders to take control of the product price determination. Some other issues involved in price determination by traders are the long distances to markets, poor road infrastructure, and the relatively limited amount of produce. Moreover, the need for quick cash to meet daily household needs weakens farmers' bargaining power.

Other transaction practices that create huge losses to farmers as local producers include *Ijon*, a system of selling produce before the harvest period. This system allows farmers to receive a down payment for their products before they are harvested. The price in such transactions is determined by both buyers and sellers, but usually the price is low and generally below the market price. Traders may offer a relatively high price but manipulate the weight by reducing the scale weight of the produce so that the traders do not incur a loss for the purchased products.

3.3.3 **Seasonality of Food Prices**

Most subsistence farmers in the research area suffer from the seasonality of food prices. In general, small-scale farmers are forced to sell part of their produce right after the harvest or even before the harvest time (*Ijon*) in order to meet their need for ready cash. At this time, prices are usually low because of the abundant supply in the local market. In fact, what the subsistence farmers sell is often not a genuine surplus: in the months prior to the next year's harvest, farmers' granaries often run low causing them to buy food from the local market. By that time, high demand and scarcity in the local market cause prices to go up, affecting the purchasing power of the households.

This seasonality of food prices affects particularly poor households because they have little 'room to manoeuvre'. On the other hand, well-off families may benefit from the seasonality of food prices. The same is true for households with a high off-farm or non-farm income who can purchase grain in bulk during times of low prices. Big farmers with enough buffer capacity can manage to delay selling their produce with the aim of fetching higher prices.

3.3.4 **Traditional Farming System**

The traditional practice of clearing land using fire continues to the present day (see Figure 3.3). During my field trips to the research area in the dry season (August to November 2010), smoke from fires was a common sight. The local economy of the study area still relies on dry land agriculture with the continuation of the cultural practice of swidden cultivation. It is true that the availability of land for cultivation has declined as a consequence of population increase, the high rate of land conversion for human settlements, commercial and permanent agricultural activities and public infrastructure developments. However, the use of fire as the main means of conducting agricultural activities remains important for farmers in the research area. The practice of traditional farming systems usually commences a few months before the onset of the rainy season.

Figure 3.3 Using Fire for Clearing Land in Research Sites

Source: Author's field survey, 2010

My direct observation of the practice of using fire provides significant insights into the traditional knowledge regarding the preservation of this practice. First of all, traditional belief still holds strongly that shifting cultivation is advantageous in addressing the problems of weeds and soil fertility decline. It is also believed that burning the land will provide fertiliser in the form of ash for their crops. Second, the practice of swidden cultivation can be seen as a coping strategy for dealing with a shortage of household labour. In this regard, men, either a father or a son, will perform the duties of cutting up the tree branches, while women (either mother or daughter) will take part in burning the land. Thirdly, the practice also reflects a rational choice to minimise the time of, and costs of, land cultivation.

The traditional farming involves mixed cropping which, according to local knowledge, aims at minimising the risk of crop failure. Crops are planted in the first week of the rainy season with no fertiliser application. Weeding activities are then conducted manually two or three times during the growing period. In this system, two or more seeds of plants such as maize and a legume are commonly put together in one hole. Other dominant crops in the same cultivated area are cassava and pumpkin.

This traditional farming system of shifting cultivation and mixed cropping is undertaken for subsistence only. Opening up new farmland is mainly driven by concerns to meet household demand, rather than to produce for a market. With no use of fertiliser, the productivity of a shifting cultivation and mixed cropping is generally low and fluctuates from year to year depending on the precipitation and the level of fertility of the cultivated area.

3.3.5 **Land Tenure**

The land tenure is closely related to the land use systems followed by the community groups in the regions and thus, can be explained from two perspectives: private and communal land. Private land refers to individually owned land such as that used for settlements, building sites, agricultural and mixed gardens; this type of land can be obtained through purchase, inheritance and temporary or indefinite usufruct of state-owned land. In recent years, for economic reasons the ownership of land has been able to be transferred from one individual to another through purchase. In emergency circumstances, for example, the sale of private land can become one of the coping mechanisms adopted by some households.

Inheritance, however, remains the most common method through which land is acquired. While most private land is passing through daughters in the matrilineal system of the Tetun and Marae (Southern Belu), a purported 'patrilineal' system is maintained by the majority of the ethnic groups (the Meto / Atoni and the Rotenese) in the research regions. In this system, only male siblings are given usufruct rights to land and can expect to inherit it after the father's death. From a gender perspective, this informal or traditional arrangement is disadvantageous for women. However, in some cases, women are permitted to cultivate the land if they have no access to any other land at all. In the Eastern Part of Timor (Belu District), a matrilineal system is followed, under which all land is passed through women.

In addition to purchase and inheritance, local people can gain access to state owned land administered by a village official previously known as a '*Temukung'*. This arrangement is sanctioned as a part of community development programs set up to encourage villagers to open up unused grassland and cultivable areas to increase household production. The ownership of this land is, however, quite unclear. Individuals who have opened up such plots of land and cultivate them continuously from year to year are considered as the de facto owners of the land and, thus, can register it some years later in their own names as their private land. However, that would be difficult for those who move from one plot of land to another, a process followed by the majority of farmers in search of better rainfall and proximity to water sources within a given area of state owned land. In many cases, the usufruct right to land would cease once they move to other plots of land.

Apart from private land, individual households that belong to the same origin group (clan or tribe) have usufruct rights over communal lands including other common property resources such as bush/grassland, forests and water sources. Members of these groups are generally given usufruct rights ('right to and use of land') including the responsibilities to protect and preserve the resources under the control of their traditional landlords. Within the Meto, the largest ethnic group in the research regions, an *amaf* is in charge of this traditional land tenure arrangement, distributing an equal share of land to each adult member (male only) of the clan for a personal garden. The usufruct rights to the land may be shared and inherited by adult (males) members of households with the understanding that sale of the land is not permitted to outsiders. Members of the clan may also have access to grazing zones, forested land and forest-related products, but they cannot claim individual ownership of properties within these communal zones. For example, collecting honey from trees in the communal forests is allowed for members of the clan, but the status of the trees where the bees build their hives remains under communal ownership. Members of a community who are outside the clan are excluded from access to the communal zones without permission from the *amaf*.

This traditional arrangement does not necessarily mean the exclusion of new entrants to the community. In fact, the new entrants may gain access (usufruct) to available communal resources for agricultural related activities and such access can be secured through the presentation of *oko mana*, a decorated betel-nut basket made of *lontar* leaf, to the chief. This tradition symbolises the payment of respect and acknowledgment of the traditional rights of the land to the tribe elder or chief.

The prevailing land tenure system in the regions is not without problems. In fact, the system per se creates a great discrepancy in land distribution among the people. Certain community groups that belong to an *amaf* or *temukung* may acquire large portions and secure the most productive land, leaving the majority of the population outside the clan or *temukung* with less fertile and marginal land units. For example, the members of the major ethnic groups in studied villages own land that is, on average, between 1 and 2 ha per individual household, while minority groups own less than 0.5 ha per household. The same is true for access to forest products.

3.3.6 **Access to Credit**

Financial institutions through which local communities gain access to credit in the two regions can be categorised into four groups: formal financial institutions (banks and non-bank institutions such as cooperatives and pawnshops); non-formal financial institutions; government programs; and traditional institutions. Most banks operating in the regions are state-owned banks such as the National Bank of Indonesia (BNI), Bank Mandiri, The People's Bank of Indonesia (BRI), and the NTT Regional Development Bank (BPD/Bank NTT). These institutions provide micro finance services such as the rural credit program (*Kupedes*) by BRI, 'Bank NTT *Peduli*' and '*Pundi Putri*' by Bank NTT and the Partnership Program / '*Program Kemitraan*' by Bank Mandiri. Nonetheless, the majority of subsistence farmers and the poor still find it difficult to access such schemes mainly due to the rigidity of loan requirements. For example, the Kupedes K-3 scheme run by BRI provides credit up to Rp. 3 million without collateral. BRI still has to comply with the requirement of business feasibility stipulated by the banking law in Indonesia which causes the provision of loans to be limited to business activities that are already well established and not to new ‘businesses’ as run by the majority of subsistence farmers. Not surprisingly, such schemes are usually mainly awarded to individuals with regular incomes or those who already own businesses. Another factor impeding access to banking institutions is the limited number of bank offices (branches) in rural areas. Together with the lack of a means of transport and communication especially in Kupang district the lack of bank branches makes it almost impossible for the poor to make use of the credit schemes provided by banking institutions.

Outside of the formal banking institutions, the poor may have access to credit from non-formal institutions managed by various non-government organizations (NGOs) such as the *Tanaoba Lais Manekat* (TLM) Foundation, *Alfa Omega Foundation* (YAO) and *Sanlima* Foundation. Government Development Programs funded by central and local governments also provide financial services that are channelled through community groups, either those established by a community’s own initiative or groups deliberately formed especially for accessing such schemes. The loans provided by these institutions are largely given in the form of revolving funds for non-farming business. Due to the time constraints set on the loan period (a maximum of one year), such schemes become less attractive for the poor to conduct their own businesses which generally take longer to make a profit and hence pay back the loan. In turn, a large proportion of a loan is often spent on other than business-related expenditure such as consumption and emergency needs.

Apart from the institutions discussed above, traditional institutions such as informal moneylenders (*rentenirs*), *arisan* groups and saving and loan groups also play an important role in providing financial services for members of the the local communities in the regions. The poor traditionally rely on *arisan* (rotating savings) activities to meet their own needs for finance. Nowadays, a new emerging informal lending institution known as ‘daily bank’ has become quite popular in Kota Kupang despite the high interest rates charged – as much as 20% per month and instalment repayments on a daily basis.

3.4 Socio-cultural Environment

3.4.1 Welfare Profile

East Nusa Tenggara Province is one of the poorest provinces in Indonesia (World Bank, 2001). One of the major impediments to development in the region is its unfavourable geographic and climatic conditions. Despite the high climate variation and infertile soils, a large proportion of population in the province relies heavily on the agricultural sector. Low income per capita, poor quality of human resources and low levels of health are the main features of poverty in the region. The chronic state of poverty in the region is confirmed by several indicators in the Human Development Index and Human Poverty Index developed by the United Nations Development Programme (UNDP) (Table 3.6).

Table 3.6 Human Development Index in NTT Province and Studied Districts, 1999 and 2002

Description		Indonesia		NTT Province		Kupang city		Kupang district	
		1999	2002	1999	2002	1999	2002	1999	2002
Human Development Index (HDI)									
Order				**24**	**28**	**80**	**53**	**273**	**329**
HDI		**64.3**	**65.8**	**60.4**	**60.3**	**66.6**	**70.9**	**57**	**56.9**
	Life Expectancy (years)	66.2	66.2	63.6	63.8	63.4	64.8	63.4	64.2
	Adult Literacy Rate (%)	88.4	89.5	81.2	84.1	94.6	97.5	75.5	80.7
	Mean Years of Schooling (years)	6.7	7.1	5.7	6	9.6	10.1	4.9	5.4
	Adjusted Real Per Capita Expenditure (Thousands of Rupiah)	578.8	591.2	576.6	563.1	0	578.8	557.7	531.6
Human Poverty Index (HPI)									
HPI		**25.2**	**22.7**	**29.5**	**28.9**	**16.7**	**14.4**	**33.2**	**27.5**
	People not expected to survive 40 years of age (%)	15.2	15	19.5	19.2	19.8	9.7	19.8	18.4
	Adult Iliteracy Rate (%)	11.6	10.5	19.6	15.9	5.4	2.5	24.5	19.3
	Population without access to safe water (%)	51.9	44.8	41.9	46.8	24.8	19.8	47.5	36.9
	Population without access to health facilities (%)	21.6	23.1	38.2	32.8	0.5	6.4	35.9	30.8
	Undernourished Children under age five (%)	30	25.8	38.7	38.8	29.3	33.9	49.5	41.8
Gender related Development Index (GDI)									
	Life Expectancy (years)	Female	68.1	65.5	65.6	63.3	71.7	65.3	66.1
		Male	64.2	61.7	61.8	61.5	67.8	61.5	62.3
	Adult Literacy Rate (%)	Female	85.7	77.4	81.4	94.5	96.6	72.1	79.4
		Male	93.5	83.5	87.1	96.9	98.5	78.6	81.9
	Mean years of schooling (years)	Female	6.5	5.2	5.6	9.3	9.6	4.6	5.1
		Male	7.6	5.9	6.4	10.3	10.7	5.2	5.7
	Proportion in workforce	Female	28.9	43.2	35.7	30.6	24.6	36.6	24.1
		Male	71.1	56.8	64.3	69.4	75.4	53.4	75.9

Source: Various (UNDP 2004, BPS NTT 2006)

Based on the 2004 Indonesian Human Development Report, the Human Development Index in East Nusa Tenggara province is lower than the Indonesian average and marks the Province as the third poorest in Indonesia in the years 1999 and 2002 (Table 3.6). In addition, the Human Poverty Index (HPI) of NTT, including those of the two regions selected for study, is higher than the national average, indicating the high level of poverty in this province. The 2004 Human Development Report also reveals the high number of poor in the region. According to the Report, about 1,260,500 poor people in NTT or around 30.7% of the total NTT population (Table 3.7) lived under the poverty line. About 88% of the heads of poor households work in the agricultural sector. Among the five districts in West Timor region, Kupang district has the highest poverty rate, at 36.4%, while Kupang city has the lowest poverty rate of 11.5% (Table 3.7). Kupang City also has one of the highest literacy rates in Indonesia.

Table 3.7 Labour force and poverty conditions by districts, 2002

Province / District	Labour Force Participation Rate (%)	Open Unemployment (%)	Per capita Expenditure		Poverty Line (Rupiah / Capital /Month	Poverty	
			Total Thousand Rupiah / Month	Food (% of total)		number of poor people (Thousand)	poverty Rate (%)
INDONESIA	67.7	10.6	206.3	58.47	108.889	38,394.50	18.2
NTT	71.8	6	112.6	71.3	86.993	1,206.50	30.7
Kupang District	71.2	4	103	76.7	77.454	148	36.4
Kupang City	55.3	14.2	187.5	61.2	88.777	29.2	11.5

Source: UNDP, 2004

3.4.2 **Health Conditions**

In addition to low income levels, poverty in NTT and the selected regions is marked by low levels of health. The HPI indicators show the extent of the high proportion of malnourished children under five years of age, both in NTT generally and in the studied districts. Infant mortality rates are also higher for NTT and for Kupang district (above 50 per 1,000), compared to the national rate of 43.5 per 1,000 (IHDR 2004). There is also a high prevalence of communicable diseases such as tuberculosis (TBC) and malaria/dengue in the West Timor region, which affects the state of people's health and their level of productivity. Malaria is endemic in the region, which accounts for a high percentage of absenteeism from school. The 2004 Report on Human Development in Indonesia also notes that access to safe water is very low especially in Kupang district. Only 63 % of its population had access to safe water in 2002. This condition may also explain why the region suffers from persistent diarrhoea.

It can be argued that the problems of health are closely associated with limited access to health services. This is confirmed by the indicators of HPI showing that at least one third of the total population of Kupang district had no access to health facilities (UNDP, 2004). Likewise, only 18% of birth deliveries in the region were assisted by medical personnel (UNDP, 2004)

Table 3.8 Health condition by districts, 2002

Province / District	Infant mortality rate (per 1,000)	Population with health problems (%)	Morbidity rate (%)	Average duration of illness (days)	Population self-medicating (%)	Birth delivery assisted by medical personnel (%)
INDONESIA	43.5	24.5	15.3	5.8	60.6	66.7
NTT	51	35.7	26.2	6.4	47.5	37.3
Kupang District	51.7	38.2	30.3	7	43.6	18.4
Kupang City	29.4	32.6	18.9	6.1	45.3	69.5

Source: UNDP, 2004

Table 3.9 Housing condition by districts, 1999 and 2002

Province /Districts	Access to safe water (%)		Households with dirt floor (%)		Households without access to sanitation (%)	
	1999	2002	1999	2002	1999	2002
INDONESIA		55.2		16.7		25
NTT	58.1	53.2	48.1	47.1	28.2	27.1
KAB KUPANG	52.5	63.1	59.7	47.9	41.4	29
KOTA KUPANG	75.2	80.2	11.3	12.9	0.3	0.3

Source: UNDP, 2004

Another Health and Demography survey carried out in 2002 and 2003 also revealed that 72 % of births occurred at home and more than 50 % of births occurred with the assistance of a traditional midwife (Suharyo, 2004). Other factors pointing to the problem of health service provision in the region are the shortage of health care workers and the poor quality of facilities offered by these health services. Although every year more health centres are built at village level, this is not followed up with the allocation of health care workers. As a result, many health centres are left unattended, are poorly maintained and eventually become useless. This is due to the fact that the allocation of central government grants to build health centres is not supported by the fiscal capacity of local governments to recruit more health care workers.

In the case of malnutrition and maternal mortality, one can also point to the paternalistic cultures of West Timor which condone the dominant role played by men in decision making, very often resulting in a delay in pregnant women being taken to health clinics. Moreover, traditional feeding habits for babies associated with the pattern of the poor nutritional value of food consumed also have devastating impacts on children. Because the mother is busy with domestic tasks and working in the fields, babies are mostly looked after by their older siblings or grandmothers and are not exclusively breast-fed. Babies are usually fed with porridge (made from either rice or corn) and soft food like mashed banana. In terms of household consumption, the subsistence family may have access to vegetables and fruit from home gardens or fields (*ladang*). However, the provision of animal and plant protein is quite problematic. Not surprisingly, household consumption suffers from low food intake in both quantity and quality especially of animal sourced protein. Thus, more carbohydrate sourced food such as corn and cassava is consumed by the household members including children than protein sources including fresh fish, eggs, milk and fresh meat This contributes to the high prevalence of malnutrition in the regions.

Together climate variability and the low access to health services due to their limited availability combined with a variety of cultural constraints exacerbates the current chronically poor state of human health in the region. Increased temperatures and changes in rainfall can change the distribution and concentration of mosquitoes, which are vectors for diseases such as malaria and dengue fever (McMichael & Githeko, 2001, p. 451). In addition, the current poor water quality due to increased erosion results from intense rainfall events, which in turn leads to an increased volume of suspended sediments, and causes frequent outbreaks of waterborne diseases such as cholera and diarrhoea.

3.4.3 **Educational Attainment**

According to the Human Development Index (HDI), NTT has a particularly low educational attainment as measured by its literacy rate and mean years of schooling, compared to the Indonesian average (UNDP, 2004). Despite a small increase in the literacy rate from 81.2 in 1999 to 84.1 in 2002, the NTT figures were still below the national average of 88.4 in 1999 and of 89.5 in 2002 (Table 3.6). Likewise, while the average years of schooling in NTT had risen to 6 years in 2002, the national average of mean years of schooling had reached 7.1 years for the same period.

At the regional level, educational attainment varies greatly between the rural and urban populations. Kupang city, with its largely urban population, has high literacy rates and average years of schooling and is above the regional average. As a rural population, Kupang district exhibited a lower literacy rate and lower mean years of schooling than the regional and Kupang city rates. In 2002, the literacy rate of the Kupang district was 80.7 % with 5.4 years of mean school years, compared to the higher literacy rate (97.5%) and mean years of schooling (10.1) in Kupang city. In this respect, the city's performance is above the Indonesian national level (89.5% for adult literacy and 7.1 for means years of schooling (UNDP, 2004); BPS 2006).

The disparity of educational attainment is not limited to rural and urban areas. It is also related to gender. In general, males have a higher literacy rate and mean years of schooling than females. The average years of schooling for women in Kupang district in 2002 was 5.1, compared to 9.6 years for women in Kupang city. For men, these figures are 5.7 in Kupang district and 10.7 in Kupang city, respectively (Table 3.6).

Trends in school attendance show that the highest school participation rate was found in the primary school ages (7-12 years), but these rates decline dramatically at the higher school levels (Table 3.10). Likewise, the age groups 16-24 years who are economically active had higher drop-out rates than the groups aged 7-15. Again, striking differences between rural and urban areas exist with regard to school participation rates and drop-out rates. The highest participation rate was found in the city, and the lowest in Kupang district for all age-groups.

Table 3.10 School attendance by district, 2002

Province / District	School Participation Rate (%)				School Drop-out Rate (%)		
	age 7–12	age 13–15	age 16–18	age 19–24	age 7–15	age 16–18	age 19–24
INDONESIA	96.1	79.3	49.9	11.7	2.8	9.4	11.1
NTT	89.7	71.4	38.7	8.1	6	24.1	28.6
KAB KUPANG	87.5	79.2	36.7	4.9	6	17.6	24.4
KOTA KUPANG	98.1	91.2	77.8	34.4	1.5	3.5	6.2

Source: UNDP, 2004

Within community groups, children from poor families were found to have lower school participation rates than children from wealthier families. The national socio-economic survey conducted in Kupang district found that in 2004, the school participation rate of children from poor families aged 7-12 years and 13-15 years was 92.98% and 69.15%, respectively, compared to the rate of non-poor/wealthier children for both age groups which was 96.33% and 81.18%, respectively (BPS 2004). Similarly, the drop-out rate of children aged 13-15 years was far higher for poor families (15.80%) than for non-poor families (9.85%) (BPS 2004).

Several important reasons can be offered to explain the discrepancies of educational attainment between rural and urban areas, in addition to the differences by gender. Low family income stands out as the first and most important reason. While the Indonesian government has introduced the School Operational Budget (BOS) to cover tuition fees, text-books and teaching activities, the poor still find it difficult to afford the associated costs of sending their children to school such as school uniforms and the extra fees imposed by school committees. The problem of income has also forced children to help support family income by working on farms or migrating to cities to be newspaper sellers, household staff and the like. In addition to family income, the distance to school also affects the rate of drop-out and school participation. This is especially true for junior and senior high schools, which are generally situated in the capital of a sub-district (*kecamatan*).

3.4.4 **Population Density**

As the capital city of East Nusa Tenggara province with a total area of only 187.27 km2 only, Kota Kupang was home to 336,922 people in 2010. This population had increased from 279,124 people in 2006, giving the region a population density of 1,865 people per square kilometre in 2010 (BPS NTT, 2011) making it the fastest growing, most densely populated area in the province.

Because some *kecamatan* of Kupang district are situated around Kupang city, Kupang district has also experienced rapid population growth. Its population stood at 304,548 in 2010 (BPS NTT, 2011) whereas in 2006, its population was 273,672. With its total area of 5,898.2 km2, its population density rose from 58.5 people per square kilometre in 2006 to 65.09 people per square kilometre in 2010.

Various factors can be linked to the rise of population in both regions. Kupang city as the provincial capital of East Nusa Tenggara has become the hub of business and economic development in the province, attracting a high rate of in-migration to the city and to its neighbour, Kupang district. The search for jobs and education is among the reasons for migration in both regions.

Figure 3.4 Map showing population density in Kupang City and Kupang District

3.4.5 **Ethnicity Affiliation**

The population of both districts of Kupang is made up of a number of ethnic groups. The bulk of the population in these two regions belongs to the largest ethnic group in Timor, the Atoni (Atoni Pah Meto or simply Meto). Due to their previous occupation of the mountainous interior of Timor where abundant natural resources were present, this ethnic group is called the *orang gunung* ('the mountain people'). Over centuries, the Atoni have expanded throughout West Timor. This migration was historically triggered by the adoption of maize (introduced by the Dutch) as a staple crop in the late 17th century (Fox, 1988, p. 269).

In addition to the Atoni, the other main indigenous ethnic group in West Timor is the Helong. The Helong originally lived in the area around Kupang Bay, Amarasi and Amfoang. However, the Atoni Meto succeeded in occupying Amarasi and Amfoang in order to exploit its abundant sandalwood (Ataupah, 1992). In the process, numerous Helong were assimilated. Some of the Helong population who had previously settled around Kupang Bay also moved to Semau after the Helong ruler granted the Dutch the right to establish a base in Kupang Bay (Ormeling, 1956). Nowadays, in addition to Semau, some Helong still live on the coast to the south of Kupang in particular in villages in the Kupang district (Oematnunu, Bolok and Kuanheum).

Apart from the indigenous groups of the Atoni Meto and the Helong, the current population of both regions is also made up of ethnic groups from surrounding islands such as Solor, Flores, Sumba, Sabu and Rote. Among these migrants, the Rotenese account for a large component of the population especially in Kupang district and some sub-districts in Kupang city. The majority of the Rotenese population resides close to the coast along the coastline of Timor. In Kupang district, the Rotenese are the second largest ethnic group after the Atoni. The first Rotenese settlements were established in Oesao, Pariti, and Bau-Bau by the Dutch to create a buffer against hostile Atoni. Ataupah (1992) asserts that the Rotenese occupied those ecological areas left vacant by the Atoni Meto. Nowadays, the Rotenese population can be found along Kupang Bay (Sumlili, Oisina, Tablolong, Tesabela, Manulai, Lasiana, Oesapa, Babau, Camplong) all the way to the enclave of Oecussi (Ambenu - Timor Leste).

The presence of the Rotenese in West Timor dates back to 1815 when the Dutch started to transport members of one domain on Rote to settle in Bau-Bau, now a sub-district in Kabupaten Kupang (Fox, 2009, p. 4). Subsequent migrations of the Rotenese to Timor have continued to the present ((Fox, 2009). While the exact number of the Rotenese population is currently unavailable, the spread of Rotenese settlements in both administrative regions indicates that the Rotenese are indeed the second largest ethnic group. Fox (2009, p. 13) who attempted to figure out the number of Rotenese population in Timor Island based on the 2000 census conducted by the Indonesian government, has suggested that roughly 33,500 Rotenese live in Kupang district and 45,000 Rotenese in Kupang city.

Other migrant groups such as people of Chinese descent and Bugis from Sulawesi have also migrated and settled, especially in Kupang city. Migrant Chinese play a strong role in the business community and have continued to expand their involvement in trade from Dutch colonial times to the present day. Their presence in the region is quite powerful and dominant compared to other ethnic groups in terms of trading and business interests. The Bugis and Macassarese from South Sulawesi, who are well-known for their seafaring and trading activities, are also present in Kupang. Even though they represent a small number compared to the entire population in the region, their retail and shipping business activities continue to have a significant impact on the local economy. Many local grocery stores (kiosks) cross the regions are owned by Bugis traders, not only in the city but also in quite remote areas in Kupang district. They also have large stalls in general shopping areas in the city and in sub-district markets in the regions. Their business activities are not confined to one place but they are also mobile traders across the regions, moving from one weekly market to another, or from one village to another on motor bikes.

The latest ethnic group to settle in Kupang city and Kupang district is from East Timor as a result of the 1999 post-independence referendum violence. An estimated number of 280,000 East Timorese fled to four districts and one city in West Timor (UNHCR, 2004; UNDP, 2005). The influx of so many displaced East Timorese was unprecedented in West Timor's history, and had a major impact on the local communities in which they settled. Based on a census conducted by the Indonesian Government on 6 June 2001, 96.72% of the estimated 284,148 displaced East Timorese had settled in West Timor. In 2001, the UNHCR offered options to them, to be repatriated or remain in Indonesia. With the support of the Indonesian governments as well as local and international NGOs, many East Timorese managed to return to their home villages. This repatriation program continued until 2005. Other East Timorese, however, chose to remain in West Timor. In late 2005, the NTT government conducted a census which showed that 91.7 per cent of the estimated 104,436 ex-East Timorese refugees had settled in West Timor. As many as 11,360 former East Timorese now reside in Kupang district and Kupang city.

3.4.6 **Language Composition and Religious Adherence**

Historically, three main indigenous (Austronesian) languages were spoken in West Timor: Dawan, Tetun and Helong (Fox, 2003, p. 5). However, given the presence of many ethnic groups, today Kupang is a polyglot region where not only *Bahasa Indonesia* as a national and official language, but also various indigenous and non-indigenous languages, are spoken. Internally each ethnic group tends to speak its own language.

Just like the languages, religion in West Timor is also intertwined with ethnicity. A large percentage of the Atoni, Helong, Rotenese, Sabunese are Protestant Christians; those from Flores Island are mainly Catholics, while the Bugis and Bajo are Muslims. Consequently, the majority of the population in Kupang district and Kupang city is Protestant Christian which accounts for 86% of the population in Kupang district and 62% of the populations in Kupang city. Catholics make up 7% of the population in Kabupaten Kupang and 24% of the population in Kota Kupang. Other religions (Islam, Hinduism, and Buddhism) make up the rest of the population (BPS NTT, 2011).

3.4.7 **Local Ethnic Conflicts**

Given the socio-cultural diversity in West Timor, social conflicts within communities over land, marriages and other customary law disputes often emerge in Kupang district and Kupang city, which, in turn, lead to ethnic, social and communal violence, sometimes resulting in fatalities. The roots of present-day conflicts are associated with competition for power, prestige and privilege among the ethnic groups in West Timor, a situation that can be traced back to the pre-colonial period when various indigenous and independent ethnic groups were continually competing and often engaged in wars against one another.

Since religion in NTT is inextricably intertwined with ethnicity, ethnic rivalry for control of strategic executive and legislative positions at the provincial level inevitably contains undertones of religious rivalry, especially between Catholics and Protestants. Ethnicity and religion have long played an important role in the election and appointment of local public officials, and ethnic and religious issues are accentuated during local elections. The recent local elections of the Governor of East Nusa Tenggara province, the Kupang Mayor and the Regent provide clear examples of the rivalry between ethnic groups with different religious affiliations.

Local conflicts also exist between former East Timorese and the local people of West Timor in Kupang district. These stem from the differences in cultural backgrounds, resentment over disparities in assistance received and competition over scarce resources. Cultural differences based on ethnicity, religion and colonial experience have contributed to the social distance between the displaced East Timorese and the indigenous West Timorese. The displaced East Timorese are Catholic, stemming from their colonial history with the Portuguese, while the locals of West Timor (at least in the Kupang area) are predominantly Protestant as a result of their colonial history with the Dutch. From the perspective of the West Timorese, the influx of East Timorese has placed additional economic burdens on host communities, as well as putting pressure on scarce local resources such as land and water. The host communities in Kupang district were compelled to allocate some of their land for permanent settlement of displaced East Timorese. In addition, as pointed out by the local newspapers, conflicts between the displaced East Timorese and host communities have often arisen from the illegal entrance of the East Timorese into their host communities' farms to steal food crops. Disputes and social tension over the management of, and access to, natural resources, such as land and water, are invariably potential sources of conflict.

3.5 Governmental Framework / Environment for Development

In addition to the bio-physical, economic and socio-cultural environments that have been previously discussed, this chapter will also cover the governmental framework / environment for development as an important part in understanding the living space of the study regions. This section will discuss a number of development programs implemented in the research regions mainly run by central and local governments.

3.5.1 **National Development Programs**

The development programs funded by the central government of Indonesia are discussed below.

School Operational Assistance *(Bantuan Operasional Sekolah – BOS)*

The national program in the education sector is the School Operational Assistance (*Bantuan Operasional Sekolah – BOS*). Under this program, primary and junior high schools receive funds from the central government, and under this program students are exempted from school tuition fees. The BOS funds are sent directly to school bank accounts, and managed by the school committee. A school may allocate these funds to cover several types of expenditures according to the budget policy.

In practice, most of the BOS funds have been used for paying teachers' honorariums, teaching and learning activities as well as the procurement of stationery and textbooks. The implementation of the BOS Program is in fact quite useful as the students' parents receive a reduction of school costs; in addition, books and equipment for teaching and learning activities have been made available to schools. Several components of school operating costs that are normally covered by tuition fees are no longer a burden on students' parents. While an exemption of tuition fees has been achieved, a reduction in the high rate of school dropouts – another objective of the program – has been difficult to achieve due to the fact that the causes for dropping out are different across levels and are complex. A relatively higher dropout rate is found in junior high schools than in primary schools.

Subsidized Rice Program *(Raskin)*

Raskin (*Beras Miskin* or 'rice for the poor') is considered as a food security program that aims at providing subsidized rice to targeted poor households to fulfil food consumption needs at reduced prices. Eligible households line up once every two or three months to buy up to 15 kilograms of rice. In 2010, the targeted households could purchase RASKIN every month at IDR 1,600 per kilogram (compared to that year's market price of IDR 5,060 per kilogram).

While this program is quite useful to address the problem of food insecurity in the research regions, the program suffers from inclusion and exclusion errors: a few poor households are still not listed, while non-poor households are included as beneficiaries.

Another issue is that some poor households in the research areas have difficulty in purchasing the whole 15 kilograms and they often voluntarily give up their rice entitlement. Delay in rice distribution is also found especially in the remote areas. This problem may give rise corruption and fraudulent practices by village officials. In other cases, the poor households may also pay more than the actual price, for additional transport and packaging costs.

Public Health Insurance *Jamkesmas (Jaminan Kesehatan Masyarakat)*

Under *Jamkesmas*, targeted groups of poor households are entitled to have free access to in and out - patient care at *Puskesmas* (Community Health Clinics) and/or Class III services at public hospitals, as the medical fees are waived by the central government. The scheme covers practically all health care services provided in the designated health centres. However, the utilization rate is still very low due to a few problems, for example many *Jamkesmas* cards did not reach the targeted beneficiaries because of difficulties in the distribution process. Other problems relate to the coverage of health facilities and services especially in rural and remote areas.

The Family of Hope Program - PKH *(Program Keluarga Harapan)*

PKH, first launched in 2007, is a cash transfer that provides direct cash benefits conditional on household participation in locally provided health and education services. It consists of two main components: a cash transfer and monitored conditionality. Household participants can receive a cash transfer, ranging from IDR 600,000 to 2,200,000 per annum, depending on the number of qualifying dependents in the household. A continued cash transfer, however, depends on certain qualifications, such as a mother's verified attendance at pre-and post-natal check-ups, a professionally-attended birth, newborn and toddler weighing and health checks, and verification that a PKH household's school-age children have good attendance records at their school. The main beneficiaries of this program are supposed to be the 'very poor' households (*Rumah Tangga Sangat Miskin /RTSM*).

Until 2010, the implementation of PKH only covered 70 districts/cities in 13 provinces including East Nusa Tenggara Province. Among the recipients in the province of East Nusa Tenggara were Kupang city and six other districts, namely Manggarai Barat, Timor Tengah Selatan, Alor, Sika, Ende, and Sumba Barat). In Kupang city, the PKH was implemented in all sub-districts, covering 25-30 per cent of the total households in each village, which were considered as very poor households (*Rumah Tangga Sangat Miskin*). In 2013, the coverage of the PKH Program was extended to include 10 local governments including Kupang district.

National Community Empowerment Program PNPM *(Program Nasional Pemberdayaan Masyarakat)*

In all districts, the PNPM (National Community Empowerment Program) is the main government source for rehabilitating and building food security and nutrition related infrastructure such as village roads, irrigation, *Puskesmas* and *Posyandu* (community health post). The PNPM provides ample funds: the budget allocated for 2010 was around 5-8 billion rupiah (US$ 5-800,000) per district. PNPM applies a 'bottom-up' approach in identifying needs and planning, using participatory assessment tools such as community focus group discussions. However, projects implemented in 2010 mostly involved the rehabilitation of infrastructure.

3.5.2 **Local Development Programs**

Development programs funded by the provincial and district governments are quite similar. These programs include community based livelihood development activities, rural infrastructure development, capacity building, and emergency relief.

Community based livelihood activities (Agriculture, Livestock and Fishery)

For the agriculture sector, local government programs include extensification through the opening-up of new units of land / fields for crop growing and the development of irrigation infrastructure, in addition to intensification through the provision of seeds, fertilizer and equipment. The program also offers capacity building, community workshops and training. Local government interventions on extensification may include the creation of a portfolio of plots with different risk attributes to manage risks, in addition to avoid financial risks of intensive agriculture. Extensification is however hindered by the scarcity of land and the limited budget for building infrastructure. However, intensification remains popular through the provision of agricultural inputs. The main challenge for this scheme is to improve farming mechanisms to avoid delays in the provision of inputs. From year to year, the supplies of improved seeds and fertilizer arrive in the villages, late mainly due to inefficiencies in the highly bureaucratised procedures and poor transport facilities. Farmers often complained that supplies arrived after sowing time. Political and social connections are also cited as other determinant factors in accessing agricultural inputs (seeds, fertilizer and equipment).

Local government also implements community based livelihood programs for coastal communities through the provision of fishing equipment including boats, seaweed cuttings, and also training in seaweed cultivation.

With regard to livestock production, cattle raising has been one of the year-to-year local government programs in Kupang districts. This program includes cattle breeding and fattening. Under the breeding program, targeted farmers are given female cattle to carry for a certain period (two to three years). The female cattle are then artificially inseminated; the beneficiaries own any calves born during the carrying period. At the end of the program, however, the farmers must return as many cattle as they received, in order for the local government to distribute the cattle to other households.

While the breeding program aims at increasing the number of cattle owned by farmers as well as the cattle population at the district level, the fattening program is an income generating activity that aims at improving farmers' welfare. The local government provides farmers with steers to carry for up to 12 or 18 months, until the cattle reach slaughter weight. The cattle are then sold and the profit is shared between the local government and the farmers. However, this scheme allows the beneficiaries to take the larger portion of the profit.

Emergency Relief Program

Under *Decentralization Law 32/2004*, local governments are required to allocate a local budget annually for emergency relief measures to provide insurance against social and natural disasters. For example, the local government responds to drought emergencies through water delivery and the provision of food and seeds. In other cases like floods and landslides, the spending of the emergency budget is directed towards public infrastructure rehabilitation including material assistance for house repairing. However, access to the emergency schemes is highly contested. In many cases, patronage relationships influence access of affected households to the schemes.

In general, the implementation of central and local government funded programs has provided benefits for most communities or households in the recipient villages. These included benefits in the provisions of services in education, health, basic infrastructure, as well as access to livelihood activities and emergency relief. However, these programs have been limited in coverage due to budget constraints, bureaucratic procedures, and power relations that prevent the needy households and local communities from accessing the programs.

3.6 **Conclusion**

'The space of vulnerability' has been discussed in this chapter. Both the bio-physical environment and the economic, socio-cultural, governmental environment as pre-determining characteristics of the studied regions were discussed to explain how this living space may shape people's vulnerability and adaptability. The next chapter will examine the regions' vulnerability to climate variability and extreme weather events. It will analyse the general patterns of rainfall and other climate stressors such as the occurrence of drought-related El Niño, floods and tropical cyclones, and how these affect the livelihoods in the studied regions.

Chapter 4 Living with Climate Variability in The Dry Land of Timor

4.1 Introduction

The previous chapter described the environment of the research area looking at a wide range of environmental aspects which shape vulnerability and adaptation. This chapter explores the current exposure of the area to climate variability and extreme weather events and attempts to identify the likely impacts of these events on people's livelihoods, especially in the agricultural sector on which the majority of the population relies for their livelihoods.

I start this chapter with an account of the general characteristics of the climate in the research area. I analyse changes in annual and monthly rainfall, inter-annual variability of annual and monthly rainfall including its spatial variability. These changes will be linked to the impacts on agricultural practices in the regions. Current exposure to climate variability and exteme weather in the form of persistent droughts (meteorological and agricultural), the occurrence of El Niño and La Niña, flooding and tropical cyclones will be the main concerns of the succeding section. These influences are linked to existing impacts on people's livelihoods such as a decline in agricultural production (harvest failure and loss of crops). The final section will focus on the indirect impacts of climate variability, namely health and food security in the research regions.General characteristics of the climate in Kupang

4.1.1 Rainfall

Rainfall is the most important climate variable as far as agricultural production in the research area is concerned. In this regard, which crops can be cultivated is partly determined by the amount and distribution of rainfall. Crop yields are also determined by a variety of variables apart from climate conditions including soil fertility, farming methods, level of technology, and farm inputs, as well as the incidence of pests. However, most of these variables do not fluctuate from year to year in the same way as climate conditions. Therefore, rainfall is the most critical factor, if we rely on climate data to assess crop yields in the research area.

However, rainfall has to be linked with temperature since potential evaporation is determined by this latter variable, as is the case with soil moisture. High temperatures at certain periods will result in a high level of evaporation, which eventually leads to more moisture being drawn from the soil and hence moisture is less available for crop growth. Other climate variables that also contribute to plant growth and the development of grains are hours of sunlight per day, radiation and wind speed. Most of the local weather stations in Kupang do not measure such variables, unfortunately. In my study, I can only rely on rainfall and temperature data. Across the research area, Lasiana is the only weather station in Kupang City measuring temperature data and other variables such as evaporation, wind speed and sunlight hours per day. Other weather stations, such as those in Naibonat, Camplong and Baun, only record rainfall data.

Figure 4.1 shows the monthly rainfall data for Kupang City from Lasiana station for the period 1990 to 2009. Rainfall is concentrated in the months of November to March with a peak in February. April also receives significant amounts of rainfall. The real dry season lasts from May to October. Even though the average annual temperature does not vary greatly from year to year (see Figure 4.2), the differences are strong enough to cause significant differences in potential evaporation, which increase the risk of drought in the region (see Table 4.1).

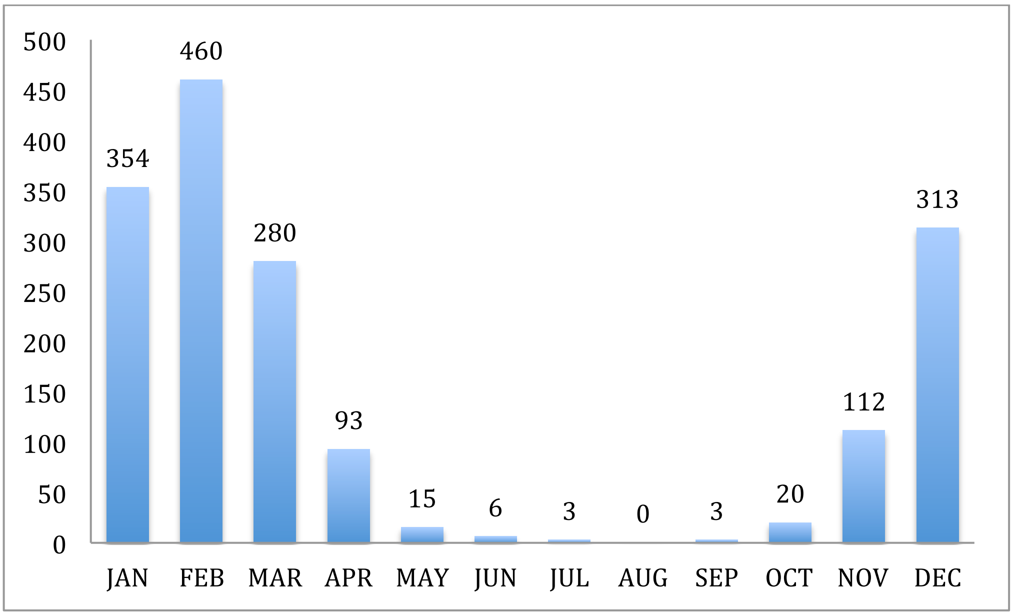


Figure 4.1. Average monthly rainfall for Lasiana, Kupang city, 1990 - 2009

Source: adapted from BMK Kupang, 2011

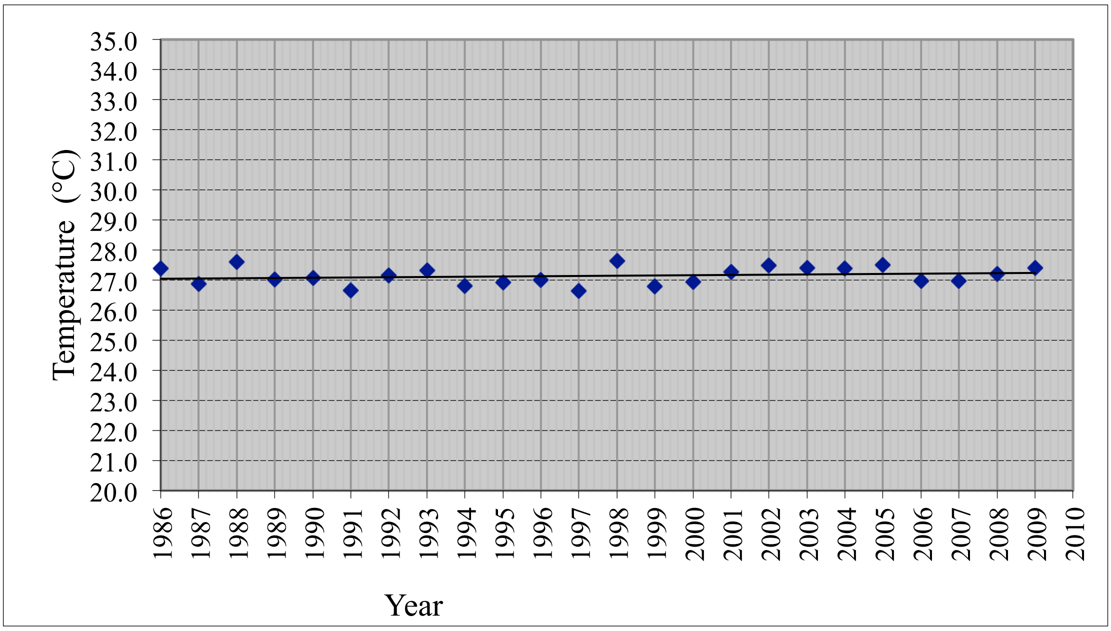


Figure 4.2 Average annual temperature in Kupang, 1986 – 2009

Source: adapted from BMK Kupang, 2011

The average evaporation rate ranges from 5.1 to 7.5 millimetres in the dry season, and around 4 millimetres in the rainy season (see Table 4.1). The highest evaporation rate occurs in September (7.5 millimetres) and the lowest rate is observed in February at 4.3 millimetres. The inter-annual variability of average monthly evaporation is high. The highest monthly evaporation measured was 8.7 mm in October 2008, while the lowest was 3.0 mm in January 2000.

Table 4.1. Average monthly evaporation, 1999 - 2009

Station : LASIANA KUPANG
Elevation : 20 meters
Sub-district : KELAPA LIMA
City : KUPANG

(Evaporation in millimetres)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1999	3.7	3.5	3.6	4.2	5.9	6.2	6.6	6.8	7.3	7.3	5.8	4.1
2000	3.0	3.5	3.6	4.2	4.4	6.0	6.8	7.1	7.4	7.5	5.7	5.0
2001	3.8	3.9	4.3	5.5	6.2	5.6	5.8	7.3	7.0	6.8	5.0	4.4
2002	4.6	4.1	5.5	5.3	6.4	6.0	6.9	7.7	6.5	6.8	7.5	5.2
2003	4.5	4.2	4.9	5.7	5.8	6.1	6.8	6.9	7.2	6.5	6.2	4.4
2004	5.2	3.8	4.6	6.1	5.3	5.9	6.5	6.2	7.8	6.6	6.7	5.6
2005	4.6	5.6	4.6	5.6	6.4	6.0	6.8	7.4	7.6	7.0	5.2	4.5
2006	3.8	5.5	4.6	4.4	5.8	5.9	6.2	7.7	7.9	8.3	7.2	5.2
2007	5.1	5.1	4.4	4.4	6.1	5.6	6.5	7.8	7.7	7.6	6.3	5.0
2008	5.0	4.0	4.3	5.0	6.5	6.0	6.8	8.1	7.9	8.7	6.4	4.9
2009	4.8	4.0	4.8	5.7	5.7	5.7	6.3	7.2	7.7	8.0	6.8	5.1
Total	48.1	47.1	49.1	56.1	64.5	65.0	72.0	80.3	82.1	81.0	68.7	53.3
Average	4.4	4.3	4.5	5.1	5.9	5.9	6.5	7.3	7.5	7.4	6.2	4.8

Source: adapted from BMK Kupang, 2011

The inter-annual variability of average annual temperature is small (see Table 4.2.). The highest mean annual temperature recorded was 27.6 degrees in 2005, the lowest mean annual temperature was 27.0 in 2000 and 2005. In general, both day and night temperatures are very high in the months prior to the rainy season. November is the hottest month with an average temperature of 29.2 degrees. This figure represents the average between night and day temperatures. The day temperature can reach above 35 degrees in the dry season. The first rains bring cooler weather and the average temperature can drop below 27 degrees. The lowest monthly temperature was recorded in July 2006 at 24.6 degrees. This drop in temperature is mainly influenced by the Australian climate and in the cold winter season, the day temperature can reach its lowest point, below 19 degrees, between July and August.

Table 4.2. Average monthly temperature, 1999 - 2009

Local station : LASIANA KUPANG
Elevation : 20 meter
Sub-district : KELAPA LIMA
City : KUPANG

(DERAJAD CELCIUS)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	AVERAGE
1999	28.6	27.1	25.1	26.3	26.5	27.3	27.2	26.2	25.7	28.8	28.8	29.1	326.7	27.2
2000	26.5	27.5	26.6	26.7	26.4	25.7	25.8	25.7	27.4	28.9	29.1	28.2	324.6	27.0
2001	27.3	27.3	27.1	27.9	27.7	26.7	25.5	25.5	27.3	28.8	28.8	27.7	327.5	27.3
2002	27.6	26.9	27.5	28.0	28.2	26.4	26.2	25.8	26.6	28.1	29.8	29.0	330.2	27.5
2003	27.8	26.9	26.6	27.6	27.4	26.5	26.4	26.2	27.4	28.6	29.5	28.0	329.1	27.4
2004	28.1	27.0	27.4	28.6	27.6	25.9	25.8	25.3	26.9	28.0	29.2	28.8	328.7	27.4
2005	27.9	28.2	27.4	27.6	27.6	26.6	26.7	26.5	27.5	28.7	28.7	27.6	331.0	27.6
2006	27.1	27.1	26.8	26.8	26.9	25.8	24.8	25.6	26.1	27.8	29.6	29.2	323.6	27.0
2007	28.2	27.8	27.0	27.2	27.6	26.7	25.5	26.0	26.6	28.5	29.0	28.4	328.6	27.4
2008	27.7	26.7	26.3	27.0	27.2	26.1	25.5	26.6	27.8	29.4	29.1	27.2	326.6	27.2
2009	27.2	26.9	26.5	28.1	27.4	26.2	25.9	26.8	27.9	28.7	29.1	28.1	328.8	27.4
TOTAL	304.1	299.4	294.4	301.8	300.6	289.9	285.4	286.2	297.2	314.4	320.7	311.3		
AVERAGE	27.6	27.2	26.8	27.4	27.3	26.4	25.9	26.0	27.0	28.6	29.2	28.3		

Source: adapted from BMK Kupang, 2011

Based on such variables of rainfall, temperature and evaporation, December, January and February can be regarded as the ‘wet’ months for the years 1999 to 2009. During these months, rainfall is significantly higher than in other months, while the temperature and evaporation drop, allowing crop development. November, March and often April receive some rainfall but it is only adequate for crops adapted to drought. On average, the months from May to October are ‘dry’ months. Rain falling before the wet months may help farmers to prepare their fields for sowing crops.

The inter-annual variability of rainfall is quite large during the rainy season (see Table 4.3.). In the years from 1990-2009 April and November had a minimum of 0 mm and a maximum of 267 and 416 mm, respectively. The minimum amount of rainfall in

December was 95 mm, and the maximum amount was 1,101mm. These figures indicate that November and the first half of December in many cases receive very little rain. More often than not, after a short rainy spell between October and early November, the dry period continues until the end of December. January is a critical month in the agricultural calendar of the research area, and the amount of rainfall received for this month ranged from 34 mm and 572 mm. The minimum amount of rainfall in February was 144 mm and the maximum amount was 882 mm. In March, these figures are 30 mm and 629 mm. Most farmers will sow their first fields with maize in December, even though the rain is often not sufficient to sustain crop growth. In the last two weeks of December or early January, the research area is more likely to experience adequate rainfall. In the months of January and February, sowing will continue including paddy where the fields receive enough water. The period of sowing often overlaps with a period of weeding and might even overlap with the earliest harvest of maize. The first crops will be harvested in early March, or after the peak of the rains. Harvesting of grains will continue from the late rainy season and early dry season.

Table 4.3. Average monthly rainfall during the rainy season in Kupang, 1990-2009

YEAR	JAN	FEB	MAR	APR	NOV	DEC
1990	269	277	272	29	26	365
1991	493	523	30	267	176	123
1992	215	496	59	178	56	95
1993	541	311	255	25	8	205
1994	300	309	317	157	38	205
1995	434	317	629	198	122	405
1996	374	516	260	58	120	1101
1997	310	708	184	3	59	191
1998	441	173	84	132	158	307
1999	408	785	489	84	186	157
2000	572	598	492	113	144	189
2001	296	343	104	29	416	278
2002	175	627	158	86	75	133
2003	367	684	402	77	40	722
2004	34	509	314	0	72	219
2005	218	144	284	49	151	284
2006	543	268	553	178	0	161
2007	244	285	385	111	78	165
2008	285	882	218	85	103	399
2009	554	454	105	3	205	556
MIN	34	144	30	0	0	95
MAX	572	882	629	267	416	1101

Source: adapted from BMK Kupang, 2011

4.1.2 **Ten-Day Rain Intervals**

The climate data presented above provides a rough idea of how dry or wet the research area is and how annual rainfall amounts have fluctuated over time. The inter-annual variability of rainfall tells us that the annual rainfall amounts can vary greatly between years. Local farmers, however, are not interested in such general climatic characteristics like total amounts and average distribution of rainfall. A year with low amounts of rainfall can be a good year if the rains fall at the right moment. In contrast, a year with a high level of rainfall can turn out to be a disastrous year if the rains are interrupted by a prolonged dry spell. Moreover, too much rain within a short time can be detrimental for crop yields. Given this, local farmers will be more interested in the distribution of rainfall over the year than in the total amount. In this respect, climate analysis for this area should include data on the ten-day rainfall intervals.

Figure 4.3 shows the average 10-day amounts of rainfall for Lasiana (1989 – 2010). In these years, the months March to November were relatively dry. It can also be seen that on average, there is adequate rain between the second half of December and early March. In this period, the rainfall fluctuated and reached a peak of 167 mm in early February, from which it dropped and then rose again in early March. The average 10-day rainfall amounts fail to capture the rainfall variability within years, however.

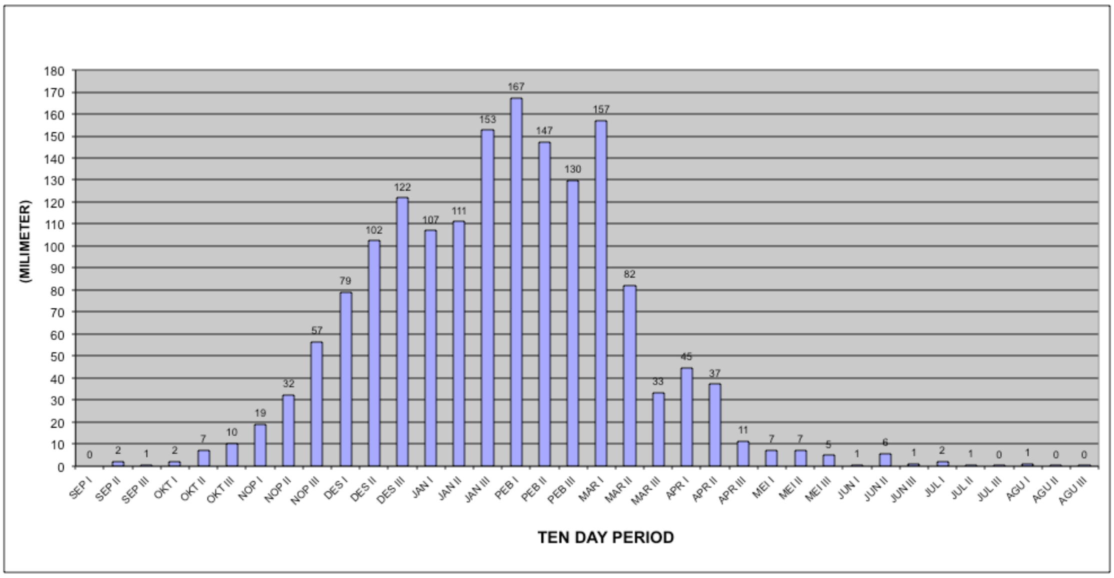


Figure 4.3. Average rainfall in 10-day periods in Lasiana, 1989-2010

Source: adapted from BMK Kupang, 2011

For this reason, it is more interesting to look at rainfall in specific years than consult average data. Table 4.4 shows the 10-day rainfall distribution from the period 1989/1990 to 2009/2010. As designated by the local weather office, the highlighted rows indicate the actual period of the rainy season for each year. Critical information on rainfall behaviour can be drawn with regard to the onset and duration of the rainy season, as well as the occurrence of dry spells.

Table 4.4. Average rainfall in 10-day periods in Lasiana, 1989-2010

Sub-district : Kelapa Lima
City : Kupang

YEAR	OCT			NOV			DEC			JAN			FEB			MAR			APR			MAY
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1
1989/1990	0	0	4	8	17	0	20	26	69	82	96	91	104	54	119	131	141	0	0	17	12	3
1990/1991	0	0	0	0	19	7	163	132	70	97	124	272	253	75	195	23	0	7	46	220	1	0
1991/1992	0	0	0	54	18	105	51	24	48	136	0	79	188	226	85	30	3	26	15	163	0	0
1992/1993	0	0	5	0	36	20	75	20	0	76	37	428	73	184	54	171	1	83	7	18	0	0
1993/1994	1	9	0	0	0	8	28	117	60	121	39	143	7	153	149	186	95	36	155	0	2	0
1994/1995	0	0	0	0	0	38	51	110	44	72	181	181	148	92	77	589	18	22	141	57	0	0
1995/1996	0	0	0	0	71	51	118	184	103	58	101	235	190	104	222	241	17	2	52	6	0	0
1996/1997	0	0	0	3	80	37	157	332	612	103	143	64	165	193	350	183	0	0	0	3	0	0
1997/1998	0	0	0	0	21	36	81	1	109	39	72	330	76	63	34	51	26	7	45	4	83	0
1998/1999	0	0	59	62	60	36	136	59	112	62	168	178	381	149	257	54	321	114	19	30	35	0
1999/2000	0	19	15	14	50	122	68	33	56	74	167	331	134	246	218	41	364	87	49	49	15	0
2000/2001	0	0	0	100	41	3	163	14	9	215	34	47	215	127	2	40	39	25	19	1	9	0
2001/2002	0	2	1	88	58	270	142	58	78	3	76	96	307	281	39	152	4	3	0	76	10	0
2002/2003	0	0	0	0	1	74	13	71	49	219	120	28	95	410	180	253	103	46	77	0	0	3
2003/2004	25	0	40	9	18	13	14	313	395	22	0	13	286	204	21	68	183	65	0	0	0	51
2004/2005	0	44	0	0	6	66	4	48	167	46	56	116	115	12	17	175	94	15	17	34	0	0
2005/2006	0	79	88	9	118	24	138	76	70	162	184	197	147	55	64	385	124	44	131	7	40	10
2006/2007	0	0	0	0	7	4	49	48	64	165	60	19	4	49	232	311	74	0	51	60	0	0
2007/2008	0	0	0	41	14	23	14	82	69	69	60	156	378	226	278	68	69	81	84	0	1	0
2008/2009	16	0	0	11	44	48	149	125	125	254	199	101	185	184	85	44	49	12	1	2	0	40
2009/2010	0	0	0	0	2	203	29	277	250	171	416	99	65	4	45	102	2	25	33	35	28	46
AVERAGE	**2**	**7**	**10**	**19**	**32**	**57**	**79**	**102**	**122**	**107**	**111**	**153**	**167**	**147**	**130**	**157**	**82**	**33**	**45**	**37**	**11**	**7**

Source: adapted from BMK Kupang, 2011

The patterns of rainfall are highly irregular from year to year, implying that great differences are evident with regard to the date of onset and duration of the rainy period. The onset of the rainy season varies significantly (Table 4.4). Early onset of the rainy season was observed in the month of October in 1998/1999 and in 2004/2005, while in most other years the rainy seasons have started in November and December. According to local farmers, onsets are difficult to predict, but in most cases the onset of the rains often tends to occur later than expected by local farmers.

The longest rainy season occurred in 2005/2006 when the rain started in the middle of October and continued to early April. However, during this year, dry spells occurred almost every month, lasting for twenty days each time. Consequently, crop disruption was certain to occur at every stage of growth, from germination to harvest period. Another longer rainy season occurred in the year 1998/1999, starting from the end of October and continuing to the end of March. It is worth nothing that very limited rainfall was observed during the early rainy season in that year. Significant rainfall was then received from the end of January to the end of March, with a short dry spell in early March. Barely two months with sufficient rain did not help crops to develop. A long rainy season was also observed in the year 2007/2008, lasting about 4 months (mid-December to early April). Significant rainfall was received on only 40 days, between mid-January and the end of February, while the first and the last 40 days received poor precipitation. There were only two wet months in the middle of the rainy season, which is not sufficient for most crops to grow well. The rainfall behaviour of these three years demonstrates that years designated as having a long rainy season do not necessarily result in good crop production due to the occurrence of dry spells and the limited amount of rainfall. Moreover, evaporation is often high causing low soil moisture which impedes germination.

On average, the rainy season is short in the region, only 2 to 3 months, from December to February. Again, the irregular and erratic onset of the rainy season from year to year is evident. In the period 1989/1990 to 2009/2010, only two consecutive years (1995/1996 & 1996/1997) followed exactly the same pattern, with the rain starting in the middle of November and continuing to early March. These two years can be considered as good years, having three consecutive months with sufficient rain to sustain crop growth. Other years with short rainy seasons were disappointing. The onset of the wet season moved back and forth from one year to another.

Some years started with abundant rainfall, which can mislead local farmers; these were succeeded by long dry spells, then short rainy spells to end the rainy season, before the dry season took hold. The years 1991/1992, 1992/1993, 2000/2001 exemplified this pattern very well. One month of dry spells in 1991/1992, 40 days and 50 days of dry spells for 1992/1993 and 2000/201, respectively, were observed at the beginning of the rainy season each year, followed by 10 days of rains, before another dry spell kicked in. Such prolonged dry spells have detrimental effects on crop. The local farmers suffered from heavy crop losses during these years.

This analysis of the available climate data leads me to argue that the major problem for crop production in the research area is the *high variability of rainfall* with respect to the onset and duration of the rains. But what does this variability mean to local farmers? It means that farmers cannot count on sufficient rain falling every year, although in some years they receive abundant rainfall. For cropping purposes, local farmers respond to the low reliability of rainfall as if they were gambling on whether this agricultural year will be wet or dry. If they predict a dry year, drought resistant crops will be sown in the lower areas. When the opposite occurs, that is, if the year turns out to be wet, local farmers can suffer from harvest failure. The reverse is also true. If they predict a wet year, maize, groundnut and millet would be given a higher priority, while leaving the low areas with only rice. The upland crops might then be destroyed if a dry year occurs instead. In reality, the farmers use their limited resources (land, labour and seed) to spread their risks.

The erratic rainfall is also associated with *false starts for the rains*, as occurred in the years 1991/1992, 1992/1993, 1997/1998, 1999/2000, 2000/2001, 2003/2004 and 2006/2007. Long dry spells occurring right after the onset of the rainy season have posed serious problems for farmers. The local farmers admit that such false rains often force them to sow early; but if a prolonged dry spell occurs, germination rates are poor and extensive wilting results. Again, such problems lead many farmers to make a second attempt at planting provided they have available reserve seed and planting stock. My argument based on the available data and my own observations is that it is the high variation between years that poses the highest risks: the less the variation, the better the crop production.

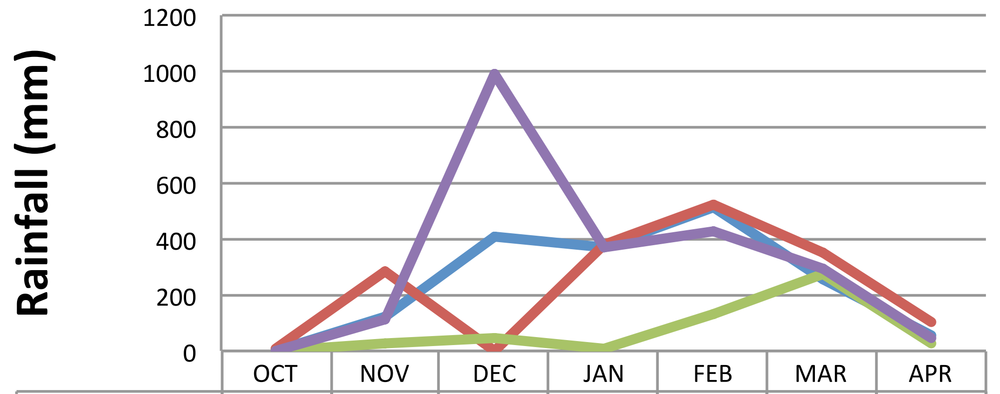
4.1.3 **Spatial Variability**

Another significant characteristic of rainfall in the study area is its high spatial variability, which farmers find as much of a threat as a lack of rainfall. Even in a year with adequate average rainfall, some areas may experience very little rain. As one official in the agriculture service agency described it, in Kupang district, rainfall varies 'not just each year but in each sub-district, it's very diverse in time and space. Sometimes it rains here, but five kilometres away it is not raining. It's very irregular'.

In fact, most farmers often complain about the irregularity of rainfall even when the climate pattern is considered ‘normal’. One can be certain that even in a ‘normal’ year, some areas will suffer from drought. Farmers gave a very good account of this phenomenon by comparing their own harvests from one place to another, taking into consideration the same inputs especially seed and tilling methods. In their words, ‘our harvest of this field was not as good as the other field, located 6 – 7 kilometres away because the other field received enough rain’. Therefore, across the geographical area of Kupang district, there can be seven, eight or more different rainfall situations in the same period. Such local variability leaves those dependent on rain-fed agriculture highly vulnerable to the unpredictability of rainfall in any particular location.

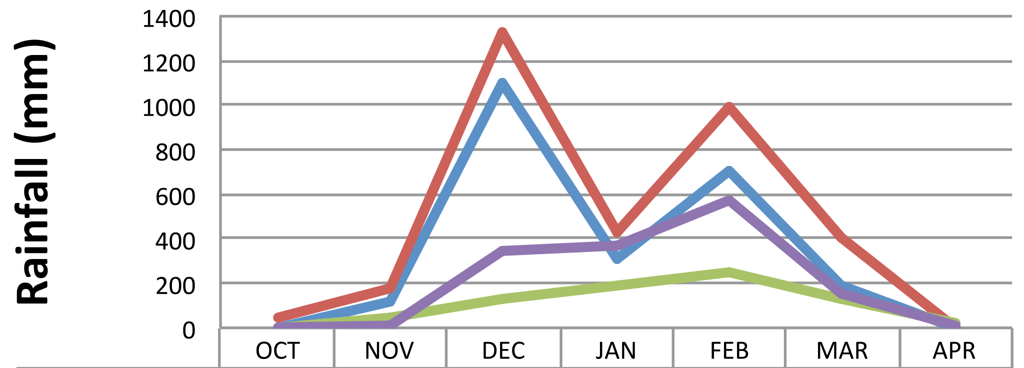
Such extreme variation puts rain-fed farming at high risk with regard to choosing the correct time for planting. In general, farmers will prepare their fields and plant when the rainy season starts. However, considering the irregularity of the onset and the length of the rainy season, in reality it is quite difficult to carry out the activities of preparing fields and planting. If there are only a few days without rain, farmers could manage. But if no rain falls for two or three weeks, then disaster is certain, considering the limited resources most farmers have, including a shortage of labour and seed availability. Those with adequate resources can hire labour for clearing their fields and replanting. However, this is not the case for small farmers who lack those resources and must take their chances with opportunities to plant. Small farmers consider rainfall variability as a game when it comes to their decision to plant since no one can figure out with certainty the correct time to plant. And as they live only from agriculture, they feel obliged to plant immediately after their field is wet enough. Otherwise they lose the opportunity. For them, it is better to plant instead of waiting.

To comprehend this spatial variability, I use monthly rainfall data from four local stations in Kupang. From the selected years (as shown in the figures below), great spatial variability of rainfalls was observed in December 1995/1996 when a higher rainfall was recorded at Baun, almost 1,000 mm, followed by the Lasiana station with just 400 mm, while the other two stations received almost no rain in that month (Figure 4.4).



	OCT	NOV	DEC	JAN	FEB	MAR	APR
LASIANA	0	122	405	374	516	260	58
NAIBONAT	10	284	0	381	520	352	101
CAMPLONG	0	28	44	12	135	275	25
BAUN	0	113	986	367	423	290	44

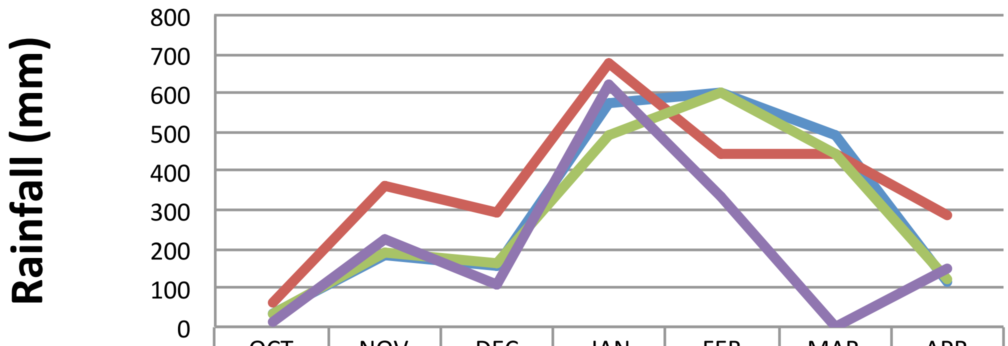
Figure 4.4. Spatial variability of monthly rainfall in Kupang, 1995/1996
Source: adapted from BMK Kupang, 2011



	OCT	NOV	DEC	JAN	FEB	MAR	APR
LASIANA	0	120	1101	310	708	184	3
NAIBONAT	43	182	1332	429	994	407	0
CAMPLONG	0	45	125	185	244	125	16
BAUN	2	14	350	375	574	158	13

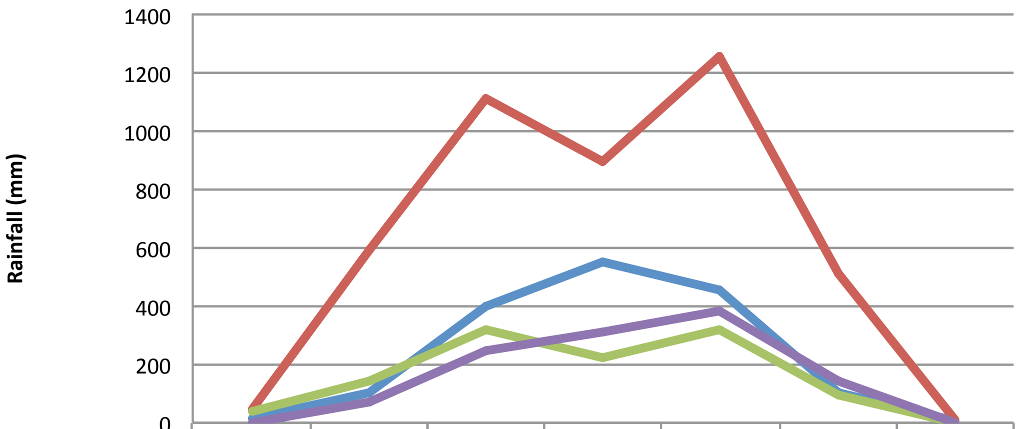
Figure 4.5. Spatial variability of monthly rainfall in Kupang, 1996/1997
Source: adapted from BMK Kupang, 2011

In the year 1996/1997 (Figure 4.5), Naibonat took over the position of receiving highest rainfall, followed closely by Lasiana, which was noticeable in the months of December and February, whereas the other two local stations (Camplong and Baun) appeared to have received lower rainfall for the same month.



	OCT	NOV	DEC	JAN	FEB	MAR	APR
LASIANA	34	186	157	572	598	492	113
NAIBONAT	62	363	292	674	442	445	283
CAMPLONG	32	193	164	495	599	443	124
BAUN	11	227	109	620	336	0	151

Figure 4.6. Spatial variability of monthly rainfall in Kupang, 1999/2000
Source: adapted from BMK Kupang, 2011



	OCT	NOV	DEC	JAN	FEB	MAR	APR
LASIANA	16	103	399	554	454	105	3
NAIBONAT	50	589	1112	897	1253	514	10
CAMPLONG	37	139	320	222	320	96	0
BAUN	0	72	245	309	381	141	0

Figure 4.7. Spatial variability of monthly rainfall in Kupang, 2008/2009
Source: adapted from BMK Kupang, 2011

The figures for 1999/2000 (Figure 4.6) display the great variation that occurred from February to March with Baun receiving less rain than the other three stations. In 2008/2009 (Figure 4.7) only Naibonat recorded a very high rainfall throughout the rainy season. Of the three remaining stations, Lasiana had somewhat higher rainfall than Camplong and Baun.

In comparing the monthly rainfall level from these four local stations, it is clear that spatial variability is high and has a significant effect on the performance of the agricultural sector especially food crop production in the regions. The differences in local crop production between villages and sub-districts in the research areas can be partly attributed to this high spatial rainfall variability.

4.2 **Persistent (Meteorological and Agricultural) Drought**

Drought is the most common phenomenon of climate variability in the study area of Kupang. Two measures of drought appear to be relevant in the research area, namely meteorological drought (as defined by rainfall deficiency based on the BMKG data), and agricultural drought, defined in terms of rainfall that is inadequate for crop development.

Local weather stations document erratic rainfall, extended dry seasons and rainfall variability, and their data point to the meteorological drought in the regions. For example, an examination of rainfall records from the two stations in Kupang, Lasiana (Kupang city) and Naibonat (Kupang district), show that the average rainfall from 1989 – 2010 in both regions was very low: for example, the maximum rainfall in Kupang municipality was 167 mm in February, while in Kupang district in late January it was 244 mm (see Figure 4.8 and Figure 4.9).

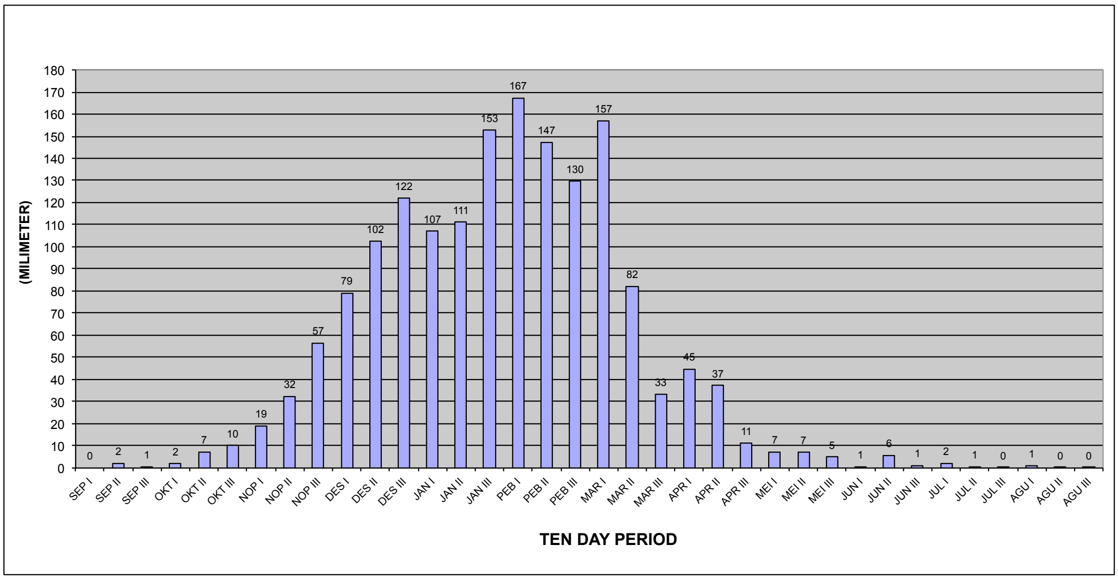


Figure 4.8. Average rainfall in Kupang (Lasiana Station), 1989-2010

Source: adapted from BMK Kupang, 2011

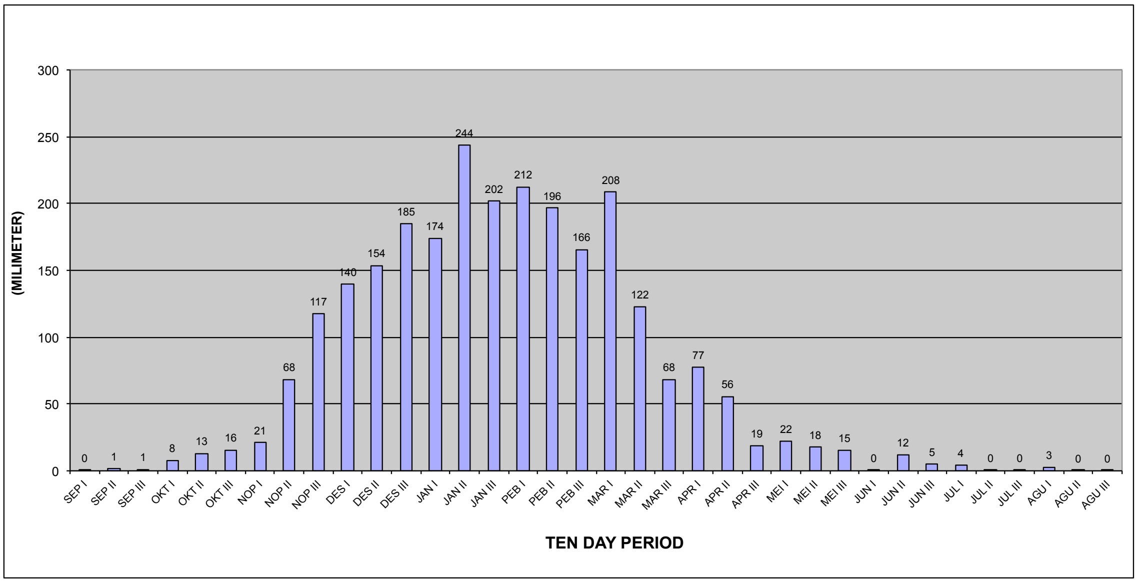


Figure 4.9. Average rainfall in Kupang (Naibonat Station), 1998-2010

Source: adapted from BMK Kupang, 2011

Both regions also experience a regular extended dry season which can last for 8 to 9 months. In most years, the rainy season is only 2 – 3 months, commencing in December and finishing in early February. However, as pointed out above, the time of onset of the rains differs from year to year. The Lasiana station shows that, in some years, the rainy season begins in late November (1991/1992, 2002/2003 and 2009/2010), while in other years, the onset of the rainy season is not until late December (1989/1990, 2004/2005, 2007/2008). The same is true in the case of Naibonat station. Rainfall variability and unreliability make it difficult for the farmers to predict precisely the timing of their cropping calendar, a crucial factor for successful crop production in the study region. Some farmers may manage to re-sow when the first sowing has failed. But other farmers suffer from limited resources (seed and labour) and have only one option under such conditions of erratic rainfall: either lose or win for the year.

Table 4.5 Rainfall variability in Kupang (Lasiana station), 1989-2010

YEAR	SEP			OCT			NOV			DEC			JAN			PEB			MAR			APR			MAY			JUN			JUL			AUG		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1989/1990	0	0	0	0	0	4	8	17	0	20	26	69	82	96	91	104	54	119	131	141	0	0	17	12	3	5	0	0	0	0	0	2	0	0	0	0
1990/1991	0	0	0	0	0	0	0	19	7	163	132	70	97	124	272	253	75	195	23	0	7	46	220	1	0	1	1	0	0	4	0	0	0	0	0	0
1991/1992	0	2	0	0	0	0	54	18	105	51	24	48	136	0	79	188	226	85	30	3	26	15	163	0	0	0	21	0	0	2	0	0	0	0	0	3
1992/1993	0	0	12	0	0	5	0	36	20	75	20	0	76	37	428	73	184	54	171	1	83	7	18	0	0	13	0	5	9	0	0	2	0	0	0	0
1993/1994	0	0	0	1	9	0	0	0	8	28	117	60	121	39	143	7	153	149	186	95	36	155	0	2	0	1	0	0	0	0	0	0	0	0	0	0
1994/1995	0	0	0	0	0	0	0	0	38	51	110	44	72	181	181	148	92	77	589	18	22	141	57	0	0	23	1	0	0	2	0	0	0	0	0	0
1995/1996	0	0	0	0	0	0	0	71	51	118	184	103	58	101	235	190	104	222	241	17	2	52	6	0	0	0	0	0	0	0	1	0	0	0	2	0
1996/1997	0	0	0	0	0	0	3	80	37	157	332	612	103	143	64	165	193	350	183	0	0	0	3	0	0	1	11	2	0	0	0	0	2	0	0	0
1997/1998	0	0	0	0	0	0	0	21	36	81	1	109	39	72	330	76	63	34	51	26	7	45	4	83	0	28	0	3	1	0	39	0	0	0	0	0
1998/1999	0	0	0	0	0	59	62	60	36	136	59	112	62	168	178	381	149	257	54	321	114	19	30	35	0	0	0	0	0	0	0	0	0	0	0	0
1999/2000	0	0	0	0	19	15	14	50	122	68	33	56	74	167	331	134	246	218	41	364	87	49	49	15	0	45	20	0	0	0	0	0	0	0	0	0
2000/2001	0	0	0	0	0	0	100	41	3	163	14	9	215	34	47	215	127	2	40	39	25	19	1	9	0	0	0	1	47	0	2	7	0	0	0	0
2001/2002	0	0	0	0	2	1	88	58	270	142	58	78	3	76	96	307	281	39	152	4	3	0	76	10	0	0	0	0	0	0	0	0	0	0	0	0
2002/2003	0	43	0	0	0	0	0	1	74	13	71	49	219	120	28	95	410	180	253	103	46	77	0	0	3	0	0	0	24	0	0	0	0	0	0	0
2003/2004	0	0	0	25	0	40	9	18	13	14	313	395	22	0	13	286	204	21	68	183	65	0	0	0	51	0	29	1	0	0	0	0	0	0	0	0
2004/2005	0	0	0	0	44	0	0	6	66	4	48	167	46	56	116	115	12	17	175	94	15	17	34	0	0	0	0	0	0	0	0	0	0	0	0	0
2005/2006	0	0	0	0	79	88	9	118	24	138	76	70	162	184	197	147	55	64	385	124	44	131	7	40	10	0	1	0	18	2	0	0	0	0	0	0
2006/2007	0	0	0	0	0	0	0	7	4	49	48	64	165	60	19	4	49	232	311	74	0	51	60	0	0	0	0	0	16	8	0	0	0	0	0	0
2007/2008	0	0	0	0	0	0	41	14	23	14	82	69	69	60	156	378	226	278	68	69	81	84	0	1	0	0	0	0	3	0	0	0	0	0	0	0
2008/2009	0	0	0	16	0	0	11	44	48	149	125	125	254	199	101	185	184	85	44	49	12	1	2	0	40	0	0	0	0	0	0	0	2	0	0	0
2009/2010	0	0	0	0	0	0	0	2	203	29	277	250	171	416	99	65	4	45	102	2	25	33	35	28	46	30	19	1	2	7	4	0	0	20	0	1
AVERAGE	**0**	**2**	**1**	**2**	**7**	**10**	**19**	**32**	**57**	**79**	**102**	**122**	**107**	**111**	**153**	**167**	**147**	**130**	**157**	**82**	**33**	**45**	**37**	**11**	**7**	**7**	**5**	**1**	**6**	**1**	**2**	**1**	**0**	**1**	**0**	**0**

dry season

rainy season

weak - moderate El Niño year

strong El Niño year

La Niña year

El Niño followed with La Niña

Source: BMG Lasiana, 2011

Table 4.6 Rainfall variability in Kupang (Naibonat station), 1989-2010

YEAR	SEP			OCT			NOV			DEC			JAN			PEB			MAR			APR			MAY			JUN			JUL			AUG		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1989/1990	0	2	0	0	0	48	12	61	24	67	181	183	303	540	248	125	47	167	437	149	0	9	165	78	23	17	0	0	9	39	0	0	0	0	0	0
1990/1991	0	0	0	0	0	0	0	24	82	170	180	14	152	122	240	120	121	312	89	9	32	247	262	16	0	2	0	0	0	0	0	0	1	1	0	0
1991/1992	0	9	0	0	0	0	68	119	93	68	20	46	66	42	73	183	211	112	40	84	28	89	120	0	0	0	78	3	0	1	2	0	0	0	1	0
1992/1993	3	0	20	0	0	10	0	159	85	264	223	28	144	226	496	201	111	91	76	50	108	7	47	0	0	9	0	2	49	1	1	3	0	0	0	0
1993/1994	0	0	0	3	48	0	0	0	104	14	75	172	86	50	179	170	318	179	196	31	68	194	0	7	0	8	0	0	0	0	0	0	0	0	0	0
1994/1995	0	0	0	0	22	0	0	12	49	121	147	61	201	431	319	165	194	114	814	0	47	192	72	0	4	47	21	1	1	2	0	0	0	0	0	0
1995/1996	0	0	0	4	1	5	7	109	168	205	154	86	34	58	289	84	206	230	321	31	0	60	41	0	0	13	0	0	0	15	0	0	0	2	0	0
1996/1997	0	0	0	0	43	0	0	78	104	276	374	682	83	250	96	299	254	441	391	12	4	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
1997/1998	0	0	0	0	0	0	0	103	34	123	6	140	46	194	345	87	61	73	13	99	75	106	4	27	0	33	0	0	3	0	48	0	0	0	0	0
1998/1999	0	0	0	0	0	94	6	101	97	44	57	184	87	426	251	361	268	272	95	257	149	68	19	74	19	0	0	0	0	0	0	0	0	0	0	0
1999/2000	0	0	0	0	27	35	116	167	80	164	19	109	66	358	250	79	209	154	20	356	69	138	71	74	2	172	72	0	3	0	0	0	0	0	1	0
2000/2001	0	0	0	0	0	3	122	149	65	177	30	9	183	151	22	169	197	2	65	79	38	2	4	7	0	0	0	0	58	0	0	0	0	0	0	0
2001/2002	1	0	0	11	17	36	22	52	253	126	90	74	112	124	160	353	276	46	154	0	0	2	169	0	0	0	0	0	0	0	0	0	0	0	0	0
2002/2003	0	14	0	0	0	0	0	0	107	54	73	83	107	126	37	86	275	166	171	180	420	216	0	0	13	0	0	0	71	0	0	0	2	0	0	0
2003/2004	1	2	0	93	0	13	2	67	62	130	399	771	28	25	55	488	334	62	59	274	130	36	0	21	0	32	43	0	0	0	0	0	0	0	0	0
2004/2005	0	0	0	0	86	0	0	0	86	6	87	252	82	47	172	77	6	36	93	588	17	0	44	2	0	0	0	0	0	0	0	0	0	0	0	0
2005/2006	0	0	0	0	12	84	0	77	72	102	85	135	252	331	340	147	137	33	431	57	54	44	20	54	88	0	0	0	42	0	0	0	0	0	0	0
2006/2007	0	0	0	0	16	0	0	14	8	73	42	53	227	103	72	0	91	192	219	82	0	40	38	0	0	18	8	4	0	0	0	0	0	0	0	0
2007/2008	0	0	0	0	0	0	16	0	122	74	200	125	369	95	100	510	259	398	59	158	34	109	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008/2009	0	0	0	50	0	0	71	122	396	635	383	94	395	430	72	600	549	104	421	8	85	0	10	0	261	0	43	0	0	0	0	0	0	0	0	0
2009/2010	0	0	0	0	0	0	0	19	372	38	399	582	628	987	417	155	2	296	213	68	79	66	83	29	54	15	54	0	10	42	31	0	0	53	0	1
AVERAGE	**0**	**1**	**1**	**8**	**13**	**16**	**21**	**68**	**117**	**140**	**154**	**185**	**174**	**244**	**202**	**212**	**196**	**166**	**208**	**122**	**68**	**77**	**56**	**19**	**22**	**18**	**15**	**0**	**12**	**5**	**4**	**0**	**0**	**3**	**0**	**0**

dry season

rainy season

weak - moderate El Niño year

strong El Niño year

La Niña year

El Niño followed with La Niña

Source: BMG Lasiana, 2011

Meteorological drought will then give way to agricultural drought in the regions. Low precipitation and high evaporation will result in low soil moisture for crop growth. As a result, crops perform poorly, causing local farmers to lose their crops, a result of both failure to plant and failure to harvest. Agriculture as the mainstay of the local economy especially for the majority of subsistence farmers can be greatly affected. Agricultural droughts can result in persistent food shortage from time to time in the regions, as crop production falls significantly below subsistence level.

4.3 El Niño and La Niña Events

The term El Niño (Spanish for "the Christ Child") was originally used by fishermen along the coasts of Ecuador and Peru to refer to a warm ocean current that typically appears around Christmas time and lasts for several months (Glantz, 1996; Fagan, 1999). Fish are less abundant during these warm intervals, so fishermen often take a break to repair their equipment and spend time with their families. In some years, however, the water is especially warm and the break in the fishing season persists into May or even June. Over the years, the term El Niño has come to be reserved for these exceptionally strong warm intervals that not only disrupt the normal lives of the fishermen but also bring heavy rains. El Niño usually occurs around Christmas and usually lasts for a few weeks to a few months. Sometimes an extremely warm event can develop that lasts for much longer time periods.

The formation of an El Niño is linked with the cycling of a Pacific Ocean circulation pattern known as the Southern Oscillation (Pidwiry, 2010). In a normal year, a surface low pressure develops in the region of northern Australia and Indonesia and a high-pressure system over the coast of Peru (Figure 4.10). As a result, the trade winds over the Pacific Ocean move strongly from east to west. The easterly flow of the trade winds carries warm surface waters westward, bringing convective storms to Indonesia and coastal Australia. Along the coast of Peru, cold bottom water wells up to the surface to replace the warm water that is pulled to the west.

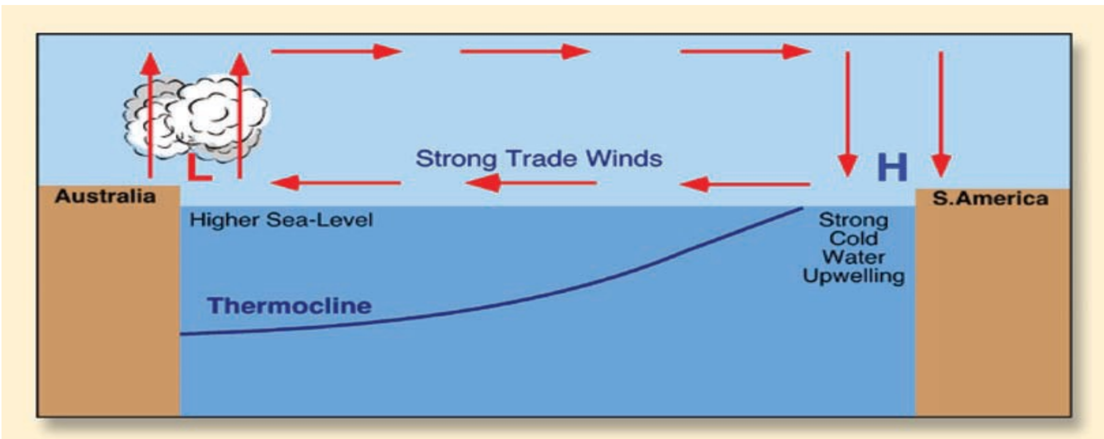


Figure 4.10 A cross-section of the Pacific Ocean, along the equator, in normal years

Source: (Pidwiry, 2010)

In an El Niño year, air pressure drops over large areas of the central Pacific and along the coast of South America (Figure 4.11). The normal low pressure system is replaced by a weak high in the western Pacific (the Southern Oscillation). This change in pressure pattern causes the trade winds to be reduced. This reduction allows the equatorial counter current (which flows west to east) to accumulate warm ocean water along the coastlines of Peru and Ecuador. This accumulation of warm water causes the thermocline to drop in the eastern part of the Pacific Ocean which cuts off the upwelling of cold deep ocean water along the coast of Peru. Climatically, the development of an El Niño brings drought to the western Pacific, rains to the equatorial coast of South America, and convective storms and hurricanes to the central Pacific (Pidwiry, 2010).

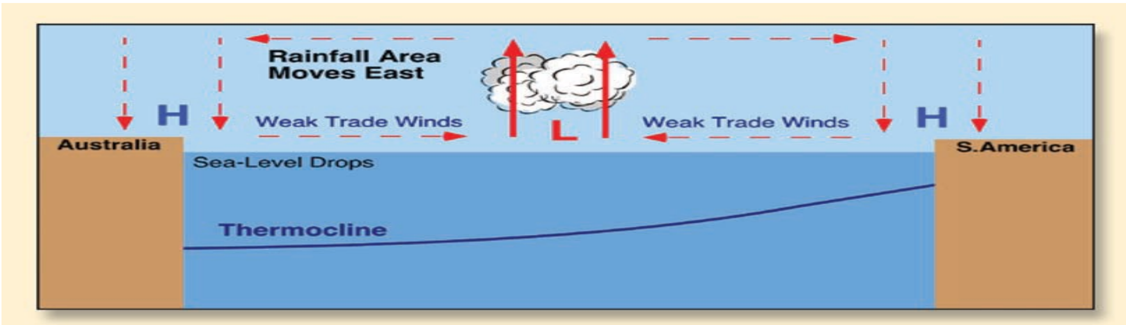


Figure 4.11 A cross-section of the Pacific Ocean, along the equator, in El Niño year
Source: (Pidwiry, 2010)

Prior to the 1980s and 1990s, strong El Niño events occurred on an average every 10 to 20 years. In the early 1980s, the first of a series of strong events developed. The El Niño of 1982-1983 brought extreme warming to the equatorial Pacific. Surface sea temperature in some regions of the Pacific Ocean rose by 6° Celsius above normal. The warmer waters had a devastating effect on marine life off the coast of Peru and Ecuador. The 1982-1983 El Niño also had a pronounced influence on weather in the equatorial Pacific region and worldwide. Several droughts occurred in Australia, Indonesia, India and southern Africa.

Scientific understanding of the processes responsible for the development of El Niño is still incomplete. Scientists are able to predict the future development of an event by noting the occurrence of particular weather precursors. Researchers also now have a fairly complete understanding of the global weather effects caused by the formation of an El Niño (Figure 4.12).

Figure 4.12 Global climatological effects of El Niño

Source: (Pidwiry, 2010)

Meteorologically, the occurrence of El Niño and La Niña events is generally measured by the Southern Oscillation Index (SOI) and Sea Surface Temperature (SST) across the Pacific Ocean. El Niño events are shown by extreme negative values of SOI, while the positive extreme values of SOI correspond to the occurrence of La Niña. Considering the variations in timing and geographical patterns of warming, it is quite difficult to define El Niño and La Niña events universally (World Meteorological Organization, 1999).

In Australia and across Southeast Asia, SOI values are strongly related to rainfall. For this reason, the SOI is commonly used as a good indicator of rainfall (Potbury, Sheales, Hussain, & Fisher, 1998; Yoshino, Urushibara-Yoshino, & Suratman, 2000). Normal climate is shown by the values of SOI about zero or ranging from negative 1 to positive 1. El Niño events occur when the values of SOI drop significantly below normal (extreme negative), while La Niña is indicated by an extreme positive SOI (Yoshino, Urushibara-Yoshino, & Suratman, 2000). It is clear that the potential effect of El Niño and La Niña is either a decrease or increase of rainfall level. When SOI values are less than -10, the El Niño events bring about a decline in rainfall, whereas when SOI values are higher than 10, La Niña induces a high rainfall level (Fox 2000).

Based on Monthly SOI data from the Australian Bureau of Meteorology from January 1875 to September 2000, Table 4.7 shows that during the period 1875 to 2000, there were 18 cases of El Niño and 15 cases of La Niña with a duration of at least four months successively; the longest duration of El Niño was 20 months in 1940/1941, while the longest period of La Niña was 16 months, occurring twice (1878/1879 and 1955/1956).

Table 4.7 Occurrence of El Niño and La Niña from 1875 - 2000

Climate Anomaly	Year	Period of Occurrence	Duration (months)	SOI Value		
				Average	Minimum	Maximum
El Niño						
1	1877/1878	06/77 - 03/78	10	-13.9	-21.1	-8.2
2	1882	06/82 - 09/82	4	-18.4	-25.6	-12
3	1888	03/88 - 07/88	5	-15.6	-23.6	-9.8
4	1896/1897	05/96 - 05/97	13	-19.3	-42.2	-7.4
5	1905	02/05 - 07/05	6	-30.0	-42.6	-16.8
6	1911	06/11 - 10/11	5	-11.5	-12.8	-8.8
7	1912	02/12 - 05/12	4	-15.1	-21.1	-9
8	1914/1915	06/14 - 05/15	12	-15.0	-21.6	-8.6
9	1923	07/23 - 11/23	5	-13.1	-18.5	-8.2
10	1940/1941	03/40 - 10/41	20	-14.6	-29.4	-8.2
11	1965	06/65 - 11/65	6	-15.0	-22.6	-11.1
12	1972	05/72 - 10/72	6	-13.6	-18.6	-8.9
13	1977	05/77 - 12/77	8	-12.9	-17.7	-9.4
14	1982/1983	06/82 - 04/83	11	-24.2	-33.3	-17
15	1987	02/87 - 09/87	8	-17.4	-24.4	-11.2
16	1991/1992	09/91 - 04/92	8	-16.5	-25.4	-8.3
17	1994	03/94 - 12/94	10	-15.4	-22.8	-10.4
18	1997/1998	03/97 - 04/98	14	-18.8	-28.5	-9.1
La Niña						
1	1878/1879	07/78 - 10/79	16	15.0	8.1	22.6
2	1886/1887	08/86 - 03/87	8	12.3	10	14.4
3	1889/1890	11/89 - 03/90	5	18.2	11	23
4	1903/1904	12/03 - 04/04	5	17.5	9.4	31.7
5	1906	08/06 - 11/06	4	16.2	9.1	21.7
6	1910	06/10 - 12/10	7	16.2	9.8	22
7	1917/1918	02/17 - 02/18	13	21.2	10	34.8
8	1938	05/38 - 08/38	4	15.7	13	18.5
9	1950/1951	02/50 - 01/51	12	16.5	7.6	26.9
10	1955/1956	05/55 - 08/56	16	13.5	9.3	19.2
11	1970/1971	09/70 - 04/71	8	16.3	10.3	22.6
12	1973/1974	08/73 - 05/74	10	16.3	9.7	31.6
13	1975/1976	06/75 - 03/76	10	16.9	11.8	22.5
14	1988/1989	07/88 - 01/89	7	15.2	10.8	21
15	1998/1999	06/98 - 01/99	8	12.2	9.8	15.6

Source: Australian Bureau of Meteorology (http:/www.bom.gov.au/climate/current/soihtm1.shtm1

The historical data also indicate that the frequency of El Niño occurrences has tended to increase for every 25 years since 1925, namely 1 case in 1926-1950, 2 cases in the years 1951-1975 and 6 cases within the period 1976-2000 (Table 4.8). Similarly, the magnitude of El Niño also tends to increase as shown by the continuous decrease in values of SOI, and reflected in the decline of SOI values from -14,6 in 1926 – 1950 to

-14,8 in 1951 – 1975, and to -17,5 in 1976 – 2000. This trend suggests that El Niño events have increased in occurrence and magnitude as well as duration.

Table 4.8 El Niño and La Niña events by 25 year period, 1875 - 2010

Period	Number of El Niño and La Niña cases	El Niño events		La Niña Events	
		Year	Annual SOI	Year	Annual SOI
I (1875 - 1900)	3 El Niño	1877	-10.04	1879	12.85
	3 La Niña	1888	-10.92	1880	7.8
		1896	-15.73	1886	7.68
II (1901 - 1925)	4 El Niño	1905	-20.01	1910	12.73
	3 La Niña	1912	-8.48	1916	7.4
		1914	-7.93	1917	20.79
		1919	-9.35		
III (1926 - 1950)	2 El Niño	1940	-13.85	1938	9.13
	2 La Niña	1941	-12.83	1950	15.38
IV (1951 - 1975)	2 El Niño	1965	-8.43	1955	10.58
	6 La Niña	1972	-7.35	1956	10.73
				1971	10.95
				1973	7.28
				1974	9.9
				1975	13.6
V (1976 - 2000)	9 El Niño	1977	-9.9	1988	7.82
	3 La Niña	1982	-13.05	1989	6.77
		1983	-8.33	1999	7.95
		1987	-13.08		
		1991	-8.78		
		1992	-10.38		
		1993	-9.47		
		1994	-11.93		
		1997	-11.67		
VI (2001 - 2010)		2002			
	2 La Niña	2006		2007	
		2009		2008	

SOI = Southern Oscillation Index.
Source: Australian Bureau of Meteorology
(http:/www.bom.gov.au/climate/current/soihtm1.shtm)

4.3.1 **El Niño Impacts on Rainfall**

Indonesia has two seasons, influenced by the monsoon circulation: a dry season and a wet season. However, no general definition is accepted to determine the onset of the wet season every year (Yoshino et al., 2000). Smith et al. (1952) used the date by which 350 mm of monthly rainfall has accumulated to determine the first day of the wet season and interpolated this for the day of the month. Instead of the 350 mm as defined by Smith, Evan (1964) has used 200 mm. Thus, the wet season in Indonesia varies by region but in general starts around September/October and continues to March/April (Agency of Meteorology and Geophysics. 2000).

In order to assess the impact of El Niño on rainfall in Kupang, monthly rainfall data from 1971 to 2008 were collected from the Meteorological Bureau of Kupang. Up until now, there have been about 8 rainfall stations in Kupang. However, due to incomplete runs of data provided by the new stations built in recent years, this analysis will only rely on a few stations from which historical data were available. The two biggest El Niño events in the last 25 years were covered by this study, namely 1982/1983 and 1997/1998, to find out how El Niño had affected the rainfall behaviour in Kupang. This analysis is based on monthly rainfall data from 1971 to 2008. The rainfall in 1982/1983 and 1997/1998 is expressed as a percentage decrease compared to the average rainfall in 1971-2008. The dry season in Kupang is considered to continue between April and September and the wet season between October and March.

Table 4.10 shows that the rainfall decrease in Kupang was higher in El Niño 1997/1998 than in El Niño 1982/1983 and that this was observed at all rainfall stations. This shows that the effect of El Niño 1997/1998 on rainfall was greater than that of the 1982/1983 event. It also affected both seasons of the year; the rainfall decrease in 1997/1998 was greater for both the wet season (36%) and the dry season (27%), as compared with the 1987/1988 event.

Table 4.9 Seasonal Rainfall in 1982/1983 and 1997/1998 compared to average rainfall in 1971-2008 by station (mm)

Station	Average 1970 - 1997			1997/1998			1982/1983		
	Wet Season	Dry Season	All Seasons	Wet Season	Dry Season	All Seasons	Wet Station	Dry Season	All Seasons
Naibonat	1720	183	1903	1399	183	1582	1625	99	1724
Oekabiti	1460	165	1625	1047	120	1167	1152	128	1280
Camplong	1245	132	1376	385	32	417	738	114	852
Lelogama	2246	390	2636	1522	298	1820	1624	357	1981
Naikliu	1372	150	1522	765	99	864	890	141	1031
Lasiana	1497	119	1616	948	99	1047			
Average	1590	190	1780	1011	139	1150	1206	168	1374

Source: adapted from BMK Kupang, 2011

Table 4.10 Rainfall decrease in 1982/1983 and 1997/1998 compared to average rainfall in 1971-2008 by season and by station (%)

Station	1997/1998			1982/1983		
	Wet Season	Dry Season	All Seasons	Wet Station	Dry Season	All Seasons
Naibonat	-19	0	-17	-6	-46	-9
Oekabiti	-28	-27	-28	-21	-22	-21
Camplong	-69	-76	-72	-41	-13	-38
Lelogama	-32	-24	-28	-28	-9	-25
Naikliu	-44	-34	-39	-35	-6	-32
Lasiana	-37	-17	-27			0
Average	-36	-27	-35	-25	-19	-25

Source: Adapted from BMK Kupang, 2011

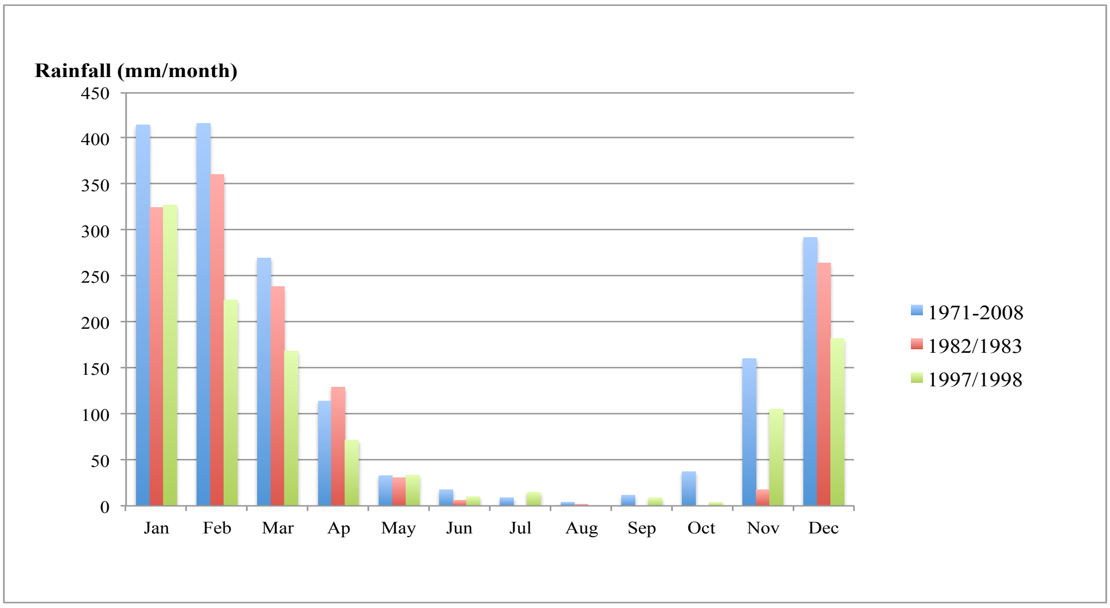


Figure 4.13 Monthly rainfall in 1982/1983 and 1997/1998 compared to average rainfall 1971-2008 in Kupang
Source: adapted from BMK Kupang, 2011

4.3.2 **Climate Variability and its Impacts on total Harvest Area**

Climate is one of the major determining factors of area harvested. During a period of ‘normal’ climate, any gap between the actual area harvested and the expected area harvested is mainly caused by non-climatic factors such as presence or absence of technological inputs. However, when the climate is ‘abnormal’, the gap becomes wider, either lower or higher, depending on the impacts induced by the climate anomaly on the harvested area. It may bring about positive or negative impacts.

In assessing how climate variability affects harvested area, this study will compare the actual harvested area with the expected area in order to find out whether climate abnormality has caused a loss or gain in harvested area. A simple method was proposed by the IPCC (2001) which uses a trend analysis of production. Another study by Gomez (1998) estimated the expected production based on a 7-year moving maximum production, while Yoshino et al. (2000) used a 4-year moving maximum production to estimate expected production. In this study, expected harvested area was based on a 3-year moving average to avoid other contributing factors, such as the impact of technological inputs. Table 4.11 shows that during the period 1980 to 2009, on average El Niño events led to a loss of food crop harvested area, while La Niña tended to increase the actual area harvested. As the previous section confirmed, El Niño events are usually accompanied by a rainfall decrease causing the actual harvested area to be lower than the expected area by about 4,500 ha or 12 per cent. The degree of area lost is higher in the dry season than in the wet season during El Niño events. These effects were confirmed by local communities during interviews and focus group discussions.

Table 4.11 Estimated loss of food crop area due to climatic variability in Kupang, 1980 - 2009

Year	SOI Value	Climatic situation	Harvest area during the wet season		Difference	
			Actual	Three year moving average	(ha)	(%)
1980	-4.32	N	31,722			
1981	-1.27	N	33,172	32,616.00	556	1.70%
1982	0.45	N	32,954	31,818.33	1,136	3.57%
1983	-20.24	EL	29,329	31,489.67	- 2,161	-6.86%
1984	0.03	N	32,186	31,570.33	616	1.95%
1985	1.10	N	33,196	31,853.33	1,343	4.22%
1986	0.41	N	30,178	30,650.00	- 472	-1.54%
1987	-11.13	EL	28,576	30,310.00	- 1,734	-5.72%
1988	-4.52	N	32,176	31,649.00	527	1.67%
1989	13.73	LA	34,195	32,826.33	1,369	4.17%
1990	-0.35	N	32,108	32,158.67	- 51	-0.16%
1991	-4.63	N	30,173	29,001.33	1,172	4.04%
1992	-12.73	EL	24,723	26,627.67	- 1,905	-7.15%
1993	-8.72	EL	24,987	24,862.67	124	0.50%
1994	-8.46	EL	24,878	25,419.00	- 541	-2.13%
1995	-9.61	EL	26,392	27,142.00	- 750	-2.76%
1996	3.45	N	30,156	28,000.00	2,156	7.70%
1997	-2.02	N	27,452	26,917.67	534	1.99%
1998	-14.28	EL	23,145	27,225.33	- 4,080	-14.99%
1999	10.51	LA	31,079	30,802.00	277	0.90%
2000	6.98	LA	38,182	36,580.33	1,602	4.38%
2001	5.99	LA	40,480	39,355.33	1,125	2.86%
2002	-2.81	N	39,404	37,770.00	1,634	4.33%
2003	-7.91	EL	33,426	41,987.67	- 8,562	-20.39%
2004	-1.34	N	53,133	37,110.00	16,023	43.18%
2005	-7.38	EL	24,771	38,739.67	-13,969	-36.06%
2006	2.77	N	38,315	33,304.00	5,011	15.05%
2007	-5.14	EL	36,826	45,177.67	- 8,352	-18.49%
2008	6.86	LA	60,392	47,685.67	12,706	26.65%
2009	7.90	LA	45,839			
Average	Normal Years				1,032	3%
	El Nino Years				- 4,575	-12%
	La Nina Years				4,200	10%

Source: adapted from BMK Kupang, 2011

The estimated loss of area due to El Niño is tending to increase. The affected area of loss ranged from 2.1 to 14.9 per cent for El Niño events occurring between1980 and 2000. However, for events that occurred between 2000 and 2009, the figures ranged from 18 to 36 per cent. The figures reveal that El Niño events have tended to magnify the impacts on food area losses, which leads to the problem of food insecurity. The IPCC (2001) offers two main factors that can explain why El Niño exacerbates the problem of food security: the increase of duration and magnitude of El Niño (1) induces rainfall reduction; and (2) decreases social capacity in anticipating or in reducing crop damage caused by water shortages induced by these events.

In contrast to El Niño which causes area losses, La Niña tends to increase the harvested food area. However, La Niña often brings about disasters caused by pests. As shown in Table 4.11, La Niña events from 1981 to 2009 caused an increase in cultivation area, compared to normal climate conditions. This is particularly true for the dry season, since La Niña rainfall reduces water problems, which usually occur in the dry season.

4.3.3 **Impacts on Harvested Area by Season and by Food Crop**

Looking at the total harvested area might not provide a clear picture of how climate variability has affected livelihood vulnerability since the impact of climate variability may vary by food crop and also by the period of cultivation. Even though a rainfall decrease associated with drought or water problems is the most common impact of El Niño and causes some decrease in food crop area, the harvested area of other food crops could otherwise increase for a number of reasons such as a crop's adaptability to withstand climate variability and the shifting cropping patterns applied by local farmers. For example, during El Niño events, farmers may shift from growing maize to growing cassava due to the fact that cassava is more tolerant of water stress. The same is true in the case of La Niña. Excessive rainfall may not always lead to an increase in harvested area since La Niña could induce pest attacks, which then cause the harvested area to decrease. Therefore, it is crucial to assess the likely impacts of climate variability by food crop and also by season.

In general, local farmers acknowledged that El Niño events have forced them to cultivate a smaller area than they could achieve during La Niña. They maintained that El Niño is more pronounced during the dry season than during the wet season when the cultivation area became even smaller simply due to water insufficiency. In contrast, a decline in food area is more likely to happen in the wet season during La Niña episodes.

Among the seven main food crops, dry land rice and soybean are the most sensitive to El Niño episodes occurring in the wet season, as reflected in a significant decline in the harvested area of these two food crops. On average, the decline in cultivation area for rice and soybean ranged from 25 to 40 per cent of the total landholding area per household during the wet season. Dry rice cultivation is intolerant of water stress because of its high water requirement, while high sensitivity to water stress is the main cause for soybean crop failure. Since the most common food crops cultivated by farmers in the wet season are rice and maize, these are the two main foods most affected by being harvested in the wet season, while maize, cassava and soybean are most affected in terms of harvest area when El Niño occurs in the dry season.

In contrast to the El Niño episodes that are associated with a decline in cultivation area, La Niña events tend to work the other way round, increasing harvested area. This is particularly true for dry season cultivation for which farmers are able to increase their harvested area for almost all food crops by 10 – 20 per cent. In the case of La Niña occurring during the wet season, farmers could increase their harvested area for wetland and dryland rice as well as maize by about 15 – 20 per cent, while the cultivation area for other food crops such as cassava, groundnut, sweet potato and soybean decreased by 10 – 25 per cent.

The increase in the area cultivated can be justified given that additional rainfall during the dry season can solve the problem of water deficiency and reduce crop failure accordingly. This is particular true for cultivating food crops on agricultural land or on farms that lack an irrigation network causing the water supply to be strongly dependent upon rainfall. In terms of La Niña during the wet season, the reason for the increased harvested area for wetland rice, dryland rice and maize is due to a shift in cropping management. When rainfall is higher than under normal climate conditions, more land is allocated to growing rice and maize rather than cassava due to their high profitability. Likewise, as the high rainfall may induce pest attacks, farmers opt to grow maize instead of soybean and groundnut due to the fact these two crops are very sensitive to pest depredation.

4.4 Encountering Climate Variability in 2010 and 2011

During my fieldwork from 2010 to 2011, the East Nusa Tenggara (NTT) province encountered a few issues of climate variability: prolonged drought in 2009/2010; moderate La Niña and floods in 2010/2011, and tropical cyclones in early 2011.

4.4.1 Prolonged Drought and Harvest Failure in 2010

On my arrival in the field in May 2010 I was overwhelmed by the headlines in the national and local newspapers which were filled with reports of harvest failure and food insecurity in East Nusa Tenggara Province. As reported by the *Jakarta Post* (national media) on 21/4/2010, twelve districts in the province had been hit by a severe food shortage due to drought and harvest failure; nine districts including Kupang district were reported to be most seriously affected by the drought, causing hundreds of people to face a critical food shortage. The head of NTT's Food Security Agency confirmed the food crisis by issuing a press release on 22/4/2010, pointing to the prolonged drought that had dried up rice fields in several regions. In addition, local media reported that in some regions, rice fields and crops had been heavily damaged due to grasshopper attacks, and called on local government bodies to assist farmers to combat these attacks. The speaker of NTT's local representative assembly (Ibrahim A Medah) held a press conference on 15 April 2010, urging the government to render speedy assistance to villages hit by drought and food shortages not only for the short term but also for the long term since the impact of the drought could last for years. In Kupang, the head of the Agriculture Service of Kupang district told the local media on 12/4/2012 that about 4,200 ha in 5 sub-districts were reported to be facing crop failure caused by prolonged drought and pest attacks (*Kupang Post* 14/4/2010).

The prolonged drought also diminished water supplies, causing farmers to halt planting. Some farmers in Naibonat, Kupang district and Oepura, Kupang municipality relied on container trucks or drilled wells to water their drying paddy fields. In Kupang municipality, drought caused water reservoirs across the city to become empty (*Kupang Post* 13/4/2010), reinforcing the persistent problem of water shortage in the region. By the end of 2010, a report issued by the Local Food Security Agency confirmed that the impact of severe and prolonged drought had reduced food crop output, causing harvest failure of 94,394 ha of crop area. About 1.2 million people or 328,000 households across 1,481 villages were affected by the drought; those suffering from food insecurity with hunger numbered 365,000, moderate hunger (332,000) and chronic or severe hunger (548,000).

Table 4.12 Total area of harvest failure in NTT, 2010

Food Crop	Area (Ha)
Paddy	25,205
Maize	61,171
Groundnut	5,492
Cassava	2,526
Total	94,394

Source: The Office of Food Security of NTT, 2010

Table 4.13 Food security condition NTT, 2010

Condition	Villages	Households	persons
Weak	400	74,774	365,007
Moderate	335	64,658	332,104
Chronic	746	189,058	548,368
Total	1,481	328,490	1,245,479

Source: The Office of Food Security of NTT, 2010

4.4.2 **2010/2011: Moderate La Niña, Floods and Tropical Cyclones**

In contrast to the previous year (with its prolonged drought), NTT was expected to experience a moderate La Niña in 2010/2011, with early onset of the rainy season and with rainfall above normal, according to a climate forecast issued by the Climatology Agency in Kupang. In normal years, the onset of the rainy season is expected in late November and early December. However, the 2010/2011 the rainy season was expected not just to come earlier but also to bring above normal rainfall. Most regions/districts were expected to begin the rainy season in late September 2010, while other regions including Kupang expected it in October and November (see Table 4.14).

Table 4.14 Forecast of the onset of 2010/2011 rainy season in NTT

No.	Region / District	Onset of rainy season	Rainfall level
1.	West Manggarai	Oct I – Oct III	AN
2.	North Manggarai	Sept III – Oct III	AN
3.	South Manggarai	Sept III – Oct II	AN
4.	Ngada	Oct III – Nov II	N
5.	Ende, Flores Timur	Nov II – Des I	N
6.	Adonara and Lembata	Nov I – Nov III	AN
7.	Alor	Nov I – Nov III	N
8.	Sumba Barat	Oct II – Nov II	N
9.	Sumba Timur	Nov I – Nov III	N
10.	Sabu Raijua	Nov II – Dec I	N
11.	Rote Ndao	Nov II – Dec I	N
12.	Kupang Kota and Municipality	Oct II – Nov I	AN
13.	TTS, TTU and Belu	Oct II – Nov II	AN
		I : dates (1-10) II: dates (11-20) III: dates (21 – end of month)	AN : Above Normal (> 115%) N : Normal (85% - 115%) BN : Below Normal (< 85%)

Source: BMK Lasiana, Kupang, adapted from Pos Kupang (August 2010)

Although this climate forecast was published in the local Kupang newspaper in early August 2010, it appears that the information was not widely circulated and did not reach most farmers. Most farmers did not anticipate this forecast's early onset of the rainy season and therefore did not make adjustments to their field preparations and planting.

In fact, such an early onset of the rainy season caused most farmers in Kupang district to miss the opportunity to plant. From year to year, the farmers prepare their land using slash-and-burn methods, starting with clearing vegetation including weeds from the fields in October, leaving them for about one month to dry out; they follow up with burning the fields in November. Planting is usually carried out in early December.

However, the unexpectedly early onset of the 2010/2011 rainy season disrupted the traditional cultivation activities. Most farmers in Amfoang, for example, failed to plant paddy and maize due to the intense rainfall in October 2010, as acknowledged by the head of Oh'Aem Dua Village (24/11/2010). In Oh'Aem Dua village, only 5 ha out of the total area of 196 ha could be planted with paddy and maize, while the remaining area was used to grow cassava and sweet potatoes. Farmers in other sub-district such as in Takari also reported the same problem caused by the rainfall variability: intense rainfall for quite a while, followed by a dry spell for a week.

Such conditions made it hard for farmers to carry out their usual activities including preparing the land and planting. Those farmers with limited seed stock were most affected; planting at the wrong time can lead to seed stock depletion, while the seed provided by the local government cannot be relied on to arrive in time.

Failure to plant was not the only impact of the unusual 2010/2011 rainfall pattern. Harvest failure was another. Intense rainfall during the rainy season caused fields to become waterlogged, damaging crops including maize, paddy and groundnut. For example, farmers in Oelomin village of Nekamese Sub-district reported that their maize crop had dried up due to excessive water logging. As Orpa Loinati put it: 'too much rain damaged our crop. Maize stalks and leaves dried up due to excessive water in the field. We also failed to expand our harvest area. Even though the fields had been cleared, weeds and other vegetation were still too wet to burn' (23 February 2011).

Another case was from Boneana hamlet, Oematnunu Village of West Kupang sub-district where 100 households suffered harvest failure due to the excessive rainfall. These farmers argued that the 2010/2011 harvests of their two main crops, maize and groundnut, were the worst for the last ten years and even worse than those of the 2004/2005 rainy season under similar climate conditions. Because these two crops, maize as the staple food and groundnut as a cash crop, play such important roles in securing household food security, farmers were certainly at high risk of suffering from food shortage in 2011. For the whole rainy season of 2010/2011, a 2,526 ha crop area in Kupang district was reported to have been affected by the excessive rainfall and pests attacks (Table 4.15). Maize was the most affected crop due to waterlogging (1,265 ha), while there was no significant difference between wet and dry land paddy in terms of area affected.

Table 4.15 Harvest failure in Kupang, 2011

Food Crop	Area (Ha)
Wet Paddy	628
Dryland Paddy	578
Maize	1,265
Cassava	55
Total	2,526

Source: BPS Kupang, 2012

Excessive rainfall was not the only extreme weather event in 2011. As one would expect, floods and landslides go hand in hand, triggered by the excessive rainfall. Tropical cyclones also hit both regions from January to March 2011, leaving hundreds of households homeless (see Table 4.16).

Table 4.16 Extreme weather events in Kupang, 2011

Type	Geographical Area affected	Dates	Costs
Landslide	**Kupang District**		
	Nunsaen Village of Fatuleu	January 2011	crop area affected
	Kupang Municipality		
	Oepura	January 2011	1 house
	Fontein	January 2011	2 houses
	Manutapen	January 2011	3 houses
Floods	**Kupang District**		
	Oesao Village, kec. Kupang Timur	April 2011	195 houses
	Naibonat dan Pukdale of Kupang Timur		300 ha of paddy field
	Pukdale Village of Kupang Timur		
Tropycal Cyclones	**Kupang District**		
	Merdeka village, Kupang Timur	January 2011	11 houses
	Tablolong of Kupang Barat	March 2011	7 Houses
	Kupang Municipality		
	Nunbaun Dela	January 2011	1 houses
	Liliba	January 2011	21 Houses
	Maulafa	January 2011	40 Houses
	Oebufu	January 2011	28 Houses
	Sikumana	January 2011	4 Houses
	Oepura	January 2011	22 Houses
	Penfui	January 2011	4 Houses
	Nunbaun Sabu	January 2011	4 Houses
	Nefonaek	February 2011	3 houses
			1 government office
	Pasir Panjang	February 2011	11 houses

Source: Various (Local Media, 2011)

4.5 Climate Variability and Human Health

Climate variability can have critical health implications. As a result of increased temperatures and changes in rainfall patterns, the incidence of climate-related diseases is generally expected to rise and pose a serious threat to human health (World Health Organization, 2003). Studies of the effects of temperature on the incidence of malaria and dengue fever have found that increased temperatures shorten the viral incubation period and the breeding cycle of mosquitoes, and increase the frequency of mosquito feeding, allowing for more efficient transmission of the parasites from mosquitos to humans (Gething et al. 2010; Parham, 2010). In modelling the effects of weather and climate change on malaria transmission, Parham identified an optimum temperature of around 32-33°C at which endemic transmission and the rate of malaria spread in disease-free regions increased.

Malaria is recognised as one of the major public health problems in East Nusa Tenggara province with a prevalence of 150 cases reported per 1000 people per year (MOH, 2008). Health officials at the local level are convinced that malaria has increased dramatically in the regions. At district level, malaria was ranked first among the 10 major public health problems and is responsible for the majority of child mortality especially in Kupang district (Health Department of Kupang district, 2010).

With regard to water-borne diseases, climate variability may have an impact on the replication rate of the bacterial and protozoan pathogens that cause diarrhoea. Climate change-induced extreme weather events such as flooding have a particularly serious effect on the incidence of waterborne diseases including diarrhoea and cholera through water quality decline associated with erosion leading to an increased volume of suspended sediments. Given the generally poor sanitation in the regions, the limited access to safe water and poor housing conditions, poor households are most vulnerable and thus, at high risk of contracting water-borne diseases. In general, an outbreak of diarrhoea occurs at the change of season (dry/rainy), but more specifically at the end of the dry season or early rainy season. The prevalence of diarrhoea among children under five years old is also high (Health Department of Kupang district, 2010).

4.6 Climate Variability and Food Security

Food security refers to a situation "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary and food preferences for an active and healthy life" (FAO, 2001, p. 38). In this view, the process of food security can be assessed from three dimensions: food availability, food access and food utilization (FAO, 2001, p. 38-40).

Food availability refers to the amount, quality and type of food a person or community has at its disposal. Such food can be supplied from local or household production, other domestic output, the efficiency and vulnerability of distribution channels and the ability of individuals or households to procure food through commercial imports, exchange, sharing and so forth. *Food access* is defined as the ability of individuals or households to procure the foods that are available, including physical and logistic access to the locations where foods can be procured, affordability of foods, as well as how food allocation mechanisms such as subsidies, trade agreements and other government policies work. *Food utilization* refers to the ability of persons to derive all potential and needed benefits from the foods they do have access to. Utilization includes obvious factors such as food safety and nutritional quality (FAO, 2001, p.38-40).

A person or household of a community is considered to be food-secure if the household has a sufficient quantity of nutritious food acquired through their own production (availability) and/or by purchasing food (access), and being healthy enough to absorb the nutrients and energy from the food consumed. Food insecurity can occur at certain times of the year (cyclical) such as between planting and harvest. Food shortage is often transitory due to a specific shock or a sudden rise in prices. However, food insecurity is considered chronic when it is persistent and long term (FAO, 2001).

4.6.1 **Food Availability**

More than half – possibly three-quarters – of the population of NTT is dependent on the agricultural sector as their main source of livelihood. Food availability is derived mainly from household production at the regional level. As subsistence farmers, they consume rice, maize, cassava and sweet potatoes; these are the main staples they obtain from their own harvests.

However, the level of food production is always disappointing from year to year. This is particularly true in the case of paddy production at household and regional level, considering that rice is the most favoured staple, compared to maize, cassava and sweet potatoes. As shown in Table 4.17, the rate of rice and maize production at provincial level has fluctuated in recent years, reaching its peak in 2009 at 600,000 tonnes and then declining in the following years. At district level, the pattern of food production in Kupang district does not differ much from that experienced at the provincial level. As the population continues to increase from year to year, however, it is plausible to regard (or rather hope) that the performance of food production can follow the same pattern as population growth especially in the production of the subsistence farmers in the regions.

Table 4.17 Staple food production in NTT, 2005 - 2011

REGION	PADDY (Tonnes)					
	2005	2006	2008	2009	2010	2011
Kupang district	16,659	36,458	42,358	37,493	35,540	42,945
Kupang city	142	652	636	986	849	1,100
East Nusa Tenggara	461,008	511,910	577,896	607,358	555,493	591,379
REGION	**MAIZE (Tonnes)**					
	2005	2006	2008	2009	2010	2011
Kupang district	35,662	44,744	64,979	62,820	-	53,719
Kupang city	2,071	1,265	1,104	1,229	-	746
East Nusa Tenggara	552,439	582,964	673,002	638,899	-	524,638
REGION	**CASSAVA (Tonnes)**					
	2005	2006	2008	2009	2010	2011
Kupang district	35,025	47,626	54,404	62,897	-	79,441
Kupang city	1,778	2,099	2,103	2,464	-	1,122
East Nusa Tenggara	891,783	938,010	928,974	913,053	--	962,129
REGION	**SWEET POTATO (Tonnes)**					
	2005	2006	2008	2009	2010	2011
Kupang district	2,155	2,994	7,939	1,596	-	8,884
Kupang city	269	70	72	122	-	125
East Nusa Tenggara	99,748	111,006	107,316	103,635	--	129,728

Source: BPS NTT, 2006 - 2012

Reliability of Agricultural Data

My confidence in the official agricultural data available in the regions is not high. It is very difficult to obtain reliable or precise estimations of local production such as crop yields and acreages, simply because these data vary greatly from one sub-district to another, from one village to another, and of course from plot to plot, even from farmer to farmer. This problem stems from a number of factors. The spatial variability in rainfall patterns is high and this may contribute to the inaccuracy or unreliability of data. Another possible explanation is related to a methodological issue. The local agricultural extension office does not collect precise production data, but relies on local people to provide them with estimates. Theoretically, this measurement involves calculating the yield of 0.2 hectare, taken from the centre of that hectare. This is not common practice, however. According to key informants (local farmers), such measurements are usually taken only on agricultural demonstration plots or in the course of production competitions. Furthermore, the measurements are made from the most accessible sections of paddy or rice fields, usually along the edges, rather than in the centre.

Still related to methodological issues, poor sampling may also involve including limited numbers of plots per field due to the limited number of official staff. Moving beyond the methodological issues, the publication of local agricultural data is not entirely immune from social, political and bureaucratic judgements. Taking this into account, during a period of local elections (for mayor or governor), one could expect an increase in the official figures for agricultural production even in dry years.

Given all of these issues, some agricultural data may lead to contradictions or disputes. The great fluctuation in sweet potato production in the case of Kupang district as presented Table 4.17 is an example of such problems in deriving a reliable regional estimation for agricultural production data.

4.6.2 **Food Accessibility**

Failure of food production does not necessarily lead to food insecurity since households might still have access to food through market transactions and social exchanges or inter-household transfers, apart from food aid. In this regard, the household expenditure share of food is often claimed as a proxy for food accessibility based on the assumption that the higher the food expenditure share, the lower the household access to food (Rusastra, Sumaryanto, & Simatupang, 2005). A high proportion of expenditure spent on food items simply means that households spend less on non-food commodities, and this points to the poor state of household wealth.

Based on the SUSENAS data, the proportion of households with lower incomes in Kupang district is higher than in Kupang city, indicating that the source of livelihood for rural populations is limited, and is mainly dependent on the agricultural sector, while city dwellers are engaged more in other sub-sectors such as services and industries (BPS 2011). This evidence suggests that people living in rural areas, those mainly employed in agriculture, and belonging to a low-income level, tend to have lower food accessibility compared to those who reside in urban areas with their main livelihood activities derived from the formal sector (services and industry).

The household expenditure structure by income group also confirms that lower income groups have higher food expenditure shares, whether rural or urban populations. More than 50 per cent of the expenditure by households in these groups was on food items. Further analysis revealed that the proportion of income allocated for food and animal-source food was 73% and 5%, respectively. Thus, while the proportion of income spent on food was very high, only a very small proportion was spent on animal-source foods. This finding confirms that the households do not have adequate access to food, in terms of quantity or quality.

Table 4.18 Share of monthly individual expenditure on food by group of income, 2011

Region	<100.000	100,000 - 149,999	150,000 - 199,999	200,000 - 299,999	300,000 - 499,999	500,000 - 749,999	750,000 - 999,999	1,000,000	Average
1	2	3	4	5	6	7	8	9	10
Kupang district	66.10	69.10	71.22	71.31	63.10	52.42	48.66	37.54	59.93
Kupang city	-	61.14	58.05	56.71	51.48	46.91	37.21	44.80	44.54
N T T	**76.37**	**73.05**	**72.57**	**71.39**	**63.12**	**53.97**	**48.32**	**35.69**	**61.81**

Source: Susenas BPS, 2011

Table 4.19 Share of monthly individual expenditure on non-food by group of income, 2011

Region	<100.000	100,000 - 149,999	150,000 - 199,999	200,000 - 299,999	300,000 - 499,999	500,000 - 749,999	750,000 - 999,999	1,000,000	Average
1	2	3	4	5	6	7	8	9	10
Kupang district	33.90	30.90	28.78	28.69	36.90	47.58	51.34	62.46	40.07
Kupang city	-	38.86	41.95	43.29	48.52	53.09	62.79	55.20	42.96
N T T	**23.63**	**26.95**	**27.43**	**28.61**	**37.88**	**46.03**	**51.68**	**64.31**	**38.32**

Source: Susenas, BPS, 2011

Comparing Kupang city to Kupang district, share of food expenditure is found to be relatively higher among the rural population (Kupang district). As shown by Table 4.18, on average the share of food expenditure in Kupang district in 2011 was almost 60 per cent in comparison to 44 per cent in Kupang city. These figures indicate that the rural population in Kupang district has relatively lower levels of wealth and food accessibility.

Access to food is also inevitably associated with access to basic infrastructure including roads and markets; this affects household access to food, causing the price of food items to vary from one place to another. The National Socioeconomic Survey (SUSENAS) 2011 reveals that the number of households without access to roads is 35% in Kupang district (BPS 2011). Moreover, road conditions in many villages in Kupang district remain very poor, and the mountainous topography makes access very difficult in the rainy season. Public transport is also still rare and relatively expensive. Markets present another issue, especially in the district of Kupang. The only place where people can shop and sell their products is the weekly market, which is located in the sub-district capital. People have to walk for hours to get to this market, preventing them from carrying many products to be sold or bought. This poor basic infrastructure is undeniably the main driver of food prices that are two or three times higher for the households in remote areas of Kupang district than in Kupang city.

4.6.3 **Food Utilisation**

Food utilization refers to the ability of a household or/and an individual to fully utilise the food they eat in order to absorb the necessary energy and nutrients. It can be assessed on the basis of several indicators such as food consumption patterns, access to health facilities and safe drinking water, nutritional status and health outcomes.

As no data are available at the moment for district level, food consumption patterns at provincial level will be used instead. Based on SUSENAS (2011), the amount of energy consumed in 2011 by people in East Nusa Tenggara province was still slightly lower than the national recommended daily allowance of 2,000 Kcal/capita/day. Moreover, there was a slight decline of 0.42 per cent, down from 1,960.28 Kcal/person/day in 2010 to 1,952.14 Kcal in 2011. Meanwhile, protein consumption in 2011 reached 52.30 grams/capita/day. Even though protein intake is just above the national recommended allowance of 52 grams, it also follows the same pattern as calorie intake. In 2011 it went down by 3.15 per cent from 54 grams in 2010. While protein intake has been at an adequate level, the energy consumption level has not yet attained such heights. Furthermore, based on the household expenditure patterns, protein consumption was primarily derived from rice and maize consumption, while animal sourced protein intake remained very low.

Access to health care is another important issue in food utilization. This is particularly true in the case of Kupang district. The nearest health facilities for most people are community health centres, most of which are located in the sub-district capitals. Reaching such facilities takes, on average, more than 30 minutes. With no public transport, hiring *ojek* (motor bikes that serve as taxis) is common and costs about IDR 5,000 per km distance. Household income level is, then, the main determinant of health care access; the higher the income level, the closer the facilities and the shorter the travel time required. Moreover, not only the distance but also the availability of health attendants makes access to health care somewhat problematic. In Kupang district, most health centres are often left unattended. Therefore, access to health care for the poorest households is not only time consuming, but is quite costly too.

Another important indicator of food utilization is access to safe water and sanitation. Based on the National Socioeconomic Survey (SUSENAS) (2011), about 21% of households in Kupang municipality were without access to safe drinking water. Almost 40% of households in Kupang municipality have access to piped water. In contrast, as many as 71% of households in Kupang district suffered from unsafe and precarious drinking water in 2011. The most common source of drinking water for households in Kupang Municipality is public wells, which are shared by 15 – 20 households; 52% of households use unprotected wells and 8.3% protected wells (BPS 2011). In some villages, public wells and clean piped water are made easily available in the centre of the Village through government programs such as the National Programme for Community Empowerment (PNPM – *Program Nasional Pemberdayaan Masyarakat*). However, only a few households benefit from piped water delivered directly to the house as access to this involves installation costs and a monthly fee. Fetching water from public wells or from the rivers is commonly practised in Kupang district, usually done by women and girls during the early morning and late afternoon. While during the rainy season most households can obtain water easily, that is not the case in the dry season when some wells run dry. Thus, households have to fetch water from different sources, usually further away from their homes.

People's awareness of the need to make water safe to drink is quite high in Kupang municipality. Almost all households drink boiled water. City dwellers are also aware of the need to wash hands before meals either with or without using soap. However, other health practices remain poor in the city such as waste disposal. The backyard is the most common place to dispose of household waste. Rural dwellers in Kupang district have poor awareness of the need to use boiled water for drinking. Fresh water is preferred by most households for drinking especially when people are working on their farms. Boiled water is mainly used for tea or coffee. Washing hands before meals is also very rare, mainly because they are hungry and are in a rush to eat.

4.7 Conclusion: Vulnerability to Climate Variability and Extreme Events

This chapter confirms that the research regions are highly vulnerable to climate variability and extreme events. The most influential climate variation in the regions is seasonal and inter-annual erratic rainfall, making it very difficult to predict the date of onset and the duration of the rainy period. Erratic rainfall is also associated with false rains in which long dry spells occur right after the onset of the rainy season. In some cases, the dry spells last up to three weeks consecutively in almost every month during the rainy season. Another important feature of the region's rainfall behaviour is spatial variability or what Ormeling (1956) label as 'micro climate diversity'. The regions are also subjected to extreme climate events such as El Niño and La Niña that are tending to increase in occurrence and magnitude as well as duration.

Such climate variability and extreme events often result in recurrent droughts and floods and these constitute a serious hazard to the subsistence agriculture on which the cultivators (agricultural households) depend. Seasonal food shortage or 'ordinary hunger' (Fox, 1977, p. 21; 2000, p. 182) is unavoidable for most subsistence farmers every year. This is also the case for prolonged dry spells and drought risks where crops are destroyed, leading to harvest failure and the regions then suffer from extra-ordinary hunger. In short, the agriculture sector has been greatly hampered by the high degree of climate variability and extreme events together with other biophysical factors such as soil infertility and the low level of technology. These impacts on people's livelihoods in the research areas are not hypothetical, but are starkly evident and not limited to loss of crops and/or harvest failure and food shortage.

However, bearing in mind that these climate-related hazards do not cause disasters (see section on vulnerability in Chapter 2: Theoretical and conceptual framework). They rather act as trigger events; they only cause disasters when they hit vulnerable people. It is therefore important to study how affected individuals and households anticipate, prepare for and respond to the climatic hazards or risks. The following two chapters (Chapter 5 and Chapter 6) will address these related issues. Chapter 5 will examine how local community groups and individual households cope with unreliable rainfall, inherently poor soil quality and droughts, while Chapter 6 will analyse the various livelihood diversification strategies adopted across wealth groups, ethnic groups and agro-ecological settings including the rural-urban dichotomy.

Chapter 5 Household Responses to Climate Variability and Change: Views from the Vulnerable

5.1 Introduction

The research regions which are the focus of this study are prone to a variety of risks arising from unfavourable climate conditions, inherently poor soil, and extreme weather events such as El Niño and La Niña. This chapter will investigate first, how household and community groups have coped with their vulnerability; and second, what adaptive strategies have been employed to mitigate their exposure to the climate-related risks.

This chapter consists of two main parts. In the first part I discuss adaptive strategies and actions adopted at household and community levels to address the poor soil conditions, and to mitigate crop failures and food shortages in dealing with the erratic precipitation and unreliable rainfall patterns. The second part will examine the coping mechanisms adopted by households and community groups in times of drought.

5.2 Soil and Water Conservation

This section will discuss the coping and adaptive strategies that have been employed by subsistence farmers in dealing with declining soil fertility on inherently barren land. Three main issues will be discussed here: (1) how local farmers asses the decline in their soil's fertility; (2) local concepts of soil classification that help them make critical decisions on farming practices; and (3) soil conservation and fertility management strategies that have been implemented.

5.2.1 Farmers' Knowledge about Soil Fertility

Declining soil fertility is one of the major constraints on crop production that smallholder subsistence farmers in the research regions of West Timor have to deal with from year to year. My discussions with local farmers whom I met during my field visits gave me the strong impression that they perceived soil fertility as a multi-faceted issue that goes beyond perceived nutrient status. Farmers assess soil fertility based on the soil's potential to produce crops. But they believe that a particular unit of land can become less fertile or will lose its nutrients if it is cultivated continuously for a certain period of time without fallowing. The crop performance, in their views, is not entirely due to the nutrient status of the soils. Other factors such as topographic position, the soils' depth and water holding capacity are included as determining factors for successful crop production. They believe that the soils at the valley bottoms, the lowest part of the toposequence, generally have a high water holding capacity, while the soils on the upper portions of a toposequence are usually shallow and, thus, have low water holding capacity.

Having said that crop performance is the main indicator of soil fertility, the loss of soil fertility it is not only confirmed by reduced crop yield. During focus group discussions, farmers living in Amabi Oefeto, Takari and Fatuleu Barat sub-districts viewed crops wilting at the conclusion of the rainy season as another easily observable indicator of declining soil fertility. A crop's performance is closely associated with the topography, water holding capacity and other physical characteristics of the soil such as depth and texture. Rocky outcrops are mainly found in areas with high levels of erosion and shallow, infertile soils. They consider that crops wilting at the end of the rainy season shows that the area has poor water holding capacity. All in all, fertile soils, according to local farmers, are dark in colour, consistently produce high crop yields, have high water retention capacity, are easy to work and produce crops and plants with large green leaves. In contrast, infertile soils are difficult to work, give low yield, are light coloured, and have low moisture holding capacity (Table 5.1).

Table 5.1. Farmers' indicators for assessing soil fertility

Indicators	Fertile soils	Infertile Soils
Crop Performance		
Crop growth rate	Fast/high growth rate	Stunted and slow plant growth
Crop yield	Relatively consistent high yields	Low yields
Colour of leaves growing crops	Large green leaves	Small/stunted yellowish leaves
Soil characteristics		
Soil colour	Dark colour	White/pale/light
Moisture holding capacity	High	Low
Soil workability	Easy to work	Difficult to work
Stoniness of soil	Few stones and pebbles present	Numerous stones and pebbles
Biological characteristics		
Presence of soil macro-fauna	Earthworms (*cacing tanah*), beetles (*kumbang*)	Few earthworms and beetles
Presence of indicator weeds	*Chromolaena odorata* with large green leaves	Grassy weeds
Topographical factors		
Position on slope	Valley bottom, lower middle slope	Upper / steep slopes

Source: FGD and field visits, 2010/2011

5.2.2 **Local Concepts of Soil Classification**

Subsistence farmers in the regions studied have their own concepts of soil classification, which are mainly derived from their past experience of the potential and constraints of their soils. These local concepts serve as a guide for the farmers on how to manage their soil for cropping. Regardless of cultural/ethnic background, three different soil types are commonly distinguished by the farmers in the regions, mainly on the basis of *soil colour and texture*. The three most common soil types are black clayey soil /dark soils (locally known as *dae nggeok / nain metan)*, reddish soils / medium-texture soils (*dae mea / nain me)* and light coloured or textured soils (*dae fulak /nain muti)*.

The local concepts of soil classification are based on recognisable and easily identifiable soil and field characteristics. In addition to colour and texture, other criteria for classification include yield, the topographic position of the field, water holding capacity and the presence of stones. Farmers cited *soil colour and texture* as an important criterion in soil classification. Soil colour provides qualitative information about soil organic matter content and the soil's hidden parent material. The darker the soils, the more organic matter they contain and the more fertile they are. The reverse is true: light-coloured soils contain less organic matter and are, thus, less fertile. In addition to colour, farmers also pay attention to the *physical aspects* of soil fertility. They use the properties of feel and touch of wet and dry soils as a means of identifying the soil texture and to assess their water holding capacity. In other words, soil water holding capacity, which is closely associated with soil organic matter content, determines the soil texture. Soil rich in organic matter has a correspondingly high water holding capacity. *Yield* is another most important factor to the farmers, although they are still aware that *topographic position* is also closely related to soil productivity. Other physical characteristics are considered equally important and are closely related to *soil texture* such as soil compaction, structure, cracking patterns, stoniness, drainage and the ability to retain moisture (Table 5.2).

Table 5.2. Main characteristics of local soil types in research regions

Characteristics	Soil Type		
	Reddish Soil	**Light coloured soil**	**Black clay / valley soil**
Soil name (FAO Classification)	Luvisols	Cambisols	Vertisols
Organic matter content	relatively high	extremely low	high
Texture	medium	light	heavy
Depth	deep	shallow	variable
Compaction	moderate	low	high
Colour	red	white	black
Cracking	slight	slight	severe
Drainage	well-drained	well-drained	poorly drained
Moisture Retention	low	low	high
Response to fertiliser	moderate	low	moderate

Source: FGD and field visits, 2010/2011

Most farmers argue that black-clayey soils are the most fertile soils compared to other soil types. These soils are believed to have a high level of nutrients and are, thus, perceived as suitable for most staple crops such as paddy and maize. However, the black soils are prone to waterlogging when wet and cracking when dry. They have low erodibility and poor drainage. Farmers characterized the reddish soils as poor to moderate in terms of productivity and fertility. Therefore, application of manure or chemical fertilizers is necessary for this soil type in order to obtain a good yield. Compared to black soils, reddish soils have more ease of workability.

Figure 5.1 Black Clay Soil in Research Sites

Source: Author's field survey, 2011

5.2.3 **Local Soil Knowledge and its Implication for Farming Practices**

Local farmers who possess adequate knowledge of soil classification are able to adjust their farming practices in terms of crop choices, soil management and seedbed preparation accordingly.

With respect to crop choices, black soils are suitable for the cultivation of most kinds of food and cash crops such as paddy, maize, groundnuts and cassava. While paddy is acknowledged as the most suitable for this soil, groundnut is mostly avoided due to the waterlogging problem of this type of soil. Given that problem, farmers highlight that such soils require the preparation of seedbeds as early as possible in the rainy season. The soils are prone to flooding and/or waterlogging which makes them hard to work and may cause crop destruction. Therefore, local farmers described the black soil as the 'best soil' under conditions of sufficient rainfall during the main rainy season. The black soils require moderate levels of precipitation for viable and successful crop production for cultivation. In the case of erratic rains, the black soils are very risky.

Excess precipitation causes the soil to become waterlogged and poses difficulties for land preparation.

The relationship between topographic position and soil characteristics also has important implications for land suitability and management practices by local farmers. With this knowledge, farmers grow their crops according to a soil location hierarchy in the landscape. In general, fast growing and drought resistant crops are planted in higher areas or steep topography areas on thinner and relatively less fertile soils (*tanah merah* 'reddish soil'or *tanah putih 'light coloured soil'*). Soils located in lower topographic situations are the most intensively cultivated and are the best for staple foods which make a major contribution to the subsistence agriculture.

5.2.4 **Soil Conservation and Fertility Management Practices**

Subsistence farmers in Kupang cope with the loss of soil fertility by implementing a variety of soil conservation and fertility practices. The most common practices and the constraints on their implementation are identified in Table 5.3.

Table 5.3. Soil fertility practices and their main constraints

Soil fertility practice	Constraints
Fallowing	Shortage of land
Application of crop residues	Use of residues for fodder and fuel
Manuring	Land fragmentation and use of manure as fuel
Mineral Fertilizers	Lack of Purchasing Power
Soil and Stone Bunds	Shortage of land
Crop rotation and Inter-cropping	-

Source: FGD and field visits, 2010/2011

5.2.4.1 Fallowing

One of the traditional practices used for restoring soil productivity is through allowing land to lie fallow (*lalunuk* – Rotenese). Most farmers believe that leaving cropland uncultivated for a year or two is important for both recovering soil fertility and minimizing soil loss. A decline in yield is believed to occur when the same plot of land is cultivated continuously, every year. Even on irrigated land, production will decline when the farmland is continuously cultivated with two to three crops a year without any fallow period, as cited by farmers in Poto and Raknamo. Most of the older farmers explained that fallowing used to be the main way of improving soil fertility.

The length of a fallow period varies according to the type of soil and the size of the land holding. Black clayey soils are commonly left fallow for one or two years, while reddish and light-coloured soils require longer fallow periods than black clayey soils. However, local farmers acknowledged a significant shortening of fallow periods in recent years. Shortage of land has caused the subsistence farmers to abandon long-term fallowing as their land holdings have become too small. Nevertheless, fallowing still remains popular in Fatuleu, Amabi Oefeto and Amfoang. This method, however, is becoming lesser popular in more densely populated areas especially in Fatukoa and Bello of Kupang city.

5.2.4.2 Mulching / Crop Residues

Another traditional practice that is still followed is leaving crop residues on the farmland after harvest. The paddy stover, maize stalks, the leaves and roots of cowpea (*kacang polong/kacang nasi*) are deliberately left on the field to decompose in the soil. Residues of groundnut, soya bean and watermelon are also left in the field and incorporated in the soil. These crop residues are left dry on the field after harvest. Some farmers may burn these residues later on in order to produce ash, which farmers consider to be fertiliser.

Farmers cited various reasons for continuing this practice. They believe they help in conserving the soil, controlling water runoff, increasing soil fertility and also protecting soil from erosion. In fact, the use of mulching for soil conservation is suitable to the climate condition of the region. As the soils of the region frequently suffer from wind and water erosion (Ormeling, 1956), mulching not only reduces wind speed on the soil surface and slows down the process of saltation during the dry season, but also serves as a barrier to the effects of heavy rain during the rainy season, reducing rainfall energy before it reaches the soil surface. Thus, mulching reduces water erosion by slowing surface runoff, slowing down its scouring effect and giving more time for water infiltration (Brown et al. 1988). Under the climate conditions in regions with high temperatures, mulching can reduce the process of evaporation and may retain moisture in the soil for cultivation.

However, due to other competitive uses of crop residues, this traditional practice is no longer as popular as before. Some farmers are forced to use crop residues as fodder for cattle as a result of the shortage of animal feed. Sometimes after harvest, livestock, especially cattle, buffalos, pigs and goats / sheep, are allowed to graze in the maize and sorghum fields where much of the stover is consumed. Unless the animals spend nights in the fields to fertilize the soil with their dung, this practice can be argued as a net nutrient loss in regard to soil conservation. Thus, this off-plot usage compromises the use of crop residues for soil conservation. In general, mulching is still practised in banana growing and horticultural areas such as in Amarasi, Amfoang and Kupang Tengah.

5.2.4.3 Manuring

The application of manure, mostly animal dung and urine, is common, and farmers view such applications as the best form of organic fertiliser to maintain and improve soil fertility. The application of animal manure is preferred by the subsistence farmers in the research regions perhaps due to their weak purchasing power and lack of means to afford inorganic fertiliser. However, only a limited amount of manure is available for fields for two main reasons: the limited number of livestock owned by farmers and the shortage of labour. Poor households have few livestock. Not surprisingly, the supply of manure is accordingly limited in comparison to farmers' demand. The shortage of labour also prevents the household members from collecting manure in the forest or around water ponds where animals feed and drink. The division of labour within households also contributes to the limited amount of manure collected. Men are committed to off - farm income generating activities, while women are mostly involved in domestic tasks such as collecting firewood and fetching water. Some poorer households use dung as fuel, contributing to the limited application of manure to fields. In other cases, some farmers just rely on the available manure in the fields when the animals feed on crop residues after harvest.

While the practice of using manure has declined in food cropping areas, it is still popular for growing horticultural crops. Usually, farmers apply manure in the seedbed before horticultural seeds are sown. The application of manure in such cultivation has not entirely replaced the use of inorganic fertiliser. However, as acknowledged by most farmers, the use of inorganic fertiliser can be reduced by using animal manure, which helps farmers to reduce their production costs.

Some farmers benefit from the presence of animals on their farmland. When range animals especially cattle are herded together to paddle the fields, they may deposit a considerable proportion of their own manure into the rice field they are trampling. In areas such as Amarasi, the practice of tethering cattle within a garden also introduces important organic matter into the soil. A considerable number of hectares of extensively grazed rangeland would be required to supply sufficient manure for one hectare of crop production. By reducing the number of free roaming cattle and increasing the number of tethered or fenced animals, the resultant increase in available manure could be effective in maintaining the soil organic matter and soil fertility of garden plots.

5.2.4.4 Mineral fertilisers

The use of chemical fertiliser is most popular among paddy farmers, while it is used in a very limited fashion for growing maize by farmers in the two regions. The majority of farmers I met said that they never use fertilizer or insecticide at all for maize. Other farmers acknowledged the importance of using fertilizer; however, they are not sure that they are able to afford to buy fertilizer every year. The lack of use of fertiliser appears to be due to two reasons; farmers' weak purchasing power is one important reason, while inherently poor soil moisture is another crucial factor. Instead of buying fertilizer, farmers prefer to spend their money on labour hire or tractor rental when they have surplus cash for input expenditure. In addition, some farmers argued that poor soil moisture content makes it unprofitable to use chemical fertilisers. For example, they claim that when rainfall is low, the application of urea could cause the soil to become even hotter, and this could eventually burn the crop.

5.2.4.5 Soil and Stone Bunds

Farmers also build embankments or ridges along the contour of slopes. Depending on the field's topography, bunds made of soil or mud are constructed on moderately sloping areas for erosion control, while stone terraces are constructed mainly on steep, eroded bare slopes. Farmers consider stone terraces as an effective measure for erosion control especially in steep landscapes.

5.2.4.6 Cropping Systems (Crop Rotation and Inter-cropping)

Crop rotation is one emerging soil fertility practice adopted in recent years by some farmers. Given the constraints on land availability, fallowing is no longer possible in most villages in the regions. Instead, crop rotation is adopted in order to improve soil productivity. Various considerations may affect local farmers' decisions on which crops to grow in rotation. However, personal preference and economic considerations, especially the price of the crop, turn out to be the dominant criteria rather than other issues such as the adaptability of the crop to the potential soil and the rainfall patterns.

The major crop rotations in areas where local farmers carry out such practices are staple crops followed by cash or fast growing crops. In general staple crops (paddy or maize and groundnut) are grown for three or four consecutive years; then, the land is planted with legumes, tubers or cassava and soybeans for at least one year. This patterns of rotation also suggests that the choice of crop is mainly driven by the farmers' desire to minimise the cost of production, especially intensive labour required for land preparation and weeding.

Apart from crop rotation, *inter-cropping* is also commonly practised across the two regions. Fields are managed on the basis of the farmers' skill, such as their knowledge about the performance of plants and the soil. In both paddy and maize fields there are always other crops planted within or along the sides of the farmland such as sorghum. Farmers also grow soybeans along the ridges of paddy terraces. Apart from providing an additional crop mostly for cash income, farmers realise that the soybean roots support the ridges, thus preventing erosion. In maize fields, peanuts, beans and sorghum are commonly planted together with maize. Usually maize and climbing beans are sown first, and then groundnut follows one week later. Some farmers may add cassava in farmland at any time during the rainy season or before the dry season commences.

Farmers may not have the scientific knowledge that, for instance, that the roots of bean plants provide nitrogen to the soil. But, generally they believe that soil fertility can be improved by planting climbing beans on their land. More importantly, some farmers explicitly argue that the climbing beans protect the maize to a certain extent during the cyclone period.

Improving soil fertility is not the only reason for intercropping. Other socio-economic motivations can be attributed to farmers' decisions to practise intercropping. One imperative is food security, followed by the need for cash. These reasons determine a farmer's decision on whether she or he will intercrop maize or paddy with sorghum, cassava or groundnut. Maize is sown first and harvested earlier than the companion crops, allowing the cassava or sorghum plants to develop. On the other hand, maize and legumes are sown around the same time but at different densities.

5.3 **Seed selection and storage: Maize**

Apart from the poor soil nutrition, local farmers in the regions are also vulnerable to climate anomalies which can lead to harvest failure and seasonal food shortages every year. This section will discuss how local farmers address their vulnerability through seed selection and storage methods. Seed selection is important to ensure good germination and to boost yield. Likewise, post-harvest storage plays an important part in maintaining seed stock for the next sowing season and also ensuring the household's food supply throughout the year.

This section focuses particularly on maize. Even though rice is the most commonly consumed staple, maize is still considered as the major staple crop that almost every household has in their gardens. In terms of total cultivation area, maize makes up a significantly larger part of farmers' fields in comparison to paddy. Moreover, maize is seen as one of the most important local staples that people in the region rely on to cope with the seasonal food shortages every year.

5.3.1 **Community Seed Selection Practices**

Most farmers select seed from the harvested ears of maize that make up their grain stocks. These stocks are composed of husked ears and include ears from the entire population of maize plants in the fields. In good harvest years, most households store the already selected seeds separately from those intended for household consumption. The reverse is true when the household production is very low; most households select the seeds just before planting season by choosing from the ears remaining after consumption of the previous season's harvest. However, when they run out of seeds altogether, most farmers either borrow (*tonda* / *tatus*) from neighbours or buy from the markets, while others just rely on seed supply from the local government and Non Government Organizations (NGOs).

The most common selection method is based on the characteristics of the maize ears after harvest. Farmers do not traditionally select maize seed in the field from promising plant types. In general, farmers look for 'big and clean ears' and 'big kernels'. Most farmers stated that they picked well-filled ears and healthy kernels. A farmer from Poto village, Kupang district explained:

'*We look at the biggest ears, then we take off the badly filled kernels, those which have begun to rot due to the humidity and those damaged by insects. Once this cleaning is complete, we shell the tip and the base of the ear so that only the finest kernels from the centre of the ear remain. These are the seeds selected for the next sowing*'.

Although large seed ears are preferred, some farmers insisted that what is more important is healthy kernels and well-filled ears; they insist that ear size does not count as much as the kernels from the centre of the ear. The five to six kernels at the top and the three to four kernels at the base of each row are excluded. Although the significance of this traditional practice was not fully understood, they believe that kernels from the ear tip will not germinate or will produce badly developed ears with small kernels. This reasoning may be justified since the kernels from the ear tip are often smaller and damaged by insects, fungi and birds.

Another important criterion in selecting seed is that the seed ear should be typical or representative of the variety. The farmers select the seed ear that resembles the maize the farmers want to harvest. Thus, they would not consider an ear with a different colour or more kernel rows than what is commonly found in a given variety. They would consider such unused ears simply as a different variety.

Farmers' criteria for seed selection can be interpreted as a double selection process that exerts two kinds of pressures: production criteria and variety preservation. Well-developed ears with healthy kernels are meant to ensure good germination and favour the more productive genotypes for the local growing conditions. The second pressure is to protect ideotypes by reinforcing the characteristics of the variety as defined by the farmers.

5.3.2 **Storage Methods**

Seed storage is important to maintain the quality and quantity of the seed. It is argued that the loss of maize seed is mainly due to the weevil *Sitophilus zeamais*, locally knows as '*fufuk'* and to the pathogen *Aspergillus flavus* (Pakan, 1996, p. 121). Insect pest damage is the main factor responsible for decline in quality and quantity as well as germination potential of the stored seeds (Olakojo & Akinlosotu, 2004; Johannesesen, 2008). High temperatures and high moisture are other major factors affecting grain quality in storage. Both high temperature and high humidity can cause a rapid decline in germination, malting quality, baking quality, colour, and many other quality characteristics (Strahan & Page, 2003). Thus an appropriate and effective method of storage is important in maintaining quality and reducing economic loss through poor plant stands resulting in poor yields.

In spite of significant advances in food storage methods, the most common storage I found in Kupang is roof storage *(loteng)*. This is the traditional storage method long practised by farmers; most households hang maize cobs from the roof over the cooking area to allow smoke to fumigate the seed (see Figure 5.2). Those who use this method pointed out that the smoke prevents the seed from spoiling and from pest infestation but they acknowledged that this method could reduce the quality of the seed, causing low germination rates and also lower yield.

Figure 5.2 *Ume Bubu* (Round House) where harvest is stored (Left) and Roof Storage (*loteng*), inside *Ume Bubu* (Right)
Source: Authors' field survey, 2011

Re-used maize/rice meal sacks are another storage method in Kupang. Polythylene, polypropylene, and cotton sacks are commonly used by households. Depending on the number of sacks, they are either stacked on the floor in an upright position or stacked on top of one another in the kitchen area or in an empty space within the house. This method provides poor protection from insects and rodents. Households with poor housing conditions also found that the maize seed stored using this method absorbed moisture from the floor, frequently giving rise to the problem of rotting.

Metal tanks and plastic bag containers are also used in household seed storage. Unlike the previous two methods, farmers use these types of storage for grain which they can hold in greater amounts for a longer duration. This storage method requires insecticide application in the tanks and plastic containers to lower post-harvest losses.

However, rather than relying only on one storage method, most farmers diversify their storage practices in order to avert losses and mitigate the risk of loss. The diversification is related to the size of household production and to the household's welfare conditions. Metal tanks can hold considerable volumes of grain and lower the quantity lost as well, compared to the traditional method of roof storage where the maize is stored on the cob. However, it is more expensive than sack storage. Thus, even though it may increase household food security, it is less accessible to poorer farmers who mostly use sacks for storing maize since these re-used commercial sacks are readily available in local markets. Due to economic or financial constraints, only relatively wealthy households diversify their storage practices by using metal tanks together with sacks, while the traditional method of roof storage remains the most popular storage method within poorer households, in addition to sack storage.

Moreover, poorer households pointed out that using metal tanks was not their main interest, as their harvests do not require a large storage capacity, indicating the inadequacy of production. Some households stated that their average storage duration ranged from 4 to 5 months, so a longer-term storage system was not necessary. This could also be interpreted as evidence that their grain is commonly consumed within only a few months, indicating persistent seasonal food shortages at the household level.

It is clear that poor households favour the traditional but less efficient storage systems due to financial constraints. An already inadequate household production coupled with this inefficient storage system may explain why poor farmers are very vulnerable to food insecurity.

5.4 Traditional Weather Forecasting: Coping with erratic rains

Given the fact that agriculture activities in Kupang are heavily dependent on rainfall, the productivity of crops strongly depends on the farmers making the most appropriate and effective decisions on farming practices in terms of timing of planting, in addition to decisions on where and what is planted. All of these farmers' decisions in turn depend on the accuracy and reliability of seasonal rainfall forecasting. Officially, the Kupang Meteorological Agency (KMA) is responsible for monitoring and predicting weather and climate in Kupang, including seasonal rainfall forecasting. Despite improvements in forecasting accuracy, the present accuracy of climate forecasting in Kupang is still questionable given the strong micro-climate variability while the number of rainfall stations is still limited in terms of geographical coverage. Even if accurate rainfall prediction were possible, access to this information is limited to those with access to media such as local newspapers and radio broadcasts. The poor and those living in remote areas such as Takari, Fatuleu and Amabi Oefeto are at a disadvantage in not being able to obtain this vital information.

With the absence or poor coverage of climate forecasts at the community level, the preserved indigenous knowledge (IK) offers a valuable method that local farmers can rely on in seasonal rainfall forecasting. In fact, local communities in different parts of the world continue to depend on indigenous knowledge in dealing with climate variability and its associated impacts such as floods and droughts. These communities, especially those in flood and drought-prone areas, have accumulated a vast body of indigenous knowledge that assists them in natural disaster prevention and mitigation (Roncoli, Ingram, & Kirshen, 2002). In light of this knowledge, it can be argued that predicting impending disasters has long been an integral part of a vulnerable community's adaptation strategies.

Historically, local farmers throughout Kupang have been coping and adapting to increased climate variability which is manifest in the form of increased frequency of droughts in particular. Thus the prediction of the seasonal weather which is of great interest, is informed through observation of atmospheric and astronomic indicators, the phenology of plants and the unusual behavior of animal, birds and insects.

The use of these local indicators in seasonal weather forecasting, which influence decisions on farming practices in Kupang, is described below.

5.4.1 **Atmospheric and Astronomic Indicators**

The elders of a community often predict future weather patterns by referring to changes in weather elements such as *wind, temperature and the appearance of clouds*. It is widely viewed that a change of wind direction is associated with a change of season. When the wind blows from west to east, this indicates that the rainy season is about to begin. Farmers then start to prepare their land and seed for the coming rainy season. Likewise, when people observe that the temperature during daytime and night-time is becoming warmer, these temperature changes are interpreted as evidence that the rain is coming soon.

Rain is also expected when clouds near the sun appear to be red in color at sunrise. The scientific literature explains that a red sky in the morning is due to the sun shining through dust (Battan, 1979). In this case, however, the dust is being pushed out by an approaching low pressure system bringing in moisture.

Some informants also observed that when it is cloudy in the east or in the west at dawn, that is, the clouds appear to be heavy and dense, with a considerable vertical extent in the form of mountains or huge towers (cumulonimbus clouds), there will be rain. The same is predicted when the moon and stars can only be seen dimly. According to Critchfield (1983), the cumulonimbus is the great thundercloud. It invariably produces at least a pronounced shower. Also, the stars and moon can be seen dimly due to altostratus clouds, which form a grayish or bluish cloud sheet, totally or partly covering the sky, and having parts thin enough to reveal the sun at least vaguely as through ground glass (Critchfield, 1983).

An approaching storm can be predicted by the elders residing along the coast. This is indicated by the appearance of hair-like clouds, called cirrus. Such traditional observations are in fact accurate. If the cirrus clouds are observed converging towards a point on the horizon, this indicates a storm approaching from that direction (Liwag, 1992). The elders on the coast believe that when the sky above the western part of the sea is cloudy or the winds tend to blow from north of the sea, a storm or typhoon is on the way.

Informants maintained that the appearance of a *rainbow* is a good indicator of upcoming rain. When a rainbow disappears as clouds come out or when a rainbow in the west is elliptical and appears in the morning, rain will come soon. The appearance of the moon is another indicator. Key informants noted that when the crescent moon is tipped on its side, there will be rain. Also, the elders are able to foretell the presence of a distant storm even on sunny days. After several careful observations, whenever a ring (corona) around the moon is observed, bad weather usually follows within a day or two. The informants stressed that when the diameter of the corona is small, a storm is near but whenever the diameter of the corona is larger than usual, a weather disturbance is will occur soon.

Coronas, according to Battan (1979), are a result of process called diffraction by which a beam of light spreads into the region behind an obstacle. The light waves coming from the moon toward the observer are slightly bent around water droplets. The light waves affected by many droplets interfere with one another on the observer's side of the droplets and the result is a concentration of light in a circle around the moon. The radius of the corona is inversely proportional to the size of the water drops, which means that a small corona indicates large drops – the more humid the air, the larger the droplets. Critchfield (1983) argued that all clouds of the cirrus or cirro-type are composed of ice crystals through which the sun or moon shines and thus, produce a halo. Liwag (1992) explained that halos are due to the refraction of light through ice crystals, and these are seen when a cirrostratus cloud covers the sun or moon. A cirrostratus is a whitish cloud veil of fibrous or smooth appearance, total or partly covering the sky, and generally producing the halo phenomenon. This may signal the approach of a storm and more often than not, precipitation follows.

Informants residing in the coastal areas anticipate coming bad weather or a distant atmospheric disturbance when some irregularities in the appearance of the sea are observed. Visible seawater evaporation was mentioned mostly by the informants as an indicator. When the sea roars, high sea waves or giant waves are seen and an intense thunderstorm is heard from a distance across the sea, a storm is certain to occur. Liwag (1992) noted that in regions where there are large and warm oceanic areas, tropical cyclones form. They begin as low pressure centers over an ocean or large bodies of water with strong circulating winds, so giant waves and phenomenal seas whipped up by violent winds spiraling around the storm's center are brought to distant shores. These irregularities are caused by a chain reaction from the immense surface circulation of a storm especially if it is still over the sea.

5.4.2 **Plant Indicators**

Most farmers use the appearance of *local trees* to forecast rainfall. They do not base their expectations on generic observation. When they use trees to forecast seasonal rainfall, they formulate their expectations on the evidence of trees that are located near their homes or farms, trees that they have been able to observe over time. For example, early sprouting of certain trees (*kayu ende* and *jati),* mark an early onset of rain. Some community members use the sprouting of Acacia trees in the dry season to indicate a good rainy season thereafter. Other indicators reported included the flowering of Poinciana trees (*Delonix* sp) because when they flower they indicate that rains are not far away. Early flowering of mango trees is also used to indicate an early onset of rains, while a late flowering indicates a late onset. When people see mushrooms sprouting in the bush, they say it indicates that the soils are moist and rains are coming. Farmers immediately rush to prepare their farms based on these observations.

5.4.3 **Animal, Bird and Insect Indicators**

Unusual behavior of ants and cicadas is often considered an indicator of the onset of the rainy season. One indication is when large groups of red ants start migrating to new sites, usually evacuating stored foods. The elders, as also confirmed by their religious beliefs, point out that ants collect and store food in preparation for the incoming rainy season. Likewise, when cicadas begin their incessant strong and high-pitched chorus, which is not heard during the day, the elders believe that the rainy season is around the corner. The literature also confirms that ants and insects are very adept at monitoring atmospheric conditions as their survival depends on it (Atkins, 1980).

Also, the migration of birds flying in groups away from the sea indicates that the rainy season is approaching. The elders living on the coast pay attention to these patterns of migration when expecting the rainy season. Welty (1982) argued that the most important advantage offered by migration is to secure a better climate for living. In this case, those birds migrate seeking a better place during the rainy season.

The appearance of adult winged termites (*anai-anai / rayap*) and moths (*ngengat*), fluttering around light sources during the night time is often cited as another good indicator of the upcoming rainy season. Likewise, the same prediction is made when dragonflies (*capung*) are flying low. This can be attributed to a drop in air pressure causing the air to become heavier, resulting in difficulty in higher altitude flying.

Some birds make mournful sounds among the trees that seem like crying. For instance, birds locally known as *doulasi*, a kind of forest cuckoo, residing in Mount Fatuleu usually start singing with very high pitched sounds and flying around from one place to another . The elders believe that the appearance of this *doulasi* bird is meant to tell the farmers to prepare their fields as the rains are near.

Informants recounted that the unusual behavior of other animals also indicates impending rain. Frogs, for example, croak near swampy areas before an upcoming rain. This is so because the air is more humid and this allows them to remain where they are. Also because frogs have a good sense of smell, they can often locate ponds from great distances away (Gordon, 1977). Some informants also observed that spiders spin shorter and thicker webs before rain comes.

5.4.4 **Rain Making Ceremonies**

Apart from reading the signs of rain on the basis of indigenous knowledge, local communities also pursue rain making ceremonies in the face of prolonged drought. Rain making ceremonies were usually organized by the head of a community and performed in sacred locations in forests or under special trees such as *beringin* (*Ficus benjamina*) that are believed to be associated with water. Such ceremonies involve sacrifices, roasting meat, singing and dancing, and are aimed at honouring and pleasing the ancestral spirits. The participants believe the rain will occur on time once that aim is achieved.

5.4.5 Meteorological versus Traditional Forecasts: Farmers' attitudes and preferences

Farmers' attitudes and preferences for weather forecasts vary, depending on the reliability and accuracy of perceived signs, the age group of the farmers, geographical conditions and access to climate forecasts. In general, people's attitudes and preferences can be divided into three main groups: those who favor either traditional or modern meteorological forecasts; those who believe in the traditional forecasts; and those who are willing to rely on both approaches.

Traditional knowledge-based forecasting was more pronounced among the older members of the community, indicating accumulated experience over many years. Younger members of communities did not readily reflect this approach. They either dismissed it or were just less interested in such farming practices. Farmers residing in remote areas are more sympathetic to the traditional approach than urban dwellers or those residing near urban areas. Access to local broadcasting also influences people's attitudes. Generally, those with access to local broadcasting are more in favour of the meteorological approach.

The farmers' preferences also vary. Those who rely on traditional forecasting have two main reasons for this reliance: they have no access to meteorological based forecasting broadcasts; and they still have confidence in the reliability and relevance of traditional methods. In the absence of meteorological forecasting, local farmers seek advice from the elders to discuss the upcoming climate conditions based on preserved traditional knowledge. For example, when expecting the rainy season or when the rainy season is still far away, the farmers visit each other, getting together to discuss traditional indicators which are prevalent at the time and that might predict rainfall behaviour. The appearance of the moon and stars, changes in wind direction and clouds are often cited as the most accurate indicators. Highlanders mostly refer to plant indicators such as mango trees as the most accurate indicators, while those residing along the coast refer to temperature changes. These findings are in line with those of Kieft's study in one mountain village of North Central Timor district where the use of astrology and physical indicators is also common among the Atoin Pah Meto (Kieft, 2001, p. 9).

These traditional indicators were used to make ‘serious’ farming decisions such as clearing new fields, setting up planting dates and selecting appropriate varieties to cope with any potential climate anomaly. They allocate enough time to prepare their land to make it ready for planting maize and other crops before the rainy season sets in including repairing and cleaning dikes for better drainage. Coastal communities make use of the traditional indicators for predicting adverse weather conditions such as heavy rains, typhoons or floods, taking mitigation actions such as repairing their houses, tightening any loosened ceilings or walls, preserving and stockpiling food and fuel and gathering firewood. Likewise, their livelihood assets such as livestock, poultry, boats and rafts are placed in safer places before the arrival of any flood or typhoon.

However, some farmers under this category complain about the lack of reliability of traditional indicators. For example, sometimes vegetation does sprout in late August just before the rainy season, but then no rain falls until December. Or clouds gather but are ‘blown away by wind and no rain falls’, and as one community member puts it, ‘clouds are not rain’. Some farmers also stated that the extinction or decline of some species of plants and birds make it difficult to predict rain. For example, the *doulasi* bird has recently disappeared from Mount Fatuleu and its surrounding areas, and people think that this species of bird is already extinct. Obviously, there is an erosion of credibility and confidence among those who base their decisions on traditional indicators. One of the main reasons cited by the farmers was the perceived increased variability of rainfall and the recurrence of droughts over the years. Increased rainfall variability and uncertainty have forced some households to conclude that ‘only God knows’. Such a fatalistic attitude, which is often common in such helpless conditions, leads them to surrender to a higher authority or power.

Those who rely on meteorological based forecasting are mainly city dwellers and farmers with access to local broadcasting (newspapers and radio). This group of farmers stated that their farming practices are mainly based on the weather forecasts provided by Climatology and Meteorology Agency. However, the reliability and accuracy of such weather forecasting are still under question since the farmers are not really convinced of the accuracy of weather prediction. In their words: 'the rainy season was expected in early November, but in fact it was one month late'.

The last group consists of those who take into account meteorological weather forecasting, but also pay attention to traditional indicators. Coastal communities can be cited as a good example of this group especially when anticipating storms or typhoons. These communities usually refer to traditional indicators only when receiving an early alert from government institutions regarding any adverse climate event.

5.5 **Household Responses to Drought**

West Timor farmers employ a wide range of coping strategies both before and after a drought. Due to the regular recurrence of this 'creeping' phenomenon in the regions, some of these strategies are incorporated into the farming system as regular procedures from year to year. Other strategies, however, are employed only under certain risky conditions and can be easily identified as risk-coping strategies. This section discusses a number of drought-coping strategies employed by farmers in the research regions, based on information derived from the farm/household survey data.

5.5.1 **Crop Management Adjustments**

Information on adjustments they make in crop management practices was obtained from farmers during interviews and the results are summarized in Table 5.4. It is obvious that farmers do not have much flexibility in pursuing management adjustments in the production of their main food crops (maize and rice) in response to drought. The late occurrence of drought can be attributed to such problem of crop management adjustments. Drought mostly occurs late rather than early, making the already short rainy season even shorter, which in turn leaves the farmers with limited time and opportunities to pursue any crop management adjustments for reducing crop losses.

Table 5.4. Percentage of farmers reporting adjustment in crop management practices during drought year in studied regions

Adjustment in crop management practices				Kupang city	Kupang district
A.	Crop establishment methods	No Change		74	83
		Shifting from transplanting to direct seeding		26	17
B.	Sowing date	No change		52	65
		Change		48	35
			a. Early sowing	10	4
			b. Late sowing	38	31
C.	Seeding rate	No change		80	92
		Change		20	8
			a. High seed rate	12	5
			b. Low seed rate	8	3
D.	Seed variety	No change		68	91
		Change		32	9
			a. Shift to early-maturing variety	19	6
			b. Shift to drought-resistant variety	3	0
			c. Shift to traditional variety	10	3
E.	Timing of inorganic fertilizer application	No change		76	91
		Change		24	9
			a. No dose application	9	4
			b. Reduce number of applications	1	1
			c. Apply only at flowering time if rain arrives	14	4
F.	Change in amount of fertilizer	No change		71	65
		Change		29	35
			a. Decrease	29	35
			b. Increase	0	0
G.	Perform resowing or replanting	Not performed		56	73
		Reasons for resowing/replanting		44	27
			a. No germination	10	4
			b. Poor germination	21	5
			c. Seedlings died after germination	13	18
H.	Manual weeding	No change		69	82
		Change		31	18
I.	Pest infestation in crop	No change		67	96
		Change		33	4
			a. Increase	4	1
			b. Decrease	29	3
J.	Next-season crop	No change		67	71
		Change		33	29
			a. Early sowing	26	19
			b. Changing of crops	7	10

Source: Household Surveys, 2010/2011

The majority of farmers follow regular crop establishment practices regardless of the occurrence of drought. However, some farmers, about 26% and 17% in Kupang city and Kupang district, respectively, shift from transplanting to direct seeding of rice during the drought years. Since direct seeding in rice production is generally labour-saving and is mainly reliant on family labour instead of hired labour, those who practise this change may have taken into account the potential loss of harvest caused by drought. Thus, impact-minimizing strategies are pursued during the drought period through saving the cost of inputs such as labour by shifting to direct seeding. In this regard, changing crop establishment methods can be regarded as an important drought -coping strategy.

Adjusting cropping patterns (timing, size and crop choices) is another important response to drought. The most prominent change in the cropping pattern is to adjust the agricultural calendar on an annual basis for both the planting and harvesting time. The time of planting is therefore a critical element in light of the erratic precipitation patterns and the barren soils of the regions. Every year some farmers in particular locations suffer from false rains that prompt them to sow, but then a long drought spell occurs (see Chapter 4: Living with climate variability). Therefore, to avoid great losses, judging and then acting at the right time for planting is in the farmers' best interest.

In general, most farmers wait for a succession of early rains before planting, in order to make sure that soil moisture is recharged to a level that will permit crops to grow. This means that planting time cannot be brought forward or carried out ahead of the rainy season. Thus, either early or delayed sowing of rice, maize and other crops depends on the monsoon precipitation. For example, farmers with unirrigated land in Takari, Fatuleu Barat, Amabi Oefeto of Kupang district, and also the villages in Kupang city reported that in 2009/2010 they had delayed planting their crops by up to 30 days in expectation of rain as the paddy fields need to be flooded before transplanting rice. Consequently, the harvest time had to be delayed to allow for maturing. This chain of events and actions is often the cause of the persistent problem of food shortage in the regions.

Adjustments like these are commonly practised by subsistence farmers with limited resources, especially of seed stock and labour. Most farmers in the regions suffer from lack of seed availability. Either buying from the local market or borrowing (*tonda* – Rotenese and *tatus* - Atoni) from either relatives or community or church groups is the most common way for farmers to access seed. Rather than buying from the market, most farmers prefer *tonda* or *tatus*. One reason for this reluctance is that farmers are suspicious about the seed varieties and quality from the local market. Thus, *tonda* or *tatus* was the only way to ensure the crop's adaptability to local climate and environment, and to ensure yield as well. More importantly, *tonda* saves cash expenditure. Around this time of year, most poor households run out of cash. Moreover, the in-kind return of such a system is preferred even though the returned amount must be at least double the amount they have borrowed.

The availability of labour within households also plays a crucial role in adjusting the agricultural calendar. Compared to the harvesting season, a shortage of labour usually occurs during the sowing season. Given the very erratic rainfall behaviour in the regions, every household usually goes out in a rush to sow their fields at the same time whenever the rains permit. Such farmers' behaviour is closely related to securing the right time-frame to plant in order to have maximum yields. During this season, labour within households is very scarce. Children are often taken out of school to provide labour during the planting season.

Despite the issues of seed availability and shortage of labour, delaying planting in the case of prolonged drought or the late onset of the rainy season is the preferred strategy to minimise farmers' economic loss. However, adjustments vary among farmers, reflecting their own capacity to cope with climatic events; these adjustments are determined by socio-economic conditions and access to accurate weather forecasts.

In the case of delayed rainfall, as a consequence of which soils become very dry, farmers dibble seeds especially maize and groundnut deeper than the normal depth into the soil in search of higher soil moisture to increase the chance of the seeds sprouting and taking root. In extreme climate events, when seeds fail to sprout or the sprouted seedlings wilt, some farmers manage to repeat the sowing (*soni* – Rotenese / Atoni).

However, *soni* depends on the availability and affordability of a second batch of seed. Some farmers may have anticipated *soni* by retaining a limited amount of seed or must again *tonda* from relatives. Otherwise, they plant different crops that have a short season and are drought resistant. In other cases where farmers think that there has been insufficient precipitation or not enough time for a crop to ripen, the chance of *soni* is dismissed.

The harvesting season is also determined by weather conditions and associated impacts such as pest attacks. In the case of La Niña events in 2010, grasshoppers (locusts, that is, grasshoppers pushed to swarm in plague proportions) attacks forced farmers in Kupang to carry out an early harvest to avoid damage to or loss of grain. Likewise, groundnut farmers wait for limited rains to harvest or will harvest the crop before the dry season sets in.

Changing the size of cropland and the type of crop are other coping strategies in dealing with extreme weather conditions. Again, the availability of labour and the ability to purchase agricultural inputs will determine farmers' decisions. In drought years, most farmers tend to decrease the area planted and shift to growing more drought tolerant crops. Only a small portion of their land is cultivated, mainly to reduce the cost of labour for land preparation, sowing and harvesting. The farmers become worried if the costs of farming are higher than their yields. Farmers in Takari and Fatuleu plant drought tolerant crops in their fields such as sugarcane, bananas and cassava. Short-season crops might also be grown, replacing rice and maize with crops such as sweet potatoes, soybeans, pumpkins and cowpeas so that before the dry season sets in, the harvesting of these crops is finished.

In La Niña years, farmers tend to increase the area of their cropland provided that they have enough resources, particularly labour, to do so. Growing more crops is also common when rainfall is above normal. In addition to maize or rice, other crops such as mungbeans are also planted within or along the sides of their fields.

Other coping mechanisms involve changing fertilizer quantity and timing, and pest management practices. The survey data, however, revealed that such tactical responses are not widely practised. The ability of these farmers to employ such responses is hindered by their weak purchasing power for agricultural inputs or their inability to buy food to substitute for crops that perform poorly in dry years.

Opportunities for making adjustments in the post-rainy season crops that follow maize and rice may arise when the primary food crop is damaged or lost to drought. Some other crops such as soybean are planted, replacing rice in dry years. However, this adjustment is somewhat limited. Only one-third of the households in the survey reported adopting such adjustments in the cropping pattern. This is mostly adopted by farmers who have access to water sources or to limited areas where residual soil moisture makes it possible. Farmers who are able to make use of such opportunities may plant a second crop early where that is possible or might switch from food crops to cash crops such as vegetables. This is mainly found in few villages in sub-districts (*kecamatan*) such as Taebenu, Amarasi and Kupang Tengah. The use of these opportunities for loss recovery is not promising, though. Overall cropping intensity is still limited as most of the land is left uncultivated during the post-rainy season due to limited access to water resources, capital and farming inputs.

5.5.2 **Consumption Adjustments**

Since paddy and maize are the main crops most heavily affected by droughts, subsistence farmers always suffer from some degree of production loss. Under this condition, most families have no option other than to make substantial adjustments in the household food balance as a post-drought coping strategy. These adjustments may vary from (a) reducing the quantity for sale and retaining seed for the next year, (b) increasing the amount of food purchased from the local market, (c) looking for other crops as substitutes for rice and maize in the consumption basket, and (d) relying on other types of food not commonly consumed as supplementation for the food deficit, to (e) a reduction in consumption, which is a common occurrence for the poorest households.

Results from the household surveys indicate that all of these kinds of adjustments are adopted to varying degrees. One of the most obvious effects of household production loss is (1) a substantial reduction in the quantity of produce sold, (2) a sharp decline in the quantity of seed reserved for the following year, and (3) a significant reduction in the amount stored for future use and/or consumption.

Despite the fact that a higher proportion of household production is meant to meet household demands for staple food, some farmers may sell their crops for cash income. Nowadays, more and more households consume more rice than maize. Thus, it is very common in the local market to see farmers selling maize in order to buy rice for household consumption, despite its relatively higher price than maize.

Many farmers stated that during drought years, the quantity of maize and rice sold decreased by 75 to 95 per cent compared to normal years. Such a reduction of grain supply will definitely have a price effect in the local market: the price asked for grain goes up. Even an inflow of grain from other areas such as neighbouring sub-districts or from the city to rural areas to compensate for local demand attracts a higher price. Such market problems result in an overall reduction in consumption per capita. This price effect is, in turn, likely to have a negative impact on the welfare of subsistence and rural households, for whom a larger share of household income is spent on maize and rice.

A significant decline in the quantity of grain retained in the farmers' granary as seed for planting during the next year was indicated by most farmers during focus group discussion. This kind of adjustment can be regarded as a rather devastating coping strategy since such a strategy almost certainly forces farmers to suffer even greater production losses in the following year.

Cassava and sorghum are amongst the most important crops used to supplement maize and rice in the household consumption basket, especially among lower income groups. Although cassava production is also affected by drought, the local indicators show an increase in cassava cultivation area during drought years. Most households stated that cassava is a popular (and necessary) supplementary crop to maize and rice, despite its less nutritional value.

Despite making various adjustments in crop choices, agricultural practices and the marketing of maize and rice (in both quantity purchased and quantity sold), most households suffer consumption losses, through reducing both (a) the number of meals per day and (b) the quantity consumed per meal. About 61 % and 76 % households in Kupang city and Kupang district, respectively, reduced the number of meals per day during drought years. This reduction resulted in a significant cut in the average number of meals per day from 2.5 to 1.9 in Kupang city, while the Kupang district showed a greater reduction: from 2.3 meals per day in a normal year to 1.6 in a drought year. About 10 to 33 per cent of households in both regions reduced the frequency of food intake from two to one meal per day (Table 5.5).

Table 5.5. Changes in household consumption behaviour between normal and drought years in the regions

Household consumption behaviour	**Kupang city**	**Kupang district**
Average number of meals per day		
Normal year	2.5	2.3
Drought year	1.9	1.6
Percentage of households reducing the number of meals per day during drought year	61	76
Number of meals per day		
Normal year (% of households)		
1	0	0
2	31	47
3 or more	69	53
Drought year (% of households)		
1	10	33
2	69	48
3	21	19
Percentage of households reducing the quantity of food per meal during drought year	69	77
Percentage of households consuming other food in drought year (which is not normally eaten)	27	33

Source: Survey Data, 2011

By comparing the number of meals between normal and drought years, the survey revealed that in general, households had a higher number of meals during normal years than dry years. At least half of the sample (69% in city and 53% in district) had three and more meals per day during normal years. This frequency of food intake was only afforded by 21% and 19% for Kupang city and Kupang district, respectively, in drought periods, while a significant percentage, 48% and 34% of households, in both regions reduced the number of meals from three and more to two meals per day. As a result, a higher percentage of households having two or even one meal a day was reported for drought years than in normal years.

The quantity of food per meal was also reduced by the majority (69 to 77 per cent) of households. Moreover, faced with food shortage, subsistence households turn to consuming food not normally eaten. This is a common coping mechanism during drought years. Such unusual food items include *putak* (*gebang* palm sago), broken rice, broken maize, wild flowers and fruits, wild leaves and vegetables, wild roots and tuber crops such as sweet potatoes, yams and cassava. Apart from a decline in the quantity of food intake, drought years are also associated with an overall decline in the nutritional content of food consumed. The majority of households reduce the quantity of food rich in vitamins and protein such as meat, vegetables, and milk. During drought years, the frequency of consumption of such high protein foods also decreases substantially.

The impacts of drought vary markedly according to class, ethnicity, gender and age. Key informant interviews indicated that women and young children are the victims of the most severe drought-related impacts. This is mainly due to their sociocultural and economic position within the family and community. Being subordinate to men within the family structure, women are generally the last to eat their meals and are even likely to receive a lesser quantity of food during period of shortages. This is especially typical of rural families. Their subordinate position may explain why women suffer poorer health during drought years. It is not surprising that during such crises, prolonged malnutrition adversely affects women's health, in particular that of pregnant and lactating women. As a direct consequence, the health status of infants and young children also suffers adversely.

Figure 5.3 ***Putak*** **sago fibre (Left), for feeding animal (Right)**
Source: Author's field survey, 2010/2011

Figure 5.4 ***Kacang Arbila Hutan*** **beans (*****Phaseolus lunatus L*****), often consumed in drought years**
Source: Author's field survey, 2011

5.5.3 **Expenditure Adjustments**

Making adjustments to household expenditure is a coping strategy forced by income loss (Table 5.6). Reducing household spending on non-essential items such as clothing and social functions, which most surveyed households do, may not have major impacts on family welfare. However, most households in both rural and urban areas find it difficult to escape their obligations to spend money on social functions such as weddings and funeral ceremonies. Due to the strong family cohesion in the regions, the principle of 'exchange and reciprocity' within clans is still strong when it comes to weddings and funeral ceremonies. Every member of a clan is obliged to make a contribution, which entails reciprocity in the future. The contribution might involve in-kind gifts (animals and food items) and/or cash payments. The details of contributions are recorded in a notebook and will be used for future reciprocity with regard to amount and/or in-kind payments. Failure to make a proper payment (at least the same amount or in-kind return) may result in being socially excluded from the clan. Most vulnerable households stated that for this compelling reason, funeral and wedding ceremonies that take place during drought years are unavoidable hazards. Recognizing the continuing need for reciprocity, many rural families make advance preparations by rearing animals that will only be used for funeral and wedding ceremonies.

Households may also reduce spending on essential items, such as medical treatment and children's education. Such reductions have pernicious effects on short and long-term family welfare. Some families may rely on medicinal plants that are available within their localities, even though their curative effects are questionable. The costs of medical treatments that rural households incur during drought years include the cost of transportation to and from health centres, or the cost of a health staff visit. Given the poor infrastructure conditions and the poor coverage of the health system, the cost of health services becomes unaffordable for vulnerable households in the dry years.

Curtailing expenditure on children's education is common in both rural and urban areas. More than 50% of the households reported doing so during drought years. This occurs for several reasons. First, the loss of income triggered by drought makes the parents unable to afford the recurring cost of education for children, even though the absolute amount of such expenditure maybe small. Second, adolescent children may be forced to give up school in order to become involved as unskilled labour to supplement family income. In Kota Kupang, for example, at almost every traffic light intersection children are found selling newspapers during and after school hours. Whatever the reasons, such curtailing of household spending is a disinvestment in human capital, which will most definitely have a major impact on their future earning potential.

Table 5.6. Household expenditure adjustments in response to drought in the studied regions (%)

Expenditure adjustments	Kupang city	Kupang district
Expenditure on new clothes curtailed	73	81
Medical treatment postponed	62	79
Social and religious functions curtailed	81	77
Children's education curtailed	54	60

Source: survey data, 2011

5.5.4 **Credit**

Borrowing is a typical coping strategy by agricultural households to deal with fluctuations in income. Borrowing may involve both cash and kind. During the time of hazards such as drought, such coping strategies tend to escalate (Table 5.7). The survey data in all sample areas indicated that the number of farmers who rely on borrowing either cash or in kind increased during the dry years. Farmers borrow mainly cash, maize and rice for consumption and also for seed, but this might also include other food crops and seeds of other crops.

Table 5.7. Changes in borrowed items during a drought year versus a normal year in the studied regions (%)

Borrowed items	**Kupang city**	**Kupang district**
Cash	15	23
Rice and or Maize	13	21
Non Food Items	6	11
Seed	19	27
All of the above	20	31

*Positive numbers indicate an increase in frequency during drought years
Source: survey data, 2011

The number of households relying on borrowing as a drought coping strategy, however, varies across the regions. More rural households appear to practise borrowing of both cash and goods in-kind during a drought year compared to normal years. For example, 23% more households in Kupang district borrowed cash compared to only 15% more households in Kupang city. This also occurs in relation to other kinds of borrowing such as food items and seed. Among all the surveyed households, borrowing all items (cash, rice and/or maize, non-food items, seed) was recorded as the most common practice in both regions. However, figures show that the percentage of sample households involved in borrowing all items is also higher in Kupang district (31%) than in Kupang city (20%). Thus borrowing tends to increase among subsistence households in times of droughts.

Institutional lending institutions for consumption purposes are not commonly available to agricultural households in such poor regions. Local kiosks or merchants and moneylenders are the main sources of credit. Borrowing from moneylenders is common among both urban and rural households. However, rural households mostly rely on obtaining credit from proprietors of local kiosks for household consumption needs. Social ties within rural communities make it possible for them to obtain food items as a soft loan.

However, borrowing money or goods as a drought-coping mechanism might also entail adverse welfare consequences. Borrowing may multiply the initial costs that a vulnerable family has to bear in the long term due to high interest rates. Credit markets are poorly developed especially in the rural areas and within the poorer regions. This condition allows lenders to raise the interest rate to extract higher payments from borrowers. Householders in the survey asserted that the interest rate during drought years increased by five to nine percentage points. In Raknamo in Sub-district Amabi Oefeto, farmers reported an average interest rate as high as 34% per annum during drought years, while borrowing seed required a three-fold return on the amount of grain borrowed. This forces vulnerable farmers to fall into a perpetual debt trap, locally known as *galing lubang tutup lubang*: ‘digging one hole to fill another’.

5.5.5 Asset Depletion

Vulnerable households may liquidate assets such as gold, jewellery and other items that represent the wealth, status or savings kept for future household needs. During times of crisis, some farmers have no option other than to forfeit their productive assets such as land and draft animals. The frequency of mortgaging or liquidation of these productive assets in the dry years was found to increase in all sample villages.

This coping mechanism definitely has major impacts on agricultural productivity in the following years. Households acknowledged that once the land is mortgaged, their access to land becomes even more limited. Sharecropping was the only way out for these farmers, and this caused a significant decline in their subsistence production level.

Table 5.8. Changes in types of assets sold in the studied regions (%)

Type of asset sold	Kupang city	Kupang district
Large animals / livestock	13	27
Small animals (pigs, sheep, local chicken, etc)	36	43
Farm tools	5	8
Household items (electronic and white goods)	23	31
Gold	7	17
Land and building	6	11
All of the above	27	39

*Positive numbers indicate an increase in frequency during drought years
Source: survey data, 2011

The sale of either large or small animals in drought years to meet cash and consumption needs is a fundamental coping mechanism of the farmers surveyed. Selling local chickens, for example, occurs simply to fulfil consumption needs (for rice or corn), while the sale of large animals, often on a regular basis as an income source, is more common during drought years as an important buffer when household income is low. A few farmers stated that in addition to mitigating the loss of income from crops, the sale of large animals such as cattle, sheep, goats and pigs was necessitated by the associated impacts of drought such as the reduction of forage and crop residues, the outbreak of animal diseases and the rise of theft. Hence the sale of livestock is a compelling coping mechanism by some farmers as a risk-averse response to drought. Cattle in this case serve as an important insurance mechanism especially for the rural population.

5.5.6 Use of Forests and Forest Products

Reliance on forest and forest products as a coping mechanism during drought years is increasing. Using the number of day-visits to forests per year as a proxy of forest use intensification, the household survey reported an increase in the average number of days farmers visited forests per year during dry years, in comparison to normal years. In fact, more vulnerable farmers in Kabupaten Kupang (rural population) relied on forests than their counterparts in Kota Kupang (urban population). The focus group discussion confirmed that small and marginal farmers intensified forest use more than other farmers. A majority of households also reported that forests became more degraded in the dry years. A long-term decline in the productive capacity of forests is unavoidable as a result of excessive exploitation during the dry years.

The use of forest and forest products in drought years can be viewed as a traditional coping mechanism that has been practised for decades in these regions. The work of Ormeling (1956) testifies to this mechanism. As food gatherers, the people of Timor return to the forests when the crops fail. In his words,

'*the Timorese possesses the same amazing knowledge of the flora of his habitat, which generally characterizes food gatherers. He uses leaves, shoots, berries, fruits, seeds, flowers, roots, tubers, bark and pith in surprising varying ways'* (Ormeling, 1956, p. 54).

Even though he was writing as early as 1957, Ormeling further argues that excessive activities by the Timorese had caused substantial forest degradation that had brought about the current savannah forests in the place of tropical monsoon forests.

Nowadays, the reliance of the people on the forests has not changed a great deal. During the period of my fieldwork in 2010/2011 (a drought year), I witnessed various forest products such as timber, charcoal, firewood, building materials (*bebak* – leaf-stalks of *gebang*), construction material (*kayu*), sago (*putak)*, arrayed in back yard gardens and along the road, ready to transport to the city or market. Likewise, I frequently also saw handicrafts such as mats and baskets made from other forest products sold by women at local markets either for cash or essential consumption goods.

5.5.7 **Labour for Cash and In-kind**

Labour in exchange for cash or in-kind payment has been widely practised in this area for decades. While the preference for cash payment has increased in recent years, in-kind payments are still popular especially in rural areas. The drought-affected households in the regions indicated that both cash and in-kind payments for labour provide an important coping strategy in times of crop and harvest failure. The labour activities in which the majority of households are involved vary, ranging from on-farm to off-farm activities. Men may become involved in livestock herding, the construction of traditional houses, the collecting of building stones, and making bricks. Women, on the other hand, may perform domestic work. Some family members may engage in on-farm labour, undertaking a specific range of tasks in return for a share of the harvest or/and a small amount of cash for the duration of the period of employment. The tasks include ploughing, weeding and harvesting.

5.5.8 **Reliance on Gvernment Relief Programs**

Government-sponsored relief programs can be regarded as an important safety net. These programs include ‘rice for the poor’ (*RASKIN – beras miskin*) and cash-for work. Raskin is a subsidized rice scheme set up by the National Government to assist communities suffering from food shortages during lean months. The target households are entitled to purchase 15 kg of rice each month, to be purchased every three months at a below-market price. For example, the price of RASKIN in 2009 was Rp.1600/kg, while the market price at the time was Rp. 6500/kg. The cash-for-work program is mainly delivered through community empowerment development projects at village level. These programs provide small amounts of cash to the poor and most vulnerable for part-time day labour on projects such as road maintenance, building small reservoirs, building community health centres, and other types of construction activities.

The implementation of the RASKIN program has been heavily criticised due to its poor coverage; some poor households were denied access to the program, while some untargeted households (richer people) were on the lists of beneficiaries (Hastuti, 2008). However this study found that the majority of households in the regions studied were dependent upon RASKIN to meet household needs, implying that no concern was expressed over its poor coverage. This was reflected in the participation rate and the adjusted local arrangements to extend the coverage among the communities. At community meetings held by the heads of villages (*kepala desa*) in consultation with the cultural heads of the village (*tokoh masyarakat*), agreement was reached in most villages studied to allow all households access to the RASKIN program with the consequence of a reduced quota for each household. In the focus group discussions, no evidence of discontent was recorded.

The participation rate in this program was found to be higher among poor households in the season of food shortage before harvest in comparison to the participation rate immediately after harvest. Despite the high participation rate, a few of the most vulnerable households chose not to purchase RASKIN rice. Among the reasons given were difficulties in securing cash and a reluctance to sell corn stocks to purchase rice.

5.5.9 **Socio-economic Variations in Drought Coping Mechanisms**

It was evident from observations and interviews that coping mechanisms vary considerably across the regions. Each individual (by gender and age, family structure, social status and group membership) may employ different strategies from others, drawn from the set of mechanisms available to them and opportunities for recovery. It is imperative to understand the variation in people's coping behaviour to discover the crucial factors underlying the social vulnerability at household and community levels.

Wealth and status play an important role in people's ability to mitigate drought related risks such as crop failure. The participatory assessment of wealthy groups in the study area, whose standing was based on livestock ownership, access to land, labour and credit institutions, housing conditions, found that these relatively wealthier groups had a greater diversity of coping mechanisms available to them. Access to agricultural inputs such as improved seed varieties, fertilizer and labour was higher within these wealthier groups than poor households. Table 5.4 regarding crop management practices during drought year shows that no change in seed variety, application of fertilizer, and use of improved seed varieties was reported by poor respondents.

People's behaviour based on age group also displayed significant differences in drought coping strategies. This study found that the very young were the most vulnerable to the effects of food scarcity or shortage during drought years. As many households reduced the number of meals and the quantity consumed per meal, the children suffered most from malnutrition and other health problems. Some school-aged children were forced to leave school and take up unskilled labour as their coping response, demonstrating how vulnerable they were to drought. Another vulnerable group within this category were younger people, most of whom were allocated inferior or marginal land by their parents and had insufficient access to labour because their own children were still young. As a consequence, their level of vulnerability was quite high and they suffered production shortfalls.

Coping behaviour based on gender shows that women and men have different responsibilities and thus take different actions. Men are supposed to be responsible for food production, while food access within households falls within the women's domain. In practice, domestic tasks such as cooking and providing meals to family members have been performed by women until now. Such cultural practices expand the roles of women not only through having access to the granary but also in ensuring the daily food consumption for the whole family. In times of shortage of grain, women might undertake several actions. A woman may decrease her own food intake, reduce the family's overall food consumption and try to overcome the food shortage by seeking help from relatives, neighbours and friends. Men become involved when the situation becomes more serious. In my study, during focus group discussions, some women stated that they often borrowed money and food from relatives and friends without the knowledge of their husbands. Selling clothes, utensils and jewellery was a strategy employed by some women in the research area. This again indicates how vulnerable women are to drought and its associated impacts.

Most families in the research area rely on children to borrow food from relatives in times of food shortages. Moreover, some families may send their children to help relatives with domestic tasks and/or farming activities such as weeding and harvesting in return for food and a small share of the harvest.

5.6 **Conclusion**

In this chapter, various coping and adaptation mechanisms used to mitigate climate-related risks were examined. The findings from this study show that a wide range of mechanisms exists at household and community levels. Some of these are culturally developed and strongly adhered to within the community. These mechanisms are vital for the people not only to understand their own vulnerability but also to help them to take action in order to mitigate climate-related risks. Mechanisms also include having traditional knowledge about soil and water conservation. Farmers who possess that knowledge are able to adjust their farming practices with regard to types of crops, soil management and the timing for field preparation. The same is true for the local knowledge about reading the signs of rain. Farmers living in quite remote areas such as Amfoang, Takari and Amabi Oefeto mostly rely on such traditional knowledge to manage their farming practices.

With regard to drought, many of the households' responses observed in the research regions were short-term coping strategies. Such examples include making adjustments to crop management practices, household consumption and expenditure. Many of these responses depleted the resource base such as reliance on forest, and the household's livelihood asset base such as disposal of assets. Therefore, such responses may not actually be economically and environmentally sustainable, and most likely would increase people's vulnerability if another shock occurs. Generally, the poorer households' range of coping strategies is very limited, being restricted by their lack of assets and other means of coping such as access to formal credit.

Having examined adaptation and coping mechanisms to drought and environmental vulnerability, the next chapter will discuss livelihood diversification as another significant strategy undertaken by individual households in enhancing their adaptation. A wide range of livelihood options will be examined across urban and rural households in the following chapter.

Chapter 6 Diversifying Livelihoods

6.1 **Introduction**

The preceding chapter explored the coping and adaptation strategies that local communities have pursued to address their vulnerability to the impacts of rainfall variability and extreme climate events. This chapter examines household strategies in making ends meet through livelihood diversification. Since agriculture remains the mainstay of the local economy, this chapter begins with an in-depth discussion of crop production and livestock rearing, followed with other important types of livelihood activities being pursued in the research areas. It will then describe and compare the strategies for diversification of activities and livelihoods being pursued in both the rural (Kupang district) and semi-urban (Kupang City) regions across groups distinguished by wealth, ethnicity, and gender.

6.2 **Crop Production**

The majority of households in the research sites are engaged in crop cultivation. For a very limited number of households, however, crop cultivation is not their main occupation. These households include teachers, health care staff and labourers who have regular salaries as their main source of livelihood, rather than gaining their livelihoods from crop cultivation.

The various forms of land utilization for crop production in the research region are discussed in the following section.

6.2.1 **Dry-land Plots (Ladang, Kebun)**

Ladang or *kebun* represent the most widespread types of land use for agricultural activity in the regions on both a shifting cultivation (swidden) and a permanent basis. Swidden cultivation or shifting plots, though they are decreasing due to increased pressure on land, are commonly situated on marginal, steep and rocky areas, while relatively flat and more fertile soils are cultivated as permanent gardens.

Shifting plots involve cleaning up and burning off (*ladang*). This is conducted in the dry season. Repetitive burning is normally required; after the first burning, the charred trunks and branches are collected together to be re-burned. No tillage is required for newly opened-up clearings. Farmers simply cultivate the ash-covered plot, using planting sticks to dibble holes for sowing maize, pumpkin and sweet potatoes. After some years, when the fertilizing effect of the ash wears off, the plots are abandoned. Farmers then look for either new potential plots to be cleared or return to previously abandoned plots.

Due to increased pressure on land associated with population growth, shifting cultivators prolong the cropping period and establish permanent plots of cultivation. Another important reason for such a change is to secure the rights of ownership on plots of land. The traditional method of land preparation – using fire – is no longer applied. Farmers admitted that ploughing is required to improve soil fertility and to gain better yields. Labour inputs for these permanent plots are heavy, however.

Most farmers in the research area rely on manpower, by using hoes (see Figure 6.1). Only a few farmers can hire hand tractors to prepare their plots. Lack of capital is usually the main constraint for hiring tractors. The most common means of addressing this issue is through forming a labour group based on kinship and social networks. The members of a group all work together, moving from one plot to another. Some farmers having extra cash may pay for labour for ploughing their land.

Figure 6.1 Tilling Alluvial Soil with (metal) Digging Sticks (Left) and Hoe (Right)

Source: Author's field work

Another type of agricultural activity requiring heavy labour is fence construction for protecting the crops from animal attack. Fences, called *lutu* in Rotenese or *bah' lele* (*pagar kebun), bah aen oe (pagar sawah*) in Atoni, are made of various types of materials derived from local resources. In the palm savannah zone, farmers use palm leaf stacks (*bebak*) of the *Corypha* palm. Another important material is stone; whenever it is available, farmers prefer stone fences, which provide a solid wall. Living fences, commonly made of *Jatropha curcas (ahi oan mutin – damar / jarak pagar), Hibiscus tiliaceus (ai feu - waru), Gossypium hirsutum (ai kabas), Agave sisalana (tali balanda), Cordyline* shrubs and castor-oil plant *(Ricinus communis) (ahi oan*), *gamal* (*Gliricidia sepium*)**,** and *kapok* (*Ceiba petandra*)**,** are also preferred for their long lasting qualities and because they also provide shade for crops. Such heavy tasks are also conducted under group labour arrangements as in the case of land preparation.

In the villages under study, the most common crop grown on *ladang* and *kebun* is maize (*pena*). In addition, a number of crops with different water requirements and different durations are grown together as local adaptations to reduce the risk caused by long dry spells and rainfall variability (see Ormeling, 1956, p. 107). Maize, pumpkin and beans are the most common seeds that farmers plant in the same hole. Other root crops that are inter-planted together with maize are cassava, yams, taro and sweet potatoes. In addition, a number of subsidiary plants are also cultivated such as groundnut, cow pea (*turis*), mung bean, and kidney beans.

Figure 6.2 Cleaning up and Burning off Dry-land Plots (*ladang*) in Research Site
Source: Author's field survey, 2010

6.2.2 Wet-land Plots (Paddy fields / Sawah)

Wet-land plots refer to paddy fields or *sawah*, which are predominantly found in lowland and flat plateau areas. In general, rice is grown as sole crop in separate plots. However, some farmers also sow maize in rice fields. The cultivation of paddy fields is largely determined by the availability of water. Two types of paddy fields are found in the research area. One is rain-fed (*sawah tadah hujan*), while the other less common type is irrigated field rice. Rain-fed fields depend entirely on water from the rain stored in the paddy fields, and supplementary runoff water from the surrounding elevated land. Given these circumstances, rain-fed paddy cultivation involves high risk. As a consequence of erratic rainfall (see Chapter 4), crop failure often occurs in these fields in dry years, and/or in the years with interruptions or prolonged dry spells. In contrast to rain-fed, irrigated paddy fields are less dependent on rainfall, but rely on water sources like springs and rivers.

The method of paddy cultivation in the research area varies based on the water regime, topography, the soil type, and the availability of labour. However, two methods are generally practiced by local farmers, namely *broadcasting* of the rice and *transplanting* from nursery-grown rice seedlings. Between the two, broadcasting has been the most widespread method that farmers traditionally adopt for paddy cultivation. Usually, farmers prepare paddy fields for planting right after the first rains, or when water conditions in the fields allow this. The water is left to saturate the field for a few weeks to soak the ground and to kill weeds. The soft muddy soil is then thoroughly trampled (*rencah*), with the help of cattle, until the mud reaches a certain consistency. This trampling is often repeated once or twice, depending on the type of soil. As such this activity is very laborious, requiring at least three men to drive the animals across the paddy fields and to prevent them from destroying the bunds. Once the trampling is done, the field is ready for sowing, before which the water on the field is drained. After a few days of sowing, water is again let into the field. When 4-5 rice leaves have appeared, the field is drained and irrigated on alternate days. Thereafter, the local farmers tend their paddy fields very little. Weeding is rarely done more than once.

Transplanting is another method of paddy cultivation that, according to local farmers provides better yields than broadcasting. Transplanting differs from broadcasting in terms of the establishment of a nursery bed and the transplanting of young seedlings. The selection of an irrigable site is required for the establishment of a nursery bed, and the closest plot of land to a water source is usually preferred. The nursery bed is puddled in the same way as the paddy field. Then the water is drained off, and the mud is flattened using a piece of wood. Thereafter, the field is allowed to dry for several hours, allowing the mud to settle and thus preventing the seedlings from sinking too deep. The rice is sown into soft flat mud. Sowing of the nursery bed takes place three to four weeks before the chief paddy field is expected to be ready for transplanting. A large number of farmers are required to do transplanting either based on reciprocal labour exchange or hired labour. The seedlings are simply pushed gently into the soft mud at varying distances (between 20 and 30 cm) from one another.

Even though it requires a great deal more work than the broadcasting method, local farmers found that the transplanting method yields much better results. Also, the method provides wider spacing and cleaner cultivation for weeding, as compared to broadcasting. Moreover, it consumes less seeds, almost half of the amount of seed used for broadcasting.

Figure 6.3 Transplanting Rice Seedlings in Paddy Field
Source: Author's field survey, 2011

6.2.3 **Mixed Gardens (Mamar)**

Mixed gardens are known as *mamar*, comprising perennial crops and any other compatible plants in a relatively small plot of land. Plots located close to water sources are known as wet *mamar*, while those a bit further from water are dry *mamar*. While the types and composition of plants vary, 'mixed gardens' generally comprise a variety of trees and horticultural crops (such as coconut, jackfruit, mangoes, avocado, betel nut, guava, bananas), forage crops (*Leucaena, Gliricidia, Sesbania, Calliandra* and grasses), in addition to valuable shrubs and medicinal crops. Some native trees and palms are also grown in the *mamar,* whether for conservation, household investment (e.g., *Santallum album*), native house-building, honey-bee hive habitat, or to harvest sweet sap (e.g, *Arenga pinnata*).

Some households keep pigs, goats and chickens in these garden areas as well. The contribution of *mamar* to household incomes is significant. Banana and coconut trees, for instance, are considered productive by villagers, who often rely on the sale of their products or trade the fruits and coconut oil to cover household expenses. Betel-nut is also sold or traded regularly in the local market. Another advantage of *mamar* is that less labour and low maintenance costs required once they are well established.

6.2.4 **Household Plots**

Most households have home yards (*kintal*) and garden plots that are located adjacent to their dwellings. Types of crops grown in household plots are determined by the ecology of the settlements. Household plots in upland areas such as Raknamo, for example, are planted with maize during the rainy season. Highlander farmers in Kauniki have household plots that correspond to 'mixed gardens'. Produce from the household plots, just like other fields, is used for household consumption as well as being sold for cash in the local markets. Produce from these plots can yield some cash income at all times. Depending on the water supply, the plots are cultivated throughout the year to produce cooking herbs and vegetables such as shallots, eggplant, chilli peppers. Maize, pumpkin, cassava and often mung beans are among the crops in household plots especially in the rainy season. They serve mainly for home consumption especially to bridge the food gap in the 'ordinary hunger' period before the harvest season. Household plots are relatively smaller in size, as compared to fields (*ladang* and *sawah*), but their contribution towards household food supply in particular in the lean season or during the seasonal food shortage period is significant.

6.2.5 **Grasslands and Forest**

Common property resources such as grasslands and forests are significant for the local economy. They include all palm forests, open pasture and other uncultivated land in the villages. Its primary use is for cattle grazing. Throughout the year, cattle roam freely throughout these open lands; they are herded, counted, and branded by their owners annually at the end of the dry season. In addition, people are often allowed to clear portions of this land for agricultural use. Mainly swidden cultivation primarily for maize production occurs on this land. More importantly, grasslands and forest are communal land to which people have direct access. The potential of grasslands is high in Kauniki, compared to other villages under study. Consequently, Kauniki has the highest cattle production in Kupang District.

6.2.6 **Trends in Crop Production**

In my in-depth discussions with farmers, I asked them to compare their most recent harvest with harvests in the past years, five, ten and fifteen years ago. I could see possible signs of a 'nostalgia effect' in the respondents' perception that harvests in more recent years have been worse than harvests in the past (ten or fifteen years ago). However, this finding can be justified by referring to the recurrent droughts and high rainfall variability in recent years when a high proportion of agricultural households have suffered from harvest failures causing household production to drop far below subsistence levels.

To obtain a picture of crop production in the studied villages, household survey respondents were asked to identify factors that affect crop production. The local farmers' perception of their own problems sheds light on the reality of crop production in the research regions. The results of the household survey regarding problems in crop production revealed that the major constraints faced by most of the respondents originate from the crop production environment – in terms of the bio-physical, socio-economic and political environment, as shown in Table 6.1, and the lack of capacity of the households to respond within this environment.

Table 6.1 Farmers' perceptions of factors affecting crop production (N=416)

Rank	Reasons given by farmers	Numbers	% of farmers
1	Erratic rainfall	396	95.19
2	Lack of farm inputs (fertilisers, seeds, pesticides, labour, etc.)	227	54.57
3	Lack of farm implements (tools, plough, tractors, etc.)	201	48.32
4	Crop destruction by pests and diseases	141	33.89
5	Natural disasters	52	12.50
6	Animals/birds destroyed crops	38	9.13
7	Poor infertile soils	26	6.25
8	Lack of agricultural training / extension services	19	4.57

Source: Household survey data, 2010

'Erratic rainfall', which can be interpreted as including high rainfall variability as well as droughts was overwhelmingly the most frequent response; it can therefore be considered a crucial factor in crop production, posing a major risk to agricultural livelihoods in the research regions. While erratic rainfall was already discussed in Chapter 4 'Living with Climate Variability', factors other than erratic rainfall which affect crop production and so pose a risk to rural livelihoods were also cited by farmers.

About half of all respondents also mentioned 'lack of farm inputs – fertilisers, seeds and labour' and 'lack of farm implements'. These two factors are considered as agricultural inputs that can be accessed by the farmers either through purchasing or provision by central and/or local government agencies, or Non Government Organizations. Fertilizer, as important agricultural input, is mostly used by farmers to grow rice on paddy land. The most common fertilizer was a complete package of N. P. K chemicals, which is commonly purchased by farmers. However, not all farmers used fertilizers. Among the reasons were a combination of the high cost and lack of knowledge of the benefits of fertiliser.

The next three factors cited are all natural, namely crop destruction by pests and diseases, natural disasters and animal or bird attacks. Crop destruction by pests and diseases was perceived by a third of the respondents as affecting crop production. Unusual insect infestations of crops by worms (army worms), aphids and weevils as well as some unidentified red ants were reported by most farmers during the recent drought of 2009/2010. In addition, the Larger Grain Borer (LGB) (*Prostephanus truncates*) beetle continues to cause huge and widespread losses in stored grain. In spite of this reported infestation, less than 10% of respondents combated the infestation by spraying crops with insecticides. The reason given by most farmers for not spraying was their lack of information and knowledge of techniques, as well as financial constraints preventing them from purchasing the required chemicals and equipment. In fact, many households acknowledged that the inadequate pest control caused produce to be damaged by pests during the 2009/2010 seasons.

Apart from pests and diseases, birds were reported as feeding on crop grain and animals like monkeys destroyed crops. While squirrels eat the seed that are dry planted, other animals feed on the green crops (like maize cobs) on the farms. However, the farmers do not have any effective methods to deter the animals from destroying their crops.

A final issue was raised by relatively few households, but it is highly crucial, since it relates to the poor coverage of agricultural extension services in the studied districts, namely the 'lack of agricultural training helping the farmers in dealing with any issues in the crop production system'. Based on fieldwork and qualitative analysis of the data collected, it seems that the provision of agricultural extension staff for individual needs is based on requests from farmers. Individual farmers have to contact and request the services of the crop extension staff, and consequently have to pay for this service. However, access to these services is rare because farmers are neither aware of the procedures nor willing to pay for such services. At community level, the extension staff hold farmers group meetings (*kelompok tani*) where issues affecting crop production are discussed and the farmers advised. However, most extension staff complained that they had inadequate transport facilities to visit all villages.

6.3 **Livestock Rearing**

Livestock have cultural and economic importance for people's lives in the research sites. Cattle, in particular, are primary stores of wealth and also play important roles in ritual events such as weddings and funerals. These large animals are the households' long-term investments as well, while smaller stock like chickens, pigs and goats are liquid assets and serve as a source of funds to meet regular household expenses. This section provides an overview of livestock ownership in the sample villages, discusses the problems faced by livestock rearers, and reviews the sale and consumption of livestock.

6.3.1 **Livestock Ownership in Sample Villages**

According to the most recent population census at village level (BPS, **2010**) as seen in Table 6.2, the majority of households in the sample villages own livestock of various kinds. The most commonly owned animals, either individually or in combination, are cattle, goats, pigs and chickens. Taken together, this is a combination of livestock holdings by households in the research area.

Table 6.2. Livestock populations in the sample villages, 2010

Village	No of HHs	Cattle	Water Buffalo	Horses	Goats	Pigs	Chickens
Kupang District							
Kauniki	569	2,627	32	27	240	626	3,240
Raknamo	427	514	-	45	250	276	1,082
Poto	623	2,087	104	21	276	576	3,818
Kupang City							
Fatukoa	578	127	-	-	152	-	-
Bello	751	275	-	-	253	-	-

Source: BPS Sub-district, 2010

These figures on the distribution of livestock populations according to agro-ecological zones (villages) are justified. The larger area of rangeland available for grazing in Kauniki and Poto is the main explanation for the much larger population of cattle in these two villages. In other villages like Raknamo, Fatukoa and Bello, cattle production tends to be more confined and raised through a stall-fed cut-and-carry system. In this case, the average holding for each farmer is two head, mainly depending on access to fodder and labour.

However, the stock figures from the village census need to be interpreted with caution. In general, the figures are better taken as an estimate only as the numbers of animals stated are most likely to be lower than the actual numbers owned. Farmers generally under-report the number of cattle for several reasons, for example minimizing their potential tax burden, and adjusting numbers to take into account potential losses from starvation, theft, and disease. Most livestock owners with more than six head of cattle claimed that they were unsure of the exact numbers in their herds; they are not sure how many animals have been born, died, or lost from year to year until they round them up for branding and counting which is normally carried out at the end of the dry season.

The distribution of livestock ownership especially cattle is highly skewed. Since cattle are an important indicator of status in traditional communities, ownership is concentrated among certain individuals, categorised as local elites in all study villages. In Kauniki, for example, about two thirds of the total cattle population is owned by the *usif* (lord) and *amaf* (heads of clans). Cattle with no brands (*hetis*) belong to the *usif* Sonba'i. These free grazing animals account for almost half of the cattle population. A few members of the clan of Sonba'i Ote own at least 250 head of cattle each. In addition to these local elites, two Chinese traders from Takari in the central sub-district own about 300 to 500 head of cattle each. In another village, one farmer admitted to owning at least 500 head or about a quarter of the total cattle population in Poto.

In all villages, relatively wealthier households own more cattle than poorer households. The importance of the wealth attached to the numbers of cattle owned is evident in the research area where those owning more than 15 cattle are among a small proportion of households with modern houses (brick or cement walls, tiled floors and corrugated iron roofs). In spite of the skewed nature of cattle ownership, the traditional system of wealth distribution based on shared ownership and shared husbandry arrangements is also evident in the research areas. This helps those with no cattle to gain access to livestock. These institutional arrangements will be discussed in the next chapter.

6.3.2 **Changes to Livestock Numbers**

Although most households in my rural sample reported that they own some livestock, almost all claimed that the numbers of animals they own today is fewer than in the past. This is contrary to information given by the Animal Husbandry Office of Kupang district. The office estimates that an increase in cattle numbers can be maintained at a level of 1 to 2 % per year. This figure was based on their calculation of a birth rate of 24% per year, as compared to a mortality rate of 6% per year, slaughter rates of 6-7% per year and an inter-island rate of 10-11% per year. Despite the official estimates, others believe that cattle population is declining. One businessman I met in the local market stated that cattle numbers raised by households are declining given the fact that many cows are slaughtered to meet the local demand for meat, while many bulls are exported to other islands. Local elites also observed that many farmers in their villages sell male calves to meet education expenses and raise them to be fattened for slaughter. Consequently cattle populations, especially of bulls, have decreased even more over the last few years.

Information gathered in the field indicates several factors affecting changes in cattle population. The most common mentioned by most households that currently own cattle is *drought related loss*. Disease was given as the second most common reason for declining livestock ownership. Although less visible and dramatic than drought events, livestock diseases emerge from this survey as a major killer of cattle, sheep and goats. This suggests a large, urgent but unmet need for veterinary services in the region, especially for immunisation of livestock. After drought and disease, which are largely beyond the control of livestock owners to prevent, the next most common reasons for declining livestock numbers can be attributed to nutritional, socio-cultural, or economic reasons. Livestock off-take is a common livestock management strategy. Nutritional reasons include selling animals to buy other types of food (mainly cereals) or consuming the animals at home. Socio-cultural reasons include making in-kind or compensation payments (*belis*). Economic reasons include selling animals to meet non-food needs for cash, or for building or repairing houses. Finally a number of misfortunes can reduce the livestock population including animals being lost and stolen. This affected relatively few households, though the impacts on livelihoods of poor households certainly have been devastating, especially where cattle have been involved.

6.3.3 **Livestock Sales and Consumption**

In general, the disposal of livestock by both rural and urban households in the research area is determined by two household circumstances: either for emergencies or under normal conditions. Livestock ownership is a source of food and represents livelihood security in case of emergencies such as harvest failure. Large animals like cattle are regarded as long-term investments. In this regard, creating a buffer in the form of livestock is one of the most common forms of insurance. As stores of food decline due to climate stress and crop failure, and households enter a deficit, an increase in stock sales in order to purchase food would be expected within poorer households. This case is different for better-off or more secure households, which only dispose of livestock to buy food in exceptionally bad years.

Under normal conditions, however, the case is different. Small animals usually function as liquid assets for households in the research area. Animals are usually sold by households when there is a need for cash, especially when the income from agricultural products is insufficient to meet everyday household expenses. For small amounts of cash, selling poultry will suffice. There is no clear seasonality in sales of poultry. Chickens and eggs, for instances, can be sold all year-round. The marketing for this is the responsibility of women and children. For household consumption, chickens (and/or) eggs are generally consumed on special family occasions or when there are guests.

For larger expenses, people turn to pigs, goats and even a small cow. The sale of such animals has two peaks, one around Christmas when Christians want to buy new clothes and/or meet Christmas related expenses. During this time, the demand for and prices of animals are usually high. The other peak occurs just prior to the period in the farming calendar before the harvest. During this peak, some households may dispose of animals for food to bridge the hunger gap during the seasonal food shortage before the harvest. Other households may sell animals for farming related expenses such as to pay for non-household labour. Unlike chickens, pigs and goats are rarely consumed by households, but they are often consumed when inviting labourers to work on their farm.

Larger expenses such as funerals, the payments of bridewealth, tertiary education costs and medical bills, or the construction of brick houses are covered through the sale of a cow or bull. However, as cattle are highly valued as the symbols of wealth and social status, the sale of cattle is generally avoided and is considered as a last resort. Famers pursue other ways first to meet cash needs. With regard to consumption, cattle are slaughtered to feed guests at weddings, funerals, and other ritual events.

6.3.4 **Livestock Prices and the Marketing System**

Livestock raising makes a significant contribution to household incomes, but the prices of animals vary greatly between markets and over time. In general, cattle sales are conducted in the village itself. Some farmers may manage to sell their cattle at the nearest weekly market or popular '*Camplong*' market. However, given the poor road conditions, which affect the cost of transport to the market, many farmers wait for the buyers to come into their villages with their own transport. This saves the villagers the cost of transporting their livestock to market. This practice, however, involves losses to the farmers because the cattle are not weighed and the price is based upon an estimate from the buyer. Other factors that determine animal price include the animal's condition that could affect breeding potential such as its breed, age, sex, weight, and body shape. Market condition is another determining factor. Temporary rises or falls in demand and supply, for example, the collapse of supply caused by drought-related loss including animal disease and being stolen also affect prices. Spatial variation in animal prices is also found across the studied villages for various reasons such as differences in transport and transaction costs on different trade routes, and market inefficiencies (for example traders taking higher profit margins in monopolistic markets). Another complex issue affecting prices is seasonality, which affects the condition of animals. It is very common that during the dry season, animals lose weight resulting in lower prices, while during the rainy season, the prices are higher since the animals are fatter.

Although livestock rearing is the most popular livelihood activity in the research region, it is clear that this is a highly risky way of making a living. The numbers of herds and flocks fluctuate due to the reasons discussed above, and income earned from livestock is therefore very unpredictable and irregular, being determined by a range of issues especially market conditions and seasonality, as well as inter-annual variations in rainfall.

6.4 **Cattle Fattening - *Paronisasi***

In addition to rearing extensive free-grazing livestock, local farmers are also involved in cattle fattening (locally known as *paronisasi*). In the fattening system, animals are tethered all the time in stalls or under very simple sheds and fed forage until they reach a certain weight. Given that, it is also best described as a cut-and-carry production system that requires sufficient labour and forage supply. It was first introduced in Amarasi, one sub-district of Kupang through a provincial government program dating back to 1971. Under this program, the provincial government bought male cattle from outside Amarasi, and then gave them to farmers in Amarasi who had an adequate supply of *Leucaena* fodder and labour. The farmers carried the cattle for 6 – 12 months until the cattle reached slaughter weight; they were then sold through traders for export off Timor. The profit after deduction of the initial cost was shared between the farmers and the government.

Figure 6.4 Paronisasi in Kauniki Village
Source: Author's field survey, 2010

Nowadays, the *paronisasi* system has been adopted by almost all communities in the West Timor region. In the studied villages, cattle for fattening come from several sources. The majority of cattle raised by local households come from the government program, in addition to local investors who buy young cattle from other villages or sub-districts and give them to local farmers to fatten. Local farmers may also have access to cattle fattening from wealthy individuals who give out their cattle for *paronisasi*.

The system of *paronisasi* tends to be conducted through complex leasing and debt arrangements or through extensive social networks of patronage. In general, the arrangements for cattle fattening are mainly based on either a profit sharing or a wage system. In the former, the profit is shared between the farmers and the local investor after the costs of production are deducted, such as the cost of a male calf, medicine and rope. In the wage system, the local farmers are rewarded based on a calculation that involves: (a) the increase in the animal's weight (the difference between the initial weight at the time of *paronisasi* and the final weight when sold); (b) an annual wage for each head of cattle; (c) a special wage arrangement between the two parties including some extra cash when the minimum weight is reached. In the views of local farmers in the studied villages, the profit-sharing arrangement is more advantageous than the wage system. Under profit-sharing, the share of profit is almost equal between the owner and the carrier; they can earn up to 50% of the final selling price, as compared to wage system which may offer about 10 – 15 % of the sale price

The government program of cattle fattening is identical to profit-sharing. If the farmer had bought the cattle from the government, then local farmers earn about 85% of the profit, while the remaining 15% goes to the government. In other cases when the farmers do not pay for the cattle until the sale of the fattened animals, the farmers return 60% of the sale price to the government, keeping the remaining 40%.

Despite its lucrative cash income, the production of cattle fattening is entirely tied to the availability of household labour, and access to forage and water sources, which affect the rate of participation. The practice of cut-and-carry forage is not only time-consuming, but also requires access to fodder such as King grass (*Pennisetum purpureum*), crop residues, and leaves and pods from trees, such as *gamal* (*Gliricidia sepium)*, *turi/gala-gala* (*Sesbania grandiflora*), kapok (*Ceiba petandra*), *lamtoro* (*Leucaena leucocephala*) and *kabesak* (*Acacia leucophloea*). Some households require access to other people's land to collect fodder and pay compensation in return. Many households in the villages under study (Kupang district) are also involved in growing fodder crops such as *Pennisetum purpureum* to meet the demand for fodder.

The period of fattening is determined by the age of the calf, and the level of fodder supply. In general, the *paronisasi* ranges from one to two years to reach the desired weight for disposing. Local farmers usually look for a calf aged 2 to 3 years, and fatten it for about one year before selling in the market. In general, one household in the village under studied tends two steers in a year.

Due to the extensive rangeland and given the labour and forage constraints, livestock production in the studied villages still relies on both the traditional rangeland grazing system and the cut-and-carry production. This bimodal type of cattle raising system contrasts with the Amarasi model (Metzner 1983) which shifted from rangeland system to the smaller stall-fed system.

All in all, the *paronisasi* system allows the local farmers to have a share of the profit in cattle rearing and increases their level of income. Farmers involved in *paronisasi* reported that the cash earned contributed about 35 to 40% of the household cash needed annually.

6.5 Lontar Tapping

Among the traditional livelihood activities conducted in the research region is '*lontar* tapping', although this is less popular than in the past. This activity was previously dominated by the Rotenese, but is now practised by other ethnic groups including the Atoni. Tapping the sap of the *lontar* palm offers edible products for household consumption including its fresh juice (*nira*) and sweet syrup (*lontar* syrup or *gula air*) made from the boiled juice. Local households especially the Rotenese used to rely on both the fresh juice and *lontar* syrup (to be mixed with water) to substitute for meals. In addition, *lontar* syrup is used to make palm sugar, sweet soy sauce, vinegar and alcohol. The *lontar* syrup can be stored for long periods; households often keep it either for substitute meals during the hunger period or sell it in the local market. Given that, *lontar* tapping is still an important livelihood activity in the research regions.

Every year, this activity is carried out in two seasons. The first season, locally known as *musim timur,* lasts from April to June; the second season lasts from September until November (*musim fanduk*). *Lontar* tapping activity involves a clear-cut division of gender roles. The men (husbands) climb the palms to do the tapping and bring down the fresh juice, while women (wives) cook the syrup, in addition to gathering firewood from nearby forest/bush. The *lontar* palm is tapped twice a day, starting from early in the morning, taking a break during lunch time, and then working until late at night, depending on the number of palm trees. Likewise, the juice is boiled twice a day.

Figure 6.5 Lontar Sapper, climbing up to collect and bring down the *nira*

Source: Author's field survey, 2011

Most households involved in *lontar* tapping do not own the trees. They tap trees on other people's land. Therefore, the produce (the juice and/or the *lontar* syrup) has to be shared between the tapper and the palm tree owner. The share system is negotiable, but in general, two thirds of the profits/ returns is kept by the households, while the remaining one third is given to the owner of the palms trees. For example, if 30 jars of *lontar* syrup are produced in one season, then about 10 jars should be given to the tree owner. If the juice is to be shared, they do it every other day, one day for the owner and the other day for the tapper.

The market demand for palm sugar is quite high. Nowadays, most households prefer to produce palm sugar to palm syrup. One household can make an average of 200 cakes of sugar a day. Every week, a household can sell up to 15,000 cakes of cooked palm sugar to the buyers who usually come once a week, earning about Rp. 250,000. This is mainly pursued by rural households. In the case of Kupang city, conversely, households have other options, either to make palm sugar or to sell the fresh juice door-to-door. Selling fresh juice is economically viable because the economic return is higher than making palm sugar or *lontar* syrup.

Figure 6.6 Boiling the fresh juice to make Syrup (Left), and Palm Sugar (Right)

Source: Author's field survey, 2011

6.6 From Maize to Manganese

Owing to the recent discovery of substantial manganese deposits in East Nusa Tenggara Province including in the Kupang district and city, many farmers, who were already disadvantaged by the short season for agricultural work and successive years of droughts, had abandoned their fields for mining sites during the period of my field work. As of December 2010, about 80 mining companies were operating in the Kupang district, absorbing a large number of workers to separate the manganese from waste rocks. The pay offered by these mining companies for this labour was about Rp. 25,000 to 30,000 (A$3.20) per day, for on average of nine hours of work a day; lunch and transport which cost about Rp. 12,500 per day (A$1.40) were at the labourer's own expense. Given this relatively low wage, many farmers preferred to working illegally on abandoned fields and in communal and protected forests, as well as on the sides of steep hills and rivers. They could collect at least 50 kg of manganese a day, earning about Rp. 50,000 (A$5). These economic incentives are higher than for traditional farming activities.

The local market price of manganese was well below the international market price. Such discrepancies in illegal traditional mining involved several layers of actors in marketing the manganese: from local farmers who dug illegally within unclaimed and abandoned fields and/or exclusively on private land, through the networks of local middlemen who visited local compounds to collect the ore from local diggers, up to the larger companies that bought the ore from the local middlemen before shipping it abroad. This complex value chain is outside the local authorities' control. Not surprisingly, little protection for local diggers was available in terms of market price.

Like traditional agricultural activities, manganese mining is a family business, involving all family members and even the extended family, making a group of 5 –10 people. Men dig, while women and children collect and sort the manganese ore. Transport from the sites remains the job of men, however. These activities are generally conducted with traditional tools; every stage of the process is done by bare hands, from digging, sorting to collecting and transporting the ores. I visited several sites where local farmers were working and found that they worked at these manganese sites all day, from dawn to dusk, without protective clothing and safety equipment such as helmets, masks, gloves and safety shoes. Most of the local diggers searched for the manganese ores with their bare hands. During breaks, they would have meals and cigarettes without washing away the toxic materials from their hands. Being exposed to the high risks of the toxic manganese dust, many of the local miners were reported to suffer from asthma, chronic lung disease and other respiratory and allergic diseases.

Figure 6.7 Digging for Manganese in Kupang District

Source: Author's field survey, 2010

Moreover, these mining activities on productive farmland, protected forests and around water sources cause obvious and serious environmental degradation. Local forest and water resources are reported to been heavily damaged. The activities during the rainy season of 2010 were closely associated with the increased incidence of flooding and landslides. In Kupang District alone, seven people (from Fatuleu, Amarasi, Sumlili/Kupang Barat) died and dozens were injured while collecting manganese ores (*Jakarta Post*, July 12, 2010). At the provincial level, these mining activities have caused at least 54 deaths since 2008; some of these were women and children (*Jakarta Post*, January 31, 2011).

Increasing competition for control over mining sites has also sparked tension between locals in West Timor. Several clashes between the indigenous groups of West Timor and former East Timorese refugees have been reported by the national media. In March 2010, for instance, several houses were torched in Oeltone Village in Fatuleu, sub-district of Kupang Kabupaten, after an ex-East Timorese refugee went missing near a manganese field in the region (*Tempo*, March 8, 2010).

While it is clear that manganese mining offers undeniably higher income than farming in the short term, the damage to people's health, and the social and environment impacts can be expected to reduce rural household livelihoods especially in relation to household food security in the long run.

6.7 Comparing Diversification Strategies

6.7.1 Urban (Kota) versus Rural (Desa)

This study has found a greater degree of diversification of livelihood initiatives in Kupang city than in Kupang district, with a higher proportion of households engaged in two or more different livelihood activities in the urban area. It is true that a broader range of income generating activities was identified within the communities studied in Kupang district than in Kupang city. The bulk of these activities, however, were mostly concentrated in a few households, with the majority of the population relying on only one or two farm and non-farm activities.

Nonetheless, the agriculture sector supports the local economy of both districts, and remains the most significant element in the rural – urban livelihood systems. This is because, first, most capital within the households is generated and accumulated through the production and sale of livestock and crops especially in the case of rural Kupang, while in the case of urban Kupang, the participation in diverse forms of income generating activities is often strongly related to agriculturally based activities. Second, agricultural labour was identified as an important livelihood activity amongst the poorer households in both regions of Kupang district and Kupang city.

Kupang city has a more vibrant non-farm economy than Kupang district. Most of the non-farm income-generating activities identified in Kupang city were found to be relatively more profitable in comparison with farming in which households in this region are able to supplement farm incomes through a wider range of income generation activities. This is somewhat in contrast to Kupang district, in the sense that most of the population, which was traditionally dependent on the production and marketing of crops and livestock, is still in the process of adaptation to recurrent drought and climate variability. While a range of income generating activities can be found in Kupang district, the majority of the population are engaged in only a few low entry-barrier activities such as farm labouring for some men and petty trading amongst women.

This study has also found that many of the non-farm activities in both districts require adding value to or exploiting primary production: for instance, trading processed foods or produce, carpentry, and the use of fuel wood in brick making or baking cakes. However an increasing number of activities depend on imported inputs (such as household goods, petrol, cement, cloth) or provide services (restaurants, retail shops/small kiosks). While these service enterprises were mostly pursued by the better-off, the majority of these had gained their start-up capital from crop production or livestock rearing, which highlights the fundamental role that the agriculture sector continues to play.

6.7.2 **Wealth Groups and Occupation**

Diversification is clearly widespread. But the strategies are likely to differ between households in the studied regions, depending on their social and economic status. A community wealth ranking was used as a template for revealing occupational diversity. The ‘very poor’ (comprising between 5% and 10% for Kupang city, and between 10% and 20% for Kupang district) were generally recognized as incapable of diversifying their livelihoods. This group, which owns very limited resources and has even lost access to land and livestock, often lacks the means to become involved in any kind of income-generating activities. In seeking employment, they depend entirely on their own labour and on the limited skills they possess. In this respect, because their own labour is their only resource they tend to maximize this, through taking up casual labouring or farm labouring. Their main access to employment is through their own labour and doing anything that comes up.

In contrast, the ‘poor’ and ‘average’ groupings (together constituting between 60% and 70% for Kupang city, and 70% and 80% for Kupang district) were, by and large, identified by this study as being capable of participating in a wide range of income generating activities. The 'poor' group, who tend to own very little land and other capital assets, suffer poor harvests and possess only a limited number of livestock, or have been affected by devastating drought, are forced by necessity to find off-farm income. In other words, rather than by a considered strategy, the diversification within this group is a *survival* strategy. The occupations this group tends to be involved in are unskilled and low paid, seasonal, sporadic and insecure. They depend on the exploitation of a common pool of natural resources such as gathering honey, mat and-rope making, gathering and selling firewood, making and selling charcoal. In the case of the rural poor, a few engage in casual farm labor and herding or in the case of their urban counterparts, in construction work. Women within this group are also responsible for household income, taking up petty trading, and processing food for sale. Where returns are inadequate to meet household expenses, those affected are trapped in a downward spiral of poverty. Households may have to resort to selling off available household assets like small animals.

In contrast to the urgent requirements faced by the 'poor', the 'average' group resorts to diversifying strategies for risk management. The main reason for the 'average' group to diversify is as a means to buffer food shortages, price fluctuations and other recurrent difficulties. In general, members of this group have sufficient land and capital assets to meet their subsistence needs. They generally own a motorcycle and have household equipment such as a television and radio. Their assets are not only the means of production but also the means of meeting secondary and/or tertiary needs.

Their income bases are greater, and are not limited to farm activities: they often make more additional income on a regular basis. They commonly seek to expand their social networks, enhance their productivity and actively seek employment opportunities. For rural households, these better off groups frequently engage in the production and sale of livestock and crops, have retail shops (small kiosks), do fish trading, and they may derive rental income from property or land. For their urban counterparts, their non-farm incomes include remittances from educated children with formal jobs. Their capacity to take risks is, however, still limited due to limited surplus from production and capital.

In contrast, those within the 'rich' group (between 10% and 15% for Kupang city, and between 5% and 7% for Kupang district), have a greater capacity and more assets to meet needs; they are considered as being able to *accumulate* capital and thus to improve their welfare to a higher level than any groups. They are usually involved in a narrower range of livelihood activities – predominantly crop and livestock production and sales, followed by service-based enterprises (such as retail and restaurants) and crop and livestock trading. Their income sources include renting out their productive assets (land and livestock) on a profit-sharing basis to poorer households. For this well-off group, diversification involves using their investments, knowledge and networks and can be said to be driven by the motivation for profit maximization. The members of this group are generally those with a livestock-based economy including high-yielding dry-land and/or irrigated crop enterprises.

They are able to make a large surplus and tend to expand their social and economic networks. They are risk takers, willing to shift investments from the agricultural-base to the more dynamic non-agricultural sector. In recent years, it has been common for members of this group to develop major political interests, running for local elections, such as for the position of member of district parliament or the legislative body (*Calon legislative*). As such, they make use of their wealth through social and political networks as much as in business investments.

Various implications can be drawn from these findings with regard to livelihood diversification. First, occupation specialization is *a product of poverty*. In this regard, the 'very poor' are the *victims* of poverty as they have no access to sufficient resources and thus fail to engage in potentially more profitable income generating activities. Second, occupation specialization is a product *of choice*. This is the case for those who are able to maintain the strongest livelihood base through focusing on one or two main livelihood generating activities, which are generally agriculturally related activities. Third, in between these two extremes is the most diverse group. They are actively engaged in various occupations in order to obtain the extra income needed to supplement subsistence crop production.

6.7.3 **Ethnicity**

The differentiation of livelihood strategies between ethnic groups can be clearly identified by the main sources of livelihood within each group. The Rotenese and the Atoni show the highest degree of dependence on crop cultivation and livestock rearing. However, a breakdown of these livelihood sources displays a significant difference between the two groups with regard to crop cultivation. Paddy cultivation is a dominant strategy among the Rotenese, while swidden (dry-land) farming especially maize dominated crop cultivation is foremost among the Atoni. Livestock rearing is a popular livelihood activity for both groups. However, more Atoni are engaged in this business than Rotenese. In contrast, the newly-settled East Timorese, who are the landless, are engaged in wage labour both on and off farm.

The disparity in livelihood strategies between ethnic groups is a reflection of social/ethnic entity. Paddy cultivation is viewed by the Rotenese in Poto not only as a symbol of wealth but also a reflection of their culture (*adat*). Likewise, for the Atoni, swidden cultivation or dry-land farming is fundamental to both their livelihood and their identity. One Rotenese explained, 'paddy cultivation is our culture', while the Atoni cited, 'our source is swidden'. In contrast, a few Atoni confided that their ambition, like that of their Rotenese counterparts, would be to cultivate more paddy fields. Nevertheless, they are limited to dry-land farming as their most available option.

The establishment and cultivation of paddy fields require better access to resources than dry-land or up-land farming, namely suitable or already-bunded and/or irrigated land, and well-timed inputs (ploughing, seeds, chemical inputs and labour), as well as access to capital and credit. Once established, paddy provides better economic returns than dry-land farms. Therefore, paddy cultivators enjoy better economic advantages than non-paddy cultivators. The East Timorese are engaged more in wage labour because of a lack of access to productive resources especially land and capital. Through establishing labour groups, they work on and off farm. On-farm labour includes weeding, ploughing, and harvesting.

Within ethnic groups

Livelihood strategies also vary within the ethnic groups with regard to resource access, welfare and social relations. Access to key resources is the main determinant of this variation.

In the village of Kauniki, a homogenous community, the variation is clearly determined by who controls the resources. And this is related to the traditional leaders (*usif* or *amaf*). Their privileged position enables them to control key resources and accumulate wealth. Communal land is under their control as is forest land. They still, to this day, enjoy a major share of forest products such as timber. Likewise, livestock is mainly acquired through inheritance, dating back to the Dutch period when the distribution of cattle centred on the local ruler or local chief and the Chinese.

Within ethnically heterogeneous communities such as Poto and Raknamo, social interaction or marriage relations has caused things to become slightly blurred. But the variation within each group is discernible to the point that it is possible to identify a more 'Rotenese-like' group and a more 'Timorese-like' group in terms of livelihood strategies, resource access and welfare. Through direct observation, this differentiation is evident: the Rotenese-like group which lacks paddy cultivation depends mainly on natural or forest products and wage labour. Likewise, the Timorese-like group is mainly engaged in paddy cultivation, livestock rearing and trading. Much is mediated through marriage and social relations. Among the East Timorese, few individuals are diversified in terms of their livelihood activities due to their limited social relations with the local population and the lack of good network relations with government officials.

6.7.4 Gender and Change

In both districts, men are engaged in a greater degree of livelihood diversification than women. More men were involved in cultivating and herding as a secondary activity in Kupang district than their counterparts in Kupang city. More women in the city were commonly engaged in trading than in the district. Among the 'poor' and 'average' groups, women were in general engaged in agricultural based activities, crop and small livestock production (chickens and pigs), some farm labouring and handicrafts (weaving, mat and basket making) especially in rural Kupang. Men within these poor and average groups were diversification actors with regard to the range of their livelihood activities and the number of these activities engaged in by individuals.

A division was observed between the main non-farm based traditional livelihood activities pursued by women in the two studied regions. These traditional practices, which are primarily naturally based resources, include the gathering of forest related products, mat-and-rope making, weaving (*ikat*), *lontar* tapping, hunting and the collection of honey. They also include some increasingly non-traditional income generating activities engaged in by men in both regions, such as carpentry and construction.

Traditional income generating activities have been practised for few decades and rely on the transfer of skills from one generation to the next. Entrance into these livelihood efforts is based mostly on the locality in which participants coming from households are situated around the natural resource. These activities have a low entry barrier and offer a low return that provides an inclusive context for engagement. However, due to the heavy labor and lack of sufficient remuneration, these traditional income-generating activities have become less attractive for more dynamics members to increase their profitability.

The non-traditional livelihood activities are primarily a result of increasing infrastructural development programs such as the construction of schools and health centres, which creates a local demand for skilled labour. In general, younger men with adequate skills and social networks were engaging in such newer forms of livelihood activities, while older and less well-connected men continued to be engaged in more traditional, non-manufacturing activities such as selling *bebak* (used for house construction) and rope making.

The perception of these non-traditional activities as an important source of income generation was somewhat contrary to the fact that some households in the research area still regard some handicraft activities especially weaving (*ikat*) as merely traditional practices rather than 'businesses' per se. This traditional understanding is not static, however. Given the increasing need for cash income especially when households are under pressure to make ends meet, culturally proscribed gender roles can shift. In this view, one can expect an increasing participation of women in the non-farm economy. A growing number of handicraft groups (*ikat*-groups) and to lesser extent baking or home made products groups have now formed in the research areas and receive technical and financial assistance from government and non-government organizations (NGOs). Such assistance may help women take up traditional activities not merely as a traditional practice but as a reliable source of household income.

Figure 6.8 East Timorese Women weaving *Ikat* in Raknamo Village
Source: Author's field survey, 2011

Apart from the persistence of traditional and non-farm activities, the most dynamic growth in the research area is in the non-traditional, commercial and service sector activities. While only practiced by very limited number of individuals and dominated by wealthier households in each village under study, the establishments of retail shops (small kiosks) and restaurants (*warung*) over the recent years are fast becoming mini-growth poles, inspiring some individuals to shift from traditional enterprises towards these non-farm income generating activities.

6.8 **Conclusions**

This chapter has discussed how agricultural households in the research regions have coped with the risks posed by climate variability through the creation of a portfolio of farming and non-farming livelihoods. Sample households diversify by complementing crop-production with livestock rearing and/or *paronisasi*, and also engaging in income generating activities in other people's farm or in the non or off-farm sector, including self-employment and gathering. However, differences in livelihood diversification can be observed between urban and rural sites, and between households. Such differentiation can be attributed to factors including the availability of and access to land and common property resources such as forest, grazing land and water sources, as well as access to credit, markets, transport, services and related infrastructure.

It is true that each household in both rural and urban Kupang has its own range of options about types of livelihood activities. However, it is the bundle of capital to which households have access or entitlement to that basically determines whether members of the households will diversify out of choice or from necessity away from farm-based activities to non/off farm activities in coping with climate variability related risks. Differences between households that determine certain types of livelihood activities are associated with ethnicity, household size, gender, as well as wealth group, ownership and access to assets. Social and/or kin-based networks, and household status and position within the village based on rights and claims to control access to key resources are also influential.

Chapter 7 Underlying Causes of Social Vulnerability

7.1 Introduction

The main objective of this thesis has been to assess social vulnerability and adaptability in the research regions. The findings of preceding chapters have confirmed that the research regions have been vulnerable to climate related risks such as rainfall variability, droughts, El Niño and La Niña, affecting agricultural production which is the mainstay of the local economy in the regions (see Chapter 4). Disruption of agricultural livelihoods, in particular loss of crops and harvest failure, are examples of the associated effects of these risks. Every year, the local population, many of whom are poor, are at risk of persistent food shortage or food insecurity, malnutrition, and health problems.

However, the vulnerability of the regions to climate variability and change does not occur in isolation, and nor is it solely due to climate perturbation. In fact, the findings from Chapters 5 and 6 identify other important factors that also reinforce each other in shaping the regions' vulnerability. When harvests failed, some community groups and individual households opted to diversify their sources of livelihoods to include non-farm based activities, which are less sensitive to climate variability, while others failed to do so. Faced with poor germination due to the occurrence of a long dry-spell, some households managed to repeat sowing, while others did not. Such examples highlight other factors than climate changes per se; many other economic, social and political factors and processes in fact shape people's vulnerability in the research regions.

Building on the findings from the preceding chapters, this chapter seeks to explain those underlying factors and processes that have worked to shape the people's vulnerability. *I argue that social vulnerability in the research areas is the result of a configuration of forces that are related and reinforce each other, and are not solely limited to climate stressors such as climate variability and extreme events; social, economic and political factors also contribute to the social vulnerability in the regions.* Among all of these, the underlying causes of social vulnerability in the regions are dependent on three main factors: (1) environmental degradation, (2) poverty and (3) differential access to resources. The following sections will discuss these three issues.

7.2 **Environment Degradation and Vulnerability**

The natural resource base has long been the main source of livelihoods in the regions and the perpetuation of this pattern has resulted in a declining natural base. The resilience and sustainability of livelihood systems in natural resource-dependent areas, by and large, rely on the susceptibility of the natural resource base to changes that are due to human intervention (Blaikie & Brookfield, 1987). Rural livelihoods are often strongly dependent on the human resource base (Scoones, 1998) and the sustainability of the resource base is fundamental to sustainable livelihoods, as seen in this definition from Farrington, Carney, Ashley, & Turton (1999).

> A livelihood is sustainable when it can cope with, and recover from stresses and shocks, and maintain or enhance its capabilities and assets, both now and in the future, while not undermining the natural resource base (Farrington et al, 1999:2, adapted from Scoones, 1998).

The psycho-sociological literature emphasizes that individuals with a high vulnerability who live in a high-risk environment have a high probability of suffering. Intervention would involve either the reduction of vulnerability or a decrease in the riskiness of the environment (Begun, 1993). In relation to natural resources, those living in the most sensitive environments (Liverman , 1990) and those with livelihoods on the margins of economic or ecological viability are believed to be the most vulnerable to change (Heathcote, 1985). Other authors, however, emphasize that some individuals avoid collapse when they are exposed to very high levels of stress (Cohler, 1987). 'These resilient individuals have the qualities and the resources to withstand lives filled with difficulty' (Begun, 1993, p.4). This point is also made in the literature that deals with coping strategies, where it is suggested that populations in more marginal environments are more successful at coping with food stress than those accustomed to more secure conditions (for example Davies, 1993).

The bulk of the local population in the research areas is highly dependent on the natural resource base. However, the environmental degradation in the research areas is evident with regard to land, forest, soils and water resources.

7.2.1 **Forest Depletion**

There is no doubt that forests and land are being degraded in the research regions. Coupled with the rising population growth, pressures on forest and land are unavoidable, as more forests and grasslands areas are converted to semi-permanent or permanent plots or sites for farming, settlements and public infrastructure. In 1993, an estimated area of 16,500 square km was covered by grasslands in the whole province of East Nusa Tenggara (Garrity, Soekardi, & Noordwijk, 1997), or about 35.8 per cent of the land area. The extent to which population growth has resulted in the conversion of forests and grasslands is still unclear, due to the lack of accurate statistics on forest loss in the province, especially in the research areas. However, much of the area covered by grasslands was once dense monsoon forest, and the grasslands are thought to be an anthropogenic consequence (Ormeling 1956; Monk *et al*., 1997). A study conducted by the Center for International Forest Research (CIFOR) concerning vegetation coverage found that human activities had reduced forest cover in NTT to about 4463 square km (9.6 per cent of land area) in 2002, with grasslands, croplands and non-vegetated areas occupying 34,389 square km (74 per cent) (Tacconi & Ruchiat, 2006).

Human intervention contributing to forest degradation is also confirmed within this study. While a lack of available farmland has reduced the practice of shifting cultivation, the use of fire (burning) is still carried out in dry-land farming within the studied villages. Moreover, forest and related products have been the main sources of rural livelihoods in the research villages. Timber, firewood and charcoal making, mat-and-rope making, building materials (timber, *bebak*), sago (*putak*) are among the forest-related products that have proved important to rural livelihoods. In times of drought, the reliance on forests and forest related products was even greater. The new emerging livelihood activity of artisanal manganese mining is another example of human intervention that causes forest degradation.

In line with Ormeling's argument, I also consider these livelihood patterns as parts of the local population's strategies to cope and adapt to the unfavorable climate and ecological constraints in the regions. However, careful distinction has to be made between 'erosive' and 'non-erosive' coping (De Waal, 1989). The fact is that the continuation of traditional coping strategies on the natural resource base in unsustainable ways can reduce short-term vulnerability but then this adaptation results in more vulnerable livelihood systems: in short, the case of the research areas demonstrates that ‘erosive’ coping, which is neither economically nor environmentally sustainable, continues. Devastating forest depletion continues to date.

7.2.2 **Land Degradation**

Added to forest depletion is the fact that relatively productive land is now a scarce resource in the research areas. As with forest depletion, population growth has resulted in major land use changes including decreasing farmland availability. As a consequence, the fallow period in the regions has decreased significantly (see Chapter 5). The short length of fallow period has the potential to increase the problem of land degradation, resulting in a decline in agricultural production both per unit of land and per unit of labour. Such a downward spiral of land degradation and forest depletion is unavoidable in the research regions.

In fact, this issue of land degradation was raised during my interviews with most farmers in Kota Kupang and Kabupaten Kupang as they compared the size of farmland they cultivated nowadays with that of the past which their fathers and grandfathers cultivated. Farmers claimed that given the same acreage of cultivation, yields were higher in the past. In the past, increasing the size of farmland or opening up new land for cultivation was, therefore, one of the most common coping strategies for farmers to feed their children. When farmers compared the present situation with the past instead of with other places, they commented that land degradation was a causal factor in declining land fertility in the research area.

It is plausible to argue that there has been a decline in soil fertility in the research area, even though in the past the soils were not fertile either. In fact, based on local people’s views a number of issues can be linked to the problem of land degradation in the region. These issues include population pressure, land use changes and the continuous practice of traditional farming methods, in swidden cultivation. Population pressure and land conversion appear to be common issues associated with land degradation in both regions: Kota Kupang and Kabupaten Kupang. While city dwellers cited the conversion of land for human settlements, commercial development, public office development and infrastructure network expansion as the main causes, rural people mainly pointed to agricultural extensification and traditional farming methods through slash-and-burn cultivation in addition to over-grazing caused by livestock production.

The degradation of land is linked to the traditional farming method of slash-and burn cultivation, which has been perpetuated since the introduction of maize by the Dutch in the 1670s (Fox, 1988). Before this, similar methods were probably used in the cultivation of dry land millet and other crops. This method involves opening up new areas for cultivation by burning the existing vegetation and planting seeds in the ashes. This continuing practice to date, according to Fox (1988), has resulted in a radical transformation of Timor. The practices of slash and burn cultivation, coupled with the possible changes in rainfall patterns, tend to increase soil erosion, which, in turn, exacerbates the problem of land degradation.

In addition, the cattle population over the decades has increased to a level that has led to environmental degradation. This is because the main source of feed is derived from native grasslands and natural vegetation. Uncontrolled, open range and indiscriminate grazing have converted the natural vegetation into extensive grassland areas, which also impede the process of forest regeneration (Ormeling, 1956; Fox, 1977; Metzner, 1977). This is a biological process known as 'savannah climax'. It is unlikely to permit forest generation in the foreseeable future. These conditions are aggravated by the poor awareness of farmers in maintaining the sustainability of the environment. An accelerated loss of natural vegetation as a result of cut-and-carry forage cannot be avoided.

7.2.3 **Soil Erosion**

Soil in the research areas is being lost through erosion but also being degraded. No exact figures with regard to the extent of soil erosion exist nor are their comparative crop yields from the past or the present to confirm this soil degradation. However, local farmers in the research areas believed that the soils' capacity to produce crop yields is decreasing. As pointed out in the previous section, most local farmers expressed their concerns over the issue of losing soil fertility, arguing that their soils were more fertile in the past. Despite the inherently poor soil quality (see Ormeling 1956; Fox 1998), it is difficult to dismiss the farmers' views. In fact, there are a number of interrelated factors causing soil erosion in the regions. High wind speeds during the dry season and high rainfall intensity in the rainy season are arguably causing soil erosion all year round in the regions (Mohr, 1933 cited in Ormeling 1956, p.210). Such climate factors are further exacerbated by the repeated practice of burning, leaving the bare or unprotected land to suffer more from rain and wind erosion.

In this study, local farmers found that rates of soil loss are particularly high on steeper cultivated slopes than on relatively flat areas. In saying that, they take into account the crop yields between two different topographical sites; generally, relatively flat areas gave better crop yields than steeper slopes. In general, the steeper slopes are chiefly cultivated with such crops as maize and cassava that do not prevent surface water flows, and thus the soil erosion is considerable as high rainfall washes away the subsoil from these areas down to the relatively flat areas of cultivation.

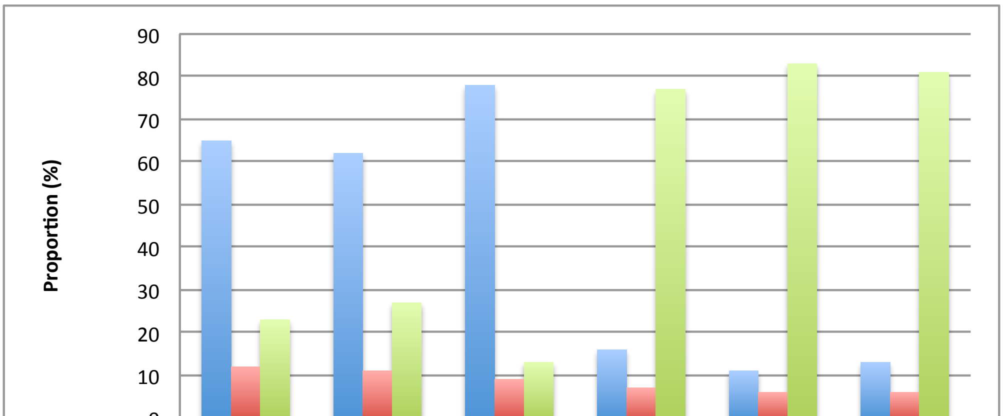
Given current trends in land use, coupled with possible changes in rainfall patterns due to climate change, rates of soil erosion may increase in the future, clearing land of established vegetation and increasing runoff rates with less water to permeate the soil. This in turn means increased rates of soil erosion, increased risk of flooding downstream, and increased sediment loads and decreased water quality downstream. Added to this also is an increase in the risk of landslides, which are a problem in the regions and which have resulted in deaths. Further, the absence of established vegetation means less retention of soil moisture, meaning that soils are drier and agricultural productivity is less than could be achieved in more settled mixed farming systems.

So the principal driver of soil erosion is human activities, especially unsustainable farming practice and poor methods of soil conservation (see Chapter 5). However, if climate change results in more intense rainfall events interspersed with intense dry spells, this together with poor soil characteristics may exacerbate soil erosion in the regions.

7.2.4 Farmers' Perceptions of Land Degradation

Local concepts of soil classification, as discussed in Chapter 5, provide little information concerning local farmers' views on land degradation and environmental conditions. In order to examine the extent to which land degradation has occurred in the research regions, understanding farmers' perception on this issue is crucial.

This section will critically examine farmers' perceptions of the changes in their field soil properties over the last seven years of cultivation period. Local farmers were asked to describe how their farmland has changed with regards to selected soil properties and environmental indicators. The results discussed in this section are mainly derived from the semi-structured questionnaire administrated to 213 household heads and the walk-over made on selected fields. Local farmers have been well aware of the changes in environmental / agronomic indicators in their fields over the last seven years of cultivation (see Figure 7.1).



	Soil fertility	Soil moisture	Depth in upper part of plot	Ease to plough	Moisture in lower part of plot	Weed occcurrence
Decreased	65	62	78	16	11	13
No Change	12	11	9	7	6	6
Increased	23	27	13	77	83	81

Figure 7.1 Farmers' assessment of the impact of land degradation within seven years of cultivation in the studied villages

Source: Household survey, 2011

Within the villages studied, the majority of household heads (65%) found that their farmland fertility is decreasing, while only about 23% of sample farmers felt the reverse: that the fertility is improving. This is an important indicator since fertility is associated with numerous indicators such as soil texture and colour, in addition to yield (see Chapter 5). The marked decline in fertility experienced by sample farmers within a cultivation period of seven years points to serious land degradation in the research areas in the form of soil erosion and nutrient mining.

Local farmers in this study also observed erosion and deposition processes on their cultivated plots. About 78% of the participating farmers said the soil depth on the upper part of their cultivated areas was declining drastically, while 83% of the respondents said more moisture and soil deposition were happening in lower sites of their plots. This finding is consistent with the previous work of Ormeling (1956) on the impacts of land degradation on soil fertility in the research regions of Timor. Erosion and deposition together with the physiographic and geomorphological composition of the sites are important elements for the soil formation process. Participating farmers said that their plots undergo a gradual transformation caused by soil erosion and deposition processes.

The majority of respondents (77%) indicated that compared to seven years ago, their fields are now easier to prepare for planting (Figure 7.1). Two implications can be drawn from this issue. First, the local farmers may find their plots easy to work as their land is losing resistance in a sense that the heavy and aggregated soil property is being lost. Another possible implication is that land preparation techniques have been improved. During interviews, a few local farmers explained that they often plough their plots several times before the planting season, as compared to one or two decades ago when most fields required no plowing. Previously seeds were mainly planted directly into the soil with a dibbler stick. This points to a major shift in planting procedures. Almost a third of the sample farmers said that when they ploughed their plots more than twice, they achieved a better yield, but only when the level of precipitation during the rainy season was at least at an average rate. They explained that a decline in the number and size of cultivable plots allowed them to have more time and energy for land preparation. Farmers generally believe that more time put into land preparation causes their plots to become more fertile.

Another agronomic indicator is the considerable increase in the occurrence of weed infestations in recent years, even with more cultivation. There is little explanation offered by the local farmers as to why weed infestation has increased recently. A few farmers simply stated that as their plots of land go 'bad', the land becomes infertile for crops but becomes more hospitable to the 'cursed' plants or weeds. In this view, farmers pointed out that weeds reduced soil quality and degraded the land, which in fact is supported by scientific studies carried out in other parts of the world (Kremer & Li, 2003; Kang, 1997; Jacome, 1993). These studies found that soils containing rich organic matter and nitrogen stocks have high levels of microbial organisms that may prevent the incursion of certain weeds.

Given that the majority of local farmers in the research regions are poor and are unable to afford weed control technologies like herbicides, they mostly rely on traditional practices of pre-planting seasonal weed reduction. Farmers usually plough their fields frequently, exposing the weed seeds to direct solar radiation in order to reduce the likelihood of the seeds germinating. Local farmers maintained that they use the occurrence of a dry spell during the rainy season to reduce weed occurrence. As weeds grow after the first rains, they use the opportunity of dry spells to plough and remove the weeds from their plots. Moreover, they used a hand weeding system (*tofa*) at various stages of their crops to control the impacts of weed competition for water and soil nutrients.

7.2.5 **Water Resources**

Water is a critical resource in the research areas. Due to the extended dry season (see Chapter 4) and the porous subsoil of the region (Ormeling 1956), the regions suffer from water shortage throughout the year. This problem of water shortage is even greater during the dry season. In the case of Kupang city, access to potable water during the dry season is limited to an average of one day every two weeks from two days in a week during the rainy season. In Kabupaten Kupang, people mostly rely on natural water sources like springs and wells. During the dry season, water levels are at their lowest. Rivers dry up shortly after the rainy season. Water levels in springs fall and most wells run dry. Villagers, mostly women and children, must walk more than one kilometer to the nearest water sources. A few trips a day to the local water supply are normally performed to meet household demands including for livestock, especially cattle.

Global climate change is most likely to result in drier dry seasons, less rain but more intense episodes, and El Nino events, causing delayed rain and/or less rain, and all these factors may become more severe. These changes will most likely aggravate the regions' existing problems with drought, floods and water availability. If climate change results in less rainfall in the dry season, then this will be a significant problem because the regions are already vulnerable to drought because of the high year-to-year rainfall variability combined with a minimal water resource infrastructure.

In conclusion, environmental degradation is one of the underlying factors that leads the local population, especially the poor, to be more vulnerable to climate related risks (see Adger & Kelly, 2001). *Degradation of land cover and soils* leads to declining agricultural productivity and therefore reduces the value of natural assets available to people. Human wellbeing depends on the sustained supply of ecosystem services; thus unsustainable use of ecosystem services increases vulnerability (Schroter, 2009). *Biological resources* provide the raw materials for livelihoods, agriculture, medicine and industry. Forests, grasslands, freshwater and other natural ecosystems provide a range of services which are vital to human welfare; they regulate water flows and water quality, control floods, pollination, carbon sequestration, soil conservation, and nutrient and hydrological cycling (MA, 2005). Therefore, biodiversity loss will lead to the erosion of ecosystem services and will increase vulnerability to the impacts of climate change (ICIMOD, 2010; UNEP, 2010). Furthermore, climate change will lead to water scarcity, increased risk of crop failure, and pest infestation. *Water shortages* affect agricultural productivity, food security and human health.

7.3 **Poverty and Vulnerability**

Apart from environmental degradation, this study has also identified poverty as one of the key drivers of vulnerability in the research areas. Compared to the relatively better-off households, it is the poorer individuals and/or households that have the least adaptive capacity to cope with drought, loss of crops and harvest failures (see Chapters 4 and 5). The *World Development Report 2000/2001* (2001) makes a clear comparison between 'the better off – upper and middle class', and 'the low income group'. The former, with stable employment, insurance, credit and assets, recover faster from disaster, as compared to the latter group, with fewer assets, almost no insurance and less diversified sources of income, as they have fewer options for coping with disaster, and in fact, a disaster can push them into destitution.

This section will look at the aspects of poverty which tend to reinforce vulnerability, and the degree to which vulnerability leads to and reinforces poverty.

7.3.1 **Poverty: Concepts and Measurements**

Poverty is a dynamic concept which has evolved from a very simple and straightforward view in terms of economic wellbeing to the notion of capability, and recently to include a much broader concept of social inclusion. The notion of economic wellbeing involves assessing poverty based on income, consumption and welfare, and can be classified into absolute, relative and subjective concepts. *Absolute* poverty generally points to the lack of the basic means of survival (OECD 1976; United Nations 1995 cited in Spicker, 2007, p. 12), through the measurement of the amount of income to purchase a minimum food intake of calories; the minimum basket of consumption goods; or a level of individual welfare required to live a basic life (Hagenaars, 1991; Macpherson & Silburn, 1998). With regard to *relative poverty,* people are considered poor when their individual income falls below the mean or median income of their societies; their level of consumption is below the society consumption level; their individual welfare level is relatively below the society's welfare (UNDP, 2000; Wagle, 2000; Wagle, 2002). In contrast to absolute and relative poverty, *subjective* poverty is mainly based on peoples' own perceptions of what level of income, consumption and welfare is perceived to be non-poor. This subjective measurement is important to reveal social inequality of poverty including cultural and geographical factors. However, it fails to provide comparable data over time across societies and also suffers from the problem of data reliability (Sen, 1987).

In addition to economic wellbeing, further research adds the notion of capability to poverty analysis. Central to the idea of capability is 'freedom and human rights', thus capabilities are argued as the key determinant factors of poverty and wellbeing (Sen, 1987, 1992, 1999). The relationship between capability and wellbeing is described by the 'means' and 'ends' relation. Capability is the 'means' to achieve wellbeing' as its 'end'. Through this description, poverty is the result of an incapability to 'function' or to ‘achieve’ wellbeing (UNDP, 2000). This notion of capability highlights the importance of improving anthropometric measures within individual capabilities such as education, health, gender disparities and social structural relationships that affect individual wellbeing (Muellbauer, 1987; Sen, 1992).

More recently, the study of poverty has expanded to include social inclusion issues. In this regard, the study of poverty is now more concerned about the social processes that contribute to the failure of securing the resources required by people to avoid being poor (Silver, 1994; Strobel, 1996). A number of studies have confirmed the interrelated cause of social inclusion and poverty (Rodgers, Gore, & Figueiredo, 1995; IILS, 1996; Gore & Figueiredo, 1997; Figueiredo & de Haan, 1998). Studies of social inclusion identify three domains, the economic, political and civic/culture domains that are crucial to determine human wellbeing. Exclusion from any of these domains will lead individuals and households to deprivation (Strobel, 1996; Atkinson, 1998; Evans, 1998; Taylor, 1999)

7.3.2 **Poverty as an Important Barrier to Adaptive Capacity**

The adaptive capacity of the households in the research regions is, to a great extent, determined by the individual and/or household assets (including knowledge) required to implement adaptation strategies. Numerous factors determining the ability to cope with and adapt to the changes include recognition of the need to adapt, willingness to undertake adaptation, and the availability of, and ability to deploy, resources (Brown, 2010). The poor have the least adaptive capacity because they have limited control over and access to key resources such as financial, technological and human assets. Many of these crucial assets have historically been allocated to previous generations. The characteristics of the assets they possess are crucial in coping and adapting to environmental changes. Those with limited assets in areas such as education, health and social networks generally are not only more vulnerable (Adger *et al*., 2004) but also are more likely to succumb to the shocks and stresses that push them into chronic poverty (Tanner and Mitchel, 2008, p.9).

Livelihood *assets* are indispensable for households to cope and/or to adapt to changes. Being poor simply implies having *limited options* or choices to cope with or adapt to environmental changes. 'If your granary is empty, you had none to plant in the ground', a very poor widow of one study village replied to me when I asked why she did not consider planting a crop since she has no other means of livelihood. This statement demonstrates a critical message about how poverty confines choices. Poverty obviously causes many limitations and barriers in eking out a living. This is closely related to Sen's (1993) view on capabilities as one important measurement of poverty: he argues that an individual can be unable to obtain food due to many reasons, not limited to lack of money.

One aspect of poverty in the research regions is the dire lack of capital to invest in improving livelihoods. The lack of financial capital in particular makes it difficult for the poor to diversify their livelihoods, even to take up a small income generating activity. As discussed in the previous chapter, the poor often fail to take up credit due to strict credit requirements such as collateral. Their main asset base is their *landholdings*, and these are small and unviable for both the very poor and poor groups in the sample villages. Moreover, the volatility of their income discourages them from applying for loans.

Consequently, the poor have limited adaptive capacity in dealing with changes. The previous chapter highlighted the fact that it is the richer households that diversify more than the poorer households. Moreover, the poorer people could not afford some of the coping strategies such as the use of fertilizer to cope with the inherently poor soil quality, as compared to richer households which can afford more fertile land as well as fertilizer. Having depleted seed stocks, the lack of savings prevents them from repeat sowing (*soni*). It is too expensive for the poor to go for a second batch of seeds when a crops has failed due to false rains or dry spell interference. Reliance on social resources based on kin and social networks was the last resort for the poor to gain access to seeds for *soni*. Ample examples are available to highlight that the resilience and adaptive capacity of poor farmers is generally limited, in comparison with the better off families.

Due to barriers such as these, people are sometimes forced to choose alternatives that are economically worse for them. For example, the disposal of assets is a popular coping mechanism to meet household expenses in the times of drought when household production falls below subsistence level. Many households in the sample villages were forced to sell assets such as livestock, household items, and gold; this includes the mortgages over land (see Chapter 5). If they had other means, they would not have disposed of these valuable assets. Taking up a loan and/or credit is another example of a coping mechanism that further causes the affected households to become even more vulnerable to falling below the poverty level. Interviews with key informants from the study villages revealed that when resources have been depleted by crop losses and debts, a serious drought and/or flood can be the event that pushes a household further into debt – *galing lubang tutup lubang* – , leading to further erosion of their livelihood base by selling vital assets.

In this case, poverty and vulnerability reinforce each other. While poverty increases the likelihood of affected households to become more vulnerable, vulnerability per se can be a gradual process, slowly leading to poverty through long-term erosion of security, entitlement and resources (Cook, 2002). It is not necessarily true that households are 'stuck' in poverty. However, the recovery period may just be longer for the poor, compared to the relatively richer households. In the study villages, those who disposed of their livestock confirmed that it is difficult to gain access to livestock again. For those relying on share rearing, for instance, renegotiation is generally required with the livestock owner. Some households were often denied access for a number of reasons including lack of trust by the owner. Even between the extended family members, drought and/or hardships may contribute to the erosion of trust, which is essential for the sharing of capital and the resources required for coping with climate related risks.

Lack of human capital is another feature of the poor in the research areas (see Chapter 3). Human capital, in particular literacy and higher education, becomes imperative in the search for employment especially skilled jobs and income opportunities in the attempt to adapt to changing conditions. Among the four income categories, only 46% of the respondents in the 'very poor' group were literate, compared to 72% in the rich group. Wage and/or casual labour was obviously seen as the only livelihood option, apart from agriculture for this non-literate group. It is therefore the lack of human capital that prevents the poor in the research regions from taking up skilled labour especially in less climate-sensitive sectors. Their excessive dependence on natural resource based activities predetermines their vulnerability.

The relationship between poverty and literacy is a vicious cycle: poor households do not have access to higher education or vocational training (or even basic education in some cases) since they cannot pay the costs, whereas the wealthy can afford to send their children for higher education. Although the government provides free basic education, the rural poor still cannot always afford the associated costs of education for children, or the cost of losing children's labour, and they are thus less likely to be educated.

The poor, especially in Kabupaten Kupang are also disadvantaged in terms of connectivity, especially to the center of the administration and market. Greater proximity to roads is generally associated with a lower incidence of poverty and improved access to infrastructural services, which mainly exist in urban centers (Hunzai *et al*., 2011). The government has invested heavily in infrastructure and outreach services and is specifically targeting the poorest districts, but the rugged terrain, remoteness, sparse population, and lack of reliable communication facilities hinder the delivery of services (for example, education and health services) in rural Kupang. *Limited accessibility* was thus another factor that reduced people's possibilities for escaping from poverty and limited their adaptive capacity.

7.3.3 **Gender and Ethnicity**

Differences in adaptive capacity in the research regions are also related to gender and ethnicity. *Patriarchal values are* still predominantly held which is one of the reasons why women in the study villages have limited access to key resources (land, livestock and education) and are economically poorer compared to men. Within households, women have limited access to food and nutritional intake, being the last to eat and thus the first to be most affected by *nutrition deficiency*. Moreover, in addition to domestic tasks such as fetching drinking water, firewood and often fodder, the coping strategies of households also rely on *women's labour* in such activities as ploughing, repeat sowing, spreading pesticides and fertilizers, and hand weeding (*tofa)*. In some cases, women must work as wage labourers with the pay rates lower than those of men due to their lack of education and financial assets. Given this situation, the adaptive capacity of women in the research regions is generally lower than that of men.

Ethnically, people belonging to particular minorities (Florenese, East Timorese) tend to have a lower adaptive capacity as a group. In addition to having lower rates of education, they generally suffer from poor access to key resources in particular land, livestock, credit, and a social network. Even though some of them are involved in subsistence agriculture, the sizes of landholdings are lower than average. Given the smaller resource base, their coping and adapting to environmental changes including climate variability is undeniably more difficult than for the indigenous groups. Since most of them are dependent on wage labour and work as sharecroppers, the decline in agricultural productivity due to climate related risks has caused these ethnic minority groups to suffer the most.

To sum up, this section has argued that adaptive capacity in the study regions was partly determined by poverty and the reliance on income sources that are highly sensitive to climate or weather patterns. As the agricultural sector as the main source of livelihood becomes increasingly at risk, other sources of income become increasingly important. Individuals and/or households who have diversified their sources of income both on and off-farm, and have higher educational attainments, are arguably the ones who are most able to cope and adapt. In saying that, it is the poorer households in the research regions, having small marginal landholdings and limited sources of income, who are the ones that find it most difficult to cope and adapt.

Poverty is one of the most important causes of vulnerability to environmental threats, on the basis that the poor tend to have much lower coping capacities and thus they bear a disproportionate burden of the impact of climate related risks. But poverty is not the only factor. The following section will highlight the role of institutions in determining access to resources as one of contributing factors to the state of vulnerability in the regions.

7.4 **Institutions, Access to Key Resources and Vulnerability**

This study finds that the way agricultural households in the research regions manage their livelihoods in the wake of environmental changes including climate variability is, to some extent, determined by the resources they have access to. Following Blaikie *et al.* (1994, p. 48), access to resources in this study refers to the ability of individuals, households and community groups (wealth and ethnicity) to use and command resources that are directly required to make ends meet or to secure a livelihood. However, it is worth noting that the way access to resources affects vulnerability is indirect, mediated through institutions that govern access to resources. In other words, institutions play an important role in determining who are excluded from access to resources and who are not. Table 7.1 presents the institutions from both studied regions that affect the ability of households to gain access to key resources.

Table 7.1 Institutions mediating access to resources in the research regions

	Land	Labour	Draught power	Livestock	Fertiliser	Seed stock	Water	Fodder	Credit	Capital equip-ment	Info
Intra-household	Inheritance / patrilineal system; Subdivision	Family labour	Borrowing loaning	Inheritance; loaning / entrustment	Gifts	Gifts	well-ownership inherited	Family labour, gifts and loans	Borrow-ing	Borrow-ing	Seasonal migration networks
Inter-household groups and practices	Customary access arrangements; sharecropping	Work parties; sowing/ ploughing/ weeding exchanges; seasonal labour exchanges	Work parties; exchan for labour	Bride-wealth; Loaning; Herding contracts		*Tonda* (borrow-ing)	Free access to communal springs and wells	communal grazing;	Kin-based loans; *arisan* (savings group)	Plough sharing;	Seasonal migration networks; farmer groups
Inter-household cash transactions	local land sale and rental	Hiring	Hiring tractors	Local markets	Markets	Markets	Local markets	Local markets	Money lending	Local markets	
Formal organisations	Land tenure legislation (Basic Agrarian Law)	Church work parties	Local government schemes (provincial and district)	Local government schemes (provincial and district)	Local govern-ment schemes / aids (provin-cial and district)	Local govern-ment schemes / aids (provin-cial and district)	Local govern-ment schemes (provin-cial and di strict)	Local govern-ment schemes (provin-cial and district)	Banks; Credit institu-tions	Local govern-ment schemes (provin-cial and district)	Extension services; Agricultu-ral and Vetenary Depart-ments, NGOs

7.4.1 **Land**

The present land use patterns for farming activities in the research area are, to large extent, determined by control over and access to land. 'Access' refers to the "freedom or ability to obtain or make use of' something" (Merriam-Webster, 1993, p. 6). This term has a similar meaning to the term property, which is "a right in the sense of an enforceable claim to some use or benefit of something" (MacPherson, 1978, p. 3). In the studied villages, local communities understand access to land as providing rights to enter into and cultivate the land accordingly. These rights are usufruct rights and can be granted to farmers based on social and market transactions. In contrast, control over land is associated with the ownership of land and how the land is managed in terms of cultivation size, types of crop, transfer of land titles and so forth.

7.4.1.1 Before and after *Basic Agrarian Law 1960*

It is essential to provide a few words on the historical features of control and access to land in the regions before and after the ratification of the *Basic Agrarian Law 1960*. Control and access to land during the colonial and early independence periods were based on *adat* regulation in which land ownership belonged to a tribal chief (*usif* and *amaf* in Timorese society) and/or local ruler (*temukung*). Local populations had the right of usufruct only. This right to a particular piece of land expired as soon as the farmer ceased to cultivate that land. Exercise of this right was supervised by the ruler's local representatives called *temukung* or *usif* /*amaf*. Under *adat* law, even today the ruler or rather his legal successor is considered the owner of the land.

After the ratification of the Basic Agrarian Law, which allowed farmers to own land, control over land changed accordingly. The plots of land cultivated on a permanent basis under communal tenancy and which previously could not be bought or sold, were converted to individual ownership under the Basic Agrarian Law. Thus, the cultivators, who previously held usufruct rights, were able to claim full control over the use of those plots of land. These legal changes also allowed outsider groups to acquire land under communal tenancy on the basis of existing usufruct rights. Claim of ownerships in the initial periods were sought through the approval of community elders, before being passed to village official (Brewer 1990 in Monk, 1997, p. 564). Under the law, people were encouraged to extend their control over land by opening up new plots of land not yet held under communal or private ownership to obtain land title.

7.4.1.2 Land Title Registration and Security of Land Control

The security of control over land is commonly sought through obtaining a land title or land property rights. In general, the majority of the rural population especially subsistence farmers in the research area do not yet have a title to the land they cultivate. In 1984, the government introduced a mass land registration programme entitled PRONA (*Program Nasional Agrarian*), providing a simple way to gain a land certificate. This program favoured local elites and the better-off families to register their land. The majority of the population, being unable to afford the considerable cost of surveying, failed or were less interested in acquiring land titles, however. Their rights of ownership are still held within the communities on the basis of existing knowledge of their rights over the land and their continuity of cultivation. This knowledge of historical cultivation is often a source of dispute for those who seeking to establish land rights between community groups and members of clans. Once the land rights are secured, the ownership is allowed to be transferred between generations mainly based on the supposed 'patrilineal' system followed by the community in the research area. In addition, market transactions through sale and purchase are also common amongst the local farmers via oral transactions that are recorded in the village office.

While control over land may have improved, the unequal or skewed distribution of land within community groups under the law is also apparent. Owing to their privileged position during the period before the law of 1960, a larger proportion of land ownership was shared among members of large ethnic groups and their chiefs and among local elites through their villages heads or *temukung*. Their previous position enabled them to acquire large portions of land. Within the traditional Timorese settlements, like Kauniki, the large landholdings belong to the clans of Kono, Bani and Suan. In other cases where there is a heterogenous ethnic composition like Poto Village, the first settlers acquired large portions of land, namely Rotenese, followed by some Atoni.

In short, today's land rights originated from a number of management and control sources. Individual ownership rights originating from individual farmers sequestering state land were allocated to the farmers and came from the clearing of forests or unproductive plots. Individual ownership rights also have their origin in what was formerly known as communal land, that is, community owned land that was shared out in rotation for cultivation. Originally this was traditional land that could not be bought or sold because it was common property.

7.4.1.3 The Distribution of Land

Social differentiation in access to land is observed in the sample villages in both Kupang City and Kupang District. Under a putatively patrilineal system, land inheritance passed from a father to his sons. This system disqualified women's claims to rights over family land. Usufruct by women is still possible with the consent of male siblings or parents, but women have no rights to sell or transfer the land. Owing to weak state intervention in land redistribution, ethnic minorities were denied access to land. Likewise, poor local farmers only gained access to marginal land that was inferior in terms of size, fertility and distance from roads and compounds. The following findings explain this social differentiation.

Kupang District

In the case of the traditional and largely homogenous Atoni village of Kauniki, twenty four (38 per cent) of the 61 sample households cultivated less than 0.25 hectares, nineteen households between 0.25 and 0.75 hectares, eight households between 0.75 and 1.5 hectares, and 10 households (15 per cent) cultivated over 1.5 hectares. These figures represent the household distribution of dryland land holdings. Irrigated land, which amounts to only 15 hectares in total, is shared by the local elites. Five hectares belong to the *usif* (the chief or king), while the remaining 10 hectares are allocated to clan members.

Wealth Group	**Size of Landholding**	
The rich	More than 1.5 ha	16%
The average	0.75 ha – 1.5 ha	13%
The poor	0.25 ha but less than 0.75 ha	31%
The very poor	Landless and less than 0.25 ha	39%

The land distribution pattern according to wealth group shows that about 70 per cent of sample households belong to the poor; the very poor cultivated less than 0.75 ha, while the average and rich, who comprise 29 per cent, owned more than 0.75 ha **(see** Figure 7.2).

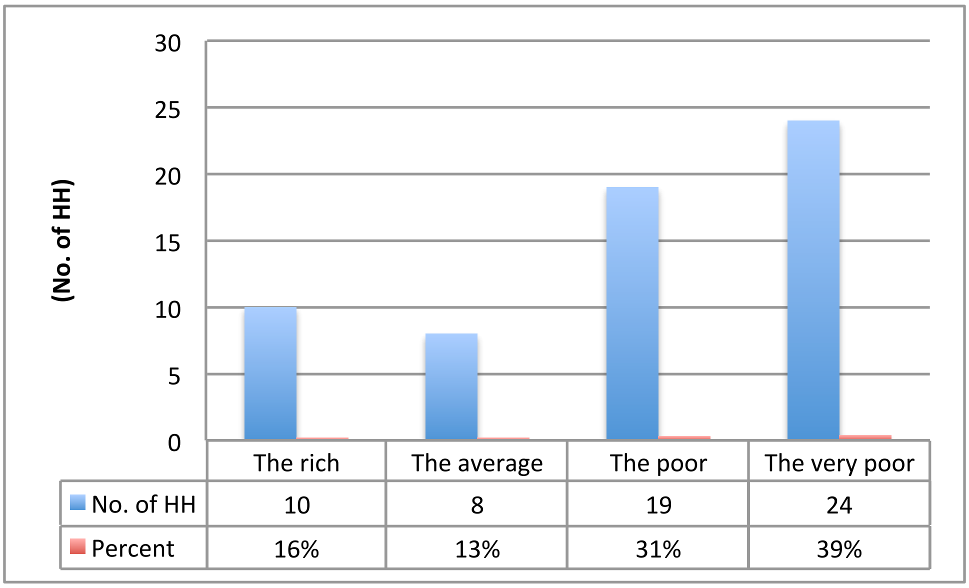
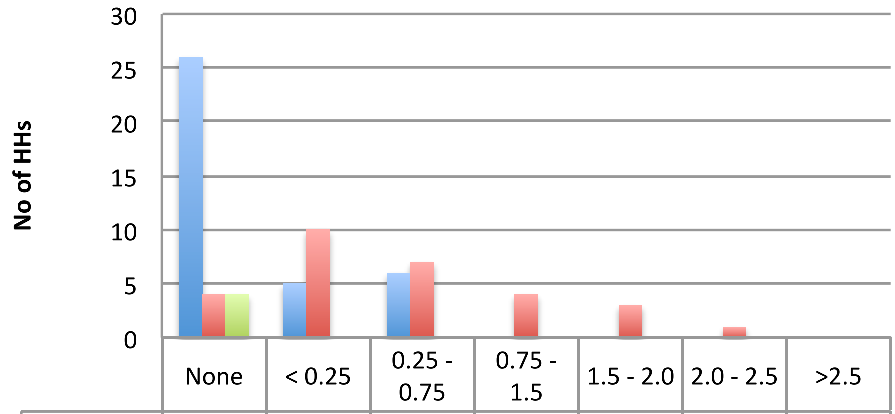


Figure 7.2. The total land owned by sample households in Kauniki Village in 2010

Source: Fieldwork (Household Survey, 2010).

Within the more heterogeneous villages of Poto and Raknamo, the social differentiation of land access is observed not only between wealth groups but also between ethnic groups. The share of land access according to wealth groups follows a similar pattern to that of Kauniki. Large landholdings belong to the richer farmers or to those with 'average' wealth. A majority of sample households, however, are poor and very poor, with size of holding less than 0.75 ha.

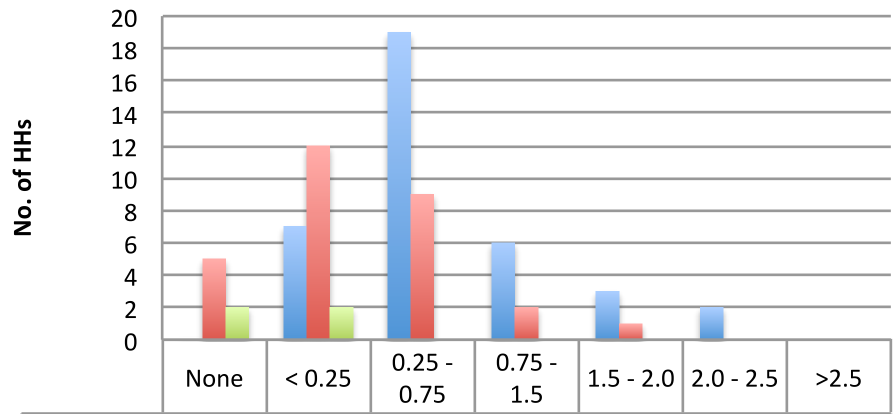
With regard to the various ethnic groups, disproportional access to land in Poto can be observed according to type of land. The Rotenese have greater access to irrigated land in Poto than do the Atoni, as shown in Figure 7.3 For example, only eleven households out of 37 the Atoni sample households had access to irrigated land, compared to the majority of Rotenese farmers: 24 of 29 Rotenese households. In contrast, all of the Atoni farmers (Figure 7.4) in this study have access to dryland and a majority (82%) cultivated dryland areas greater than 0.25 hectares, compared to Rotenese farmers (41%).



	None	< 0.25	0.25 - 0.75	0.75 - 1.5	1.5 - 2.0	2.0 - 2.5	>2.5
Timorese	26	5	6				
Rotinese	4	10	7	4	3	1	
Other	4						

Figure 7.3. Access to irrigated land (Ha) by ethnic groups in Poto, 2010

Source: Household survey, 2010



	None	< 0.25	0.25 - 0.75	0.75 - 1.5	1.5 - 2.0	2.0 - 2.5	>2.5
Timorese	0	7	19	6	3	2	
Rotinese	5	12	9	2	1		
Other	2	2					

Figure 7.4. Access to dryland (Ha) by ethnic groups in Poto, 2010

Source: Household survey, 2010

Table 7.2. Number of household heads with access to land (irrigated and dryland) by village and ethnic group

Village	Ethnic Group	Type of Land	Access to area of land (ha)							Total No. of Households
			None	< 0.25	0.25 - 0.75	0.75 - 1.5	1.5 - 2.0	2.0 - 2.5	>2.5	
Poto	Timorese	Irrigated Land	26	5	6					37
	Rotinese		4	10	7	4	3	1		29
	Other		4							4
	Timorese	Dryland	0	7	19	6	3	2		37
	Rotinese		5	12	9	2	1			29
	Other		2	2						4
Raknamo	Timorese	Irrigated Land	12	9	2	1				24
	Rotinese		5	8	4	1				18
	East Timorese		7							7
	Other		1							1
	Timorese	Dryland	1	13	5	3	2			24
	Rotinese		2	11	2	2	1			18
	East Timorese		5	2						7
	Other		1							1

Source: Household survey, 2010

In the case of Raknamo, the two ethnic groups – both Atoni and Rotenese – have a proportionally similar access to land (irrigated and dryland). With respect to irrigated land, more Timorese farmers than Rotenese are landless. However, Atoni (18%) and Rotenese (16%) had access to irrigated land of less than 0.25 hectare **(**Figure 7.5**).**

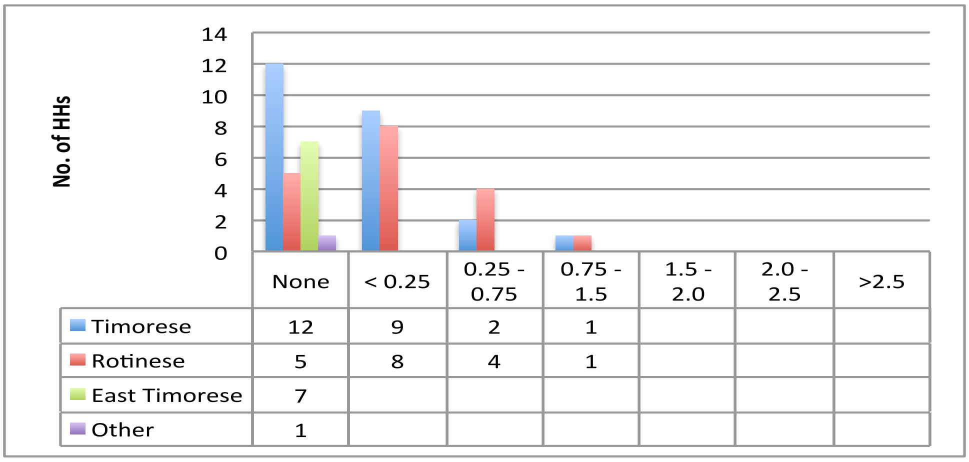
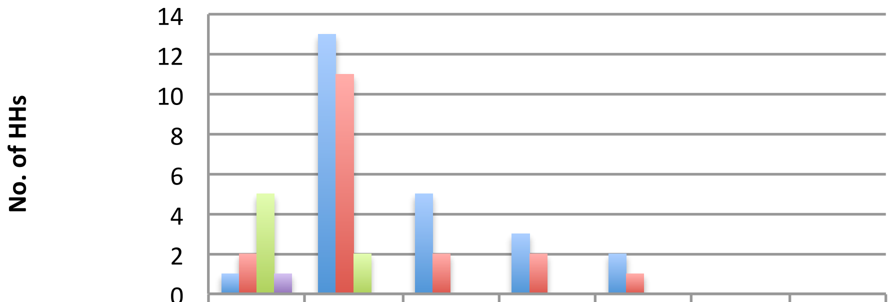


Figure 7.5. Access to irrigated land (Ha) by ethnic group in Raknamo, 2010

Source: Household survey, 2010



	None	< 0.25	0.25 - 0.75	0.75 - 1.5	1.5 - 2.0	2.0 - 2.5	>2.5
Timorese	1	13	5	3	2		
Rotinese	2	11	2	2	1		
East Timorese	5	2					
Other	1						

Figure 7.6. Access to dryland (Ha) by ethnic groups in Raknamo, 2010
Source: Household survey, 2010

In terms of dryland, as seen in Figure 7.6 above, Atoni / Timorese had a somewhat greater access than Rotenese farmers. For example, 10 percent of Timorese owned dryland of more than 0.25 and less than 0.75 hectares, as compared to four per cent of Rotenese. However, if these two groups of Rotenese and Timorese are considered as the indigenous ethnic groups in the village, comparison with the newly settled East Timorese, shows a strikingly skewed distribution of land. East Timorese representing an ethnic minority are *landless*; they had no access to either irrigated land or dryland.

Kupang City: Fatukoa and Bello

Kupang city is the fastest growing and most densely populated region in the Province of East Nusa Tenggara. The population density in the region was 1,865 people per square kilometre in 2010, showing a sharp increase from 1,545 people per square kilometre in 2006 (BPS, 2011). As a consequence of this high density, pressure on land continues to increase as well. Changes of land use and land tenure go hand in hand. This has had considerable implications for land distribution and access, with associated impacts on household economies in the region.

Based on household surveys in the two villages of Fatukoa and Bello, about 60 per cent of the households in these villages depend on agriculture for their main livelihoods. However, only 7 per cent now own farm land, ranging from 0.25 ha to

0.80 ha. About 93% of the land reported by the sample households to said to be owned by 'outsiders' and was accessible only through a sharecropping system. As most of households interviewed obtained their current land through inheritance (equal shares among male heirs) access to land in recent years has diminished; there has also been a decrease in the size of land holdings to which local households have access.

The sale of agricultural land to outsiders is common, causing the ownership of land in the villages under study to pass increasingly into the hands of outsiders (city dwellers) who find agricultural land a profitable investment. The owners rent the land to locally resident sharecroppers. Forty-five per cent of the households interviewed had sold some land in the past. Of those households that had sold land, the average area sold was 0.50 hectare but the range was from as low as 0.20 hectare to as high as 0.85 hectare. There were various motives, as reported by these households, for selling their land: paying for their children's tertiary education, a need to invest in other forms of businesses activities, acquisition of capital for investment in productive assets (primary livestock), and fulfilling significant household needs including wedding expenses for their children.

7.4.1.4 Origins of the Land and its Dynamics

The unequal distribution of land among the groups of different wealth and ethnicity and between and within villages in the research regions stems from a variety of different sources and overlapping historical systems, such as communal land and the so-called 'patrilineal' system, the rights of first settlement, and allocation by government and market transactions. To explain this, control and access to land are examined in order to tease out why some groups have greater control over and access to more land than others.

7.4.1.4.1 <u>Traditional Timorese village of Kauniki</u>

Initial access to land was through the practice of swidden cultivation on communal land under the control of *usif* and *amaf*. Land under this system involved communal tenancy. However, since the ratification of the *Agrarian Law 1960*, cultivators have been able to claim ownership over land based on existing cultivation. The privileged positions of *usif* and *amaf* enabled them and their family members to acquire a significant portion of the communal land. Not surprisingly, land distribution in

Kauniki is highly unequal: the family of the *usif* acquired major portions of land, which could subsequently be transferred to the next generation. The survey found that members of *usif* or *amaf* households (Kono, Suan and Bani) all had at least 2 ha and more of land, while others had less than 0.5 hectare.

An important feature of Timorese culture is patronage relationships. Patrons (the chief/*usif/amaf)* support their clients in times of hardship in return for services, labour, or agricultural products. The *usif* help their clients by employing them, providing loans, or by providing inputs. Unlike a bank, patrons do not ask for collateral or interest, but receive a share of the clients' output, or clients pay by supplying labour. These relationships can therefore be instrumental in improving access to financial assets for the poor, while they can also be powerful tools of exploitation and marginalisation.

*7.4.1.4.2 **Poto Village***

Unequal access to land in Poto has a cultural and historical basis.. Ethnicity and duration of residence form the bases for social and economic differentiation. Of the two large ethnic groups, the first settlers to the village were Rotenese, who settled in *Dusun* 3 of Poto around the 1930s. Oral sources reported that only a few households settled there first, and after some time a number of other Rotenese farmers arrived. Having a comparative advantage in paddy cultivation (as their prime livelihood strategy), the Rotenese helped each other clear the shrub forest, and converted it to permanent paddy fields. The Timorese moved down from the hills in the 1970s under a government resettlement program. As swidden cultivators, the Atoni were less interested in paddy fields. Dry-land farming was their prime livelihood strategy, and consequently they allocated labour investment to shifting cultivation during the early decades of settlement. The combination of cultural practice and precedence in residence were the main determinants of the subsequent unequal access to land between the two ethnic groups. The Rotenese acquired a larger area of irrigated land, while the Atoni owned more dryland farms.

Ethnicity has strong implications for the livelihoods of farmers living in Poto. However, after years of living together in the same village, intermarriages between these two different ethnic groups has, to some extent, removed the cultural barriers but extended the boundaries of social ties. Family and social ties have facilitated the transfer of livelihood orientations among these two ethnic groups. The Atoni have learned how to cultivate paddy fields from the Rotenese. As a result, today's Atoni, who were traditionally swidden cultivators, are now engaged in wet-paddy farming and *lontar* tapping, the traditional domain of the Rotenese. In turn, the acquisition of irrigated land by Atoni farmers is evident, where none existed before,

7.4.1.4.3 <u>Raknamo village</u>

The striking social differentiation in land holdings in Raknamo between the indigenous Timorese and Rotenese and the ex-East Timorese new settlers can be attributed to a high level of resistance by the indigenes to the new settlers. The indigenous groups previously gave migrants access to their land through sharecropping. But due to repeated failures of this in-kind sharing arrangement, the migrants have been denied access to land. Some migrant households tried to gain access to land through illegal means and this triggered social conflict over land between the two groups. Lack of social connections and of trust may further explain the resistance of the long-settled Rotenese and Timorese. Both Rotenese and Timorese tried to create boundaries on their land through new investment in perennial crops, land titling, and they also expanded their holding size by clearing unclaimed forest.

7.4.1.5 A Field of One's Own: lending, borrowing, rental and sharecropping

While the control or ownership of land is unequally distributed, cultivating someone's field is commonly practised through borrowing, lending, renting or sharecropping. At least one in five farmers I met admitted being involved in these practices, arguing that such practices are an important means of expanding their farming portfolio, and gaining a diversity of micro-environments that they can exploit. This in turn assists them to reduce potential crop loss due to pests, disease and the irregularity of rainfall regimes.

The types of farmland and the arrangements under which farmers give their plots of land to others vary. Both borrowing and lending are commonly practised in rural Kupang on the basis of family relationship. Within households, land is acquired in the first instance by inheritance. Since inheritance under the patrilineal system followed in the regions is divided among sons, an inherited holding may be inadequate to support a family. Additional arable land may be obtained by gift from a relative, a patron, or ones father before his death.

For example, it is common for female-headed households or women to beg a parcel of land from male siblings who hold the formal title to the land. Someone who intends to leave part of their own land fallow will beg land to cultivate temporarily from other family members in the compound or hamlet. In other cases, many of the large landholders allow kin and other farmers (to whom they have social ties) to cultivate for their own benefit portions of their land. Borrowing and lending practices are also found in urban Kupang, based not only on social ties but also between land-owners living outside the village and the households that previously owned the piece of land.

No mandatory payments are required in these practices. Usually voluntary payments are made in the form of token gifts such as a basket or two of produce to the landowners. In contrast, payments are really expected from those who lack family and social connections. If a tenant fails to send any produce to the landowner for two or three consecutive years, his access is denied. An example of this is between the newly settled East Timorese and the indigenes in Raknamo. Some East Timorese reported that after two consecutive years of crop losses, they were unable to make voluntary payment to the landowner and they were denied access to cultivate. Apart from drought and pest attacks causing crop losses, farmers reported the cultivation of marginal plots (with regard to distance from main road, poor soil nutrients, and hilly and steep topography). Under such tenure arrangements, tenants are forced to make voluntary payments every now and then. In addition, maintaining a close relationship with the landowners is another important means to secure a tenure arrangement, as argued by some new settlers in Raknamo.

Sharecropping is the system of land control and management encountered most often in the study area. The motivation behind sharecropping varies. Farmers who own large holdings usually undertake sharecropping to reduce the burden of care and labour that has to be given to agricultural activities, in view of the fact that wealthy farmers usually carry out non-farm activities. For landowners who work as public servants or private employees without time to cultivate the land, as is the case of Kota Kupang (Faukoa), sharecropping is often used as a means of managing their assets.

I observed that under this system of sharecropping, landowners enjoy higher benefits than the cultivators. The landowners who, in most cases, provide the inputs, receive two-thirds of the net harvest, while the remaining one-third goes to the cultivators. In this respect, compensation based on the success of the harvest, the risk of annual harvests is equally shared between the two. In bad years, for example, the share of the cultivators is significantly less, indeed not equal to, the cost of the labour. Moreover, instead of hiring labour, using sharecroppers prevents the liquidation of assets (animals) to pay wages. In addition, sharecroppers are considered to be more reliable, as they live in the village and are often members of the landowner's extended family. Wage labourers generally come from the neighbouring sub-districts or villages. For the landless farmers, however, the sharecropping system is mostly pursued as a means of control and maintenance of their access to the land since they work the same plots from year to year.

In addition to sharecropping, renting land from other landowner households for cash payment is less common. In this system, the tenants hold the sole responsibility for which crops are to be cultivated as well as the provision of inputs and they gain all the harvest from the rented plot. Rental land requires capital investment; for this reason, this system is carried out mainly among big farmers or wealthy households. The rental system enables lease-holders to manage the land according to the principle of profit maximization. In farming on rented land, the tenants manage it in a way that yields maximum profit in the shortest possible time during the period of the agreement.

7.4.2 **Livestock**

7.4.2.1 Initial Acquisition of Livestock

The first acquisition of cattle by men occurs typically in their early thirties or late twenties. The source of this initial acquisition of cattle for all the men interviewed, illustrated in Table 7.3, shows the importance of non- and/or off-farm income among urban households and herding payments among rural farmers as the route to cattle acquisition. In addition, inheritance and bequests from fathers are also important sources of cattle acquisition for both rural and urban residents. Reliance on these sources may explain why the accumulation of cattle is very slow in the research area. Crop sales are another common means among the sample households; it was the principal route through which women purchased cattle in the past. A surplus harvest in a good year can be converted to livestock by farmers as an insurance strategy.

Table 7.3 Initial acquisition of cattle (%)

Source	City	District
Non/Off-Farm Income	56	10
Crop sales	8	11
Inheritance	11	16
Given by father	16	13
Herding payment	4	38
Bridewealth	1	4
Government program	4	8

Source: Household survey, 2010

Bridewealth, one of the common methods in the past to own cattle, has now become less significant. It was also the other major route through which women could acquire cattle, from the marriage of a daughter. The evolution of bridewealth payments from traditional gifts of livestock to the payment of cash may explain this decline. Other possible means of acquisition are through government programs. The low level of acquisition in this way compared with other forms of acquisition shows that entry barriers are difficult for the majority of poorer households.

7.4.2.2 Shared ownership, share-rearing arrangements and profit sharing

This section will focus on the institutions mediating access to resources especially livestock, grazing areas and fodder. Comprehending such arrangements and their differentiation between and within villages and among various ethnic groups is critical to understanding the agricultural livelihoods in the research areas. In general, *intra-household arrangements* are the initial step for accessing these resources. Those lacking resources within their own households will then look to institutions outside the domain of the household. These include *inter-household arrangements*, as well as larger and more formal institutions.

In the research area, institutional arrangements that mediate access to livestock include *shared ownership*, *share-rearing arrangements* and *profit sharing arrangements*. Individuals and households, through these institutional arrangements, are able to gain access to livestock and gradually build up a herd and also obtain access to animal products such as manure and draft power. The complexity of these arrangements is considerable, requiring continuing negotiations, and managing the power relations between the parties.

Under *shared ownership*, two individuals make an equal contribution of cash to buy an animal. One of them will be in charge as herder and part-owner, while the other will be part-owner only. This arrangement is common for large animals and is a half-half arrangement. Individuals take up shared arrangements for a variety of reasons. This is because they may be short of cash or have low purchasing power, as commonly found among poor households in the regions. In other cases, an individual or household in the face of an emergency might need to raise cash by selling off part of what was a fully-owned animal. In doing so, the individuals may be able to maintain their half ownership, while looking for a future chance to buy back the animal once their fortunes improve. Alternatively, a household attempting to build up a herd may buy half an animal. Under these shared ownership arrangements, the two owners will share-own equally any offspring produced. In other instances, the money earned will be divided equally, when the animal (or its offspring) is sold.

These part ownership institutions are arguably beneficial for the farmers. In their words, 'owning two halves is better than one whole, as you have rights of access over two animals instead of one'. This farmer's view reflects common strategies in coping with their local conditions by dealing with problems through a *risk-spreading strategy*. The risk of livestock disease, a lack of fodder, labour or grazing area are among the reasons for taking up these share ownership arrangements. As is the case of Raknamo (Kupang District) and Fatukoa and Bello (Kupang City) where the fodder and grazing area is short supply, someone else has to invest the labour and effort in feeding.

Another arrangement is *profit sharing* in which one individual buys an animal and gives it to other parties or individuals to look after. Unlike the share-ownership, which is mainly kin-based and an inter-household arrangement, profit sharing tends to go beyond the informal sharing and exchange relationships of local households to connect with other households of relatives and friends further away.

For income generating activities, profit sharing based on a fattening program (*paronisasi*) is more popular than other arrangements. It is also more labour intensive, as relies mainly on cut-and-carry methods. Entry to this arrangement is mainly driven by the need to generate cash income for household expenses, and this is especially the case for local investors. Under this arrangement, the keeper or farmer will be rewarded based on one of the following measures: weight gain (Rp. 7,500 for every kilogram of body weight gained), profit sharing (the owner deducts the original costs, then the profit is equally divided between the owner and the keeper), and/or fixed wage labour (Rp. One million). An agreement is reached through negotiations between the local investor and the farmer. All of the expenses (associated costs) including the risk of loss due to disease are the owner's responsibilities, while the keeper is in charge of providing feed, mainly based on cut-and-carry methods.

The profit sharing, under a government program, includes breeding and fattening (*paronisasi*). In addition to generating cash income, this program aims at encouraging the accumulation of household livestock. This is done by providing calves or credit for the farmer to buy their own cattle. After a certain period (one year or two), the farmer receives all of the profits, while the initial cost of instalment is reallocated to another farmer who has not participated before. Profits from the sale of cattle are expected to be used to buy more cattle for asset accumulation.

In the research area, farmers also gain access to livestock through a *share-rearing arrangement*. Under this mechanism, an individual owns an animal outright and gives it to another to look after. The full ownership remains with the owner. There are numerous reasons for a household to undertake this arrangement. Shortage of labour and fodder are the main reasons, similar to the case between poor households and their richer relatives or friends. A share-rearing arrangement also exists as part of the patronage relationship, which is more common in the traditional Timorese village of Kauniki. The patrons (the *usif* and/or *amaf* and the Chinese traders) give their animals to their clients as herders (*atukus*). Each *atukus* is generally in charge of 25 to 30 head of cattle and is rewarded with in-kind benefits / allowances such as rice and betel nut (*sirih pinang*), roughly equal to Rp. 75,000 (A$ 7). On the top of this, the *atukus* is often rewarded with either one calf every year or ten per cent of the profit from the sale of cattle.

The arrangements for both profit and rearing-sharing are usually informally agreed upon between the two parties and a set of fairly standard codes of conduct is agreed to.

These include the right of the owner to withdraw the animal at any time, the right to come and inspect the animal or animals, the right to be informed of death, illness or injury and the right of the holder to the animal's manure and draft power. All calves remain owned by the original owner and the right to sell or slaughter the original beast or the calves also remains his.

Figure 7.7 ***Bali*** **Cattle and** ***Atukus*****, in Kauniki Village**
Source: Author's field survey, 2011

7.4.2.3 The Social Differentiation of Livestock Ownership and Access

7.4.2.3.1 Between Villages and Between Ethnic Groups

The share-ownership arrangement is common in all villages, unlike other arrangements. In Kauniki, about a third of households are engaged in share rearing arrangements, far more than in other villages under study. The relative homogeneity of the Atoni population in Kauniki serves as bonding that lowers cultural barriers that usually prevent households from participating in share-rearing arrangements within the village. Moreover, the existence of abundant grazing land and also sources of fodder in Kauniki are among the main pull factors for households from outside the village (especially local Chinese traders) to lend their animals to the Atoni households in Kauniki. In Poto, share-rearing arrangements between the Atoni and Rotenese are evident; more Rotenese lend their animals to Atoni households. This arrangement is mainly mediated through inter-marriage and social ties or networks. In the case of Raknamo, the East Timorese households as new settlers and their lack of social connections with local households have limited access to any arrangements for access to livestock. In Kupang City, there is a lower participation rate in such arrangements, generally due to a lack of sources of fodder and grazing land.

7.4.2.3.2 ***Wealth, Age and Gender***

Social differentiation is also found in terms of wealth and gender. A general pattern observed in all villages is that the richer households are involved in lending animals because they are generally short of labour and need to alleviate pressure on their fodder sources. Lending animals to a few households in different locations also spreads the risk especially from disease. Likewise, a higher proportion of people from the poorer households in all villages are the main animal keepers. The only exception for this is in the villages of Kupang city and Raknamo where there is a lower participation in shared rearing among the poorest wealth group who are East Timorese. The most likely reason for this is that members of this group have limited access to grazing land and also limited labour, which is indispensable for cut-and-carry work in any site where accessing fodder is a key constraint.

The differences in stock ownership and access by the age of the household head can be considered according to patterns of household development. The accumulation of cattle occurs until the age of 50 or so, during the period of household establishment; thereafter the numbers decline as cattle are disposed of for school fees, to send children to secondary school and later for bridewealth for sons' marriages. Access to cattle shows a similar pattern with age. The data indicates that cattle are predominantly lent to the 31-40 year age group, who show higher levels of access than actual ownership. Lending cattle is common among men in the 51-70 age group.

In all villages, ownership and access to livestock are gender-differentiated. Women and/or female-headed households own far fewer livestock than men and/or male-headed households. Likewise, women's access to livestock through institutional arrangements is limited in nature. The arrangements, of course, are subject to access to capital, labour and fodder. In this regard, some women who are able to buy livestock can enter into these arrangements by lending an animal to others especially to male siblings or relatives. Restricted by access to labour and fodder, the participation of women in borrowing animals is rare and only occurs for short-term periods. Female-headed households with sons may be able to be involved. In most cases, keeping animals is heavy work especially in collecting fodder, which is the main reason for the low participation of women in keeping animals for others.

The institutional arrangements discussed in this section point to various mechanisms that help households or individuals to gain access to resources that they might otherwise not be able to benefit from. However, this does not suggest that all households or individuals have equal opportunities to access resources through these institutions. Socially differentiated access is still observed, for reasons of power relations, and the social and cultural contexts. Taking these into account, some individuals and households are better able to negotiate access to resources than others.

7.4.3 **Labour**

The nature of agricultural activities (farming and livestock) in the research area is labour intensive work, starting from clearing the fields, fence erecting, followed by ploughing (or *rencah*), planting /sowing, weeding and carrying on until harvesting, in addition to rearing livestock all year round. The nature of the work load is generally determined by the nature of the rainfall regime including the risk of drought. Labour bottlenecks usually occur during the times when planting and the first weeding must occur, which is done right after the newly planted crop shows above ground. An unpredictable arrival of the first rains turns out to be the first condition to prompt farmers to urgent planting. In this respect, planting as large an area as possible is necessary to offset the effects of drought if it occurs. Urgent planting also takes into account the need to re-allocate labour to weeding within a few days, in addition to minimizing the risks of harvest loss that may be caused by late planting. In the case of poor rains, labour is required for replanting if necessary. Weeding consumes the labour force in the weeks following, from the dawn to dusk. The first weeding normally takes longer (given the delicate nature of the young crops) than the second weeding. However, both weeding efforts must be completed as soon as possible.

The nature of this agricultural work highlights the importance of having sufficient labour within households. These labour-dependent activities may explain why rural households in the past viewed having many children as necessary for producing a substantial surplus. Today's agricultural work still relies on intra-household labour. Under this arrangement, men provide the greater part of family labour, which includes land preparation, fence erection, weeding, driving away destructive animals, the transportation of crops from far distant fields, and marketing the surplus as well as livestock rearing. Women's share in agricultural work is significant too. On top of domestic work such as the preparation of food and the necessary functions of reproduction, women are involved in the hoeing of fields, planting, weeding, scaring away birds, harvesting, transporting crops to the home, and finally in processing and storing crops.

Household labour

Family labour is most commonly used for agricultural activities. The organization of family labour rests largely on the household head (usually man). Many tasks have broadly recognized gendered roles: ploughing (male), manure application (female), and division of these is therefore straightforward. For those tasks where such a division is less clear (such as weeding with a hoe, harvesting) the division is more flexible, and therefore more open to negotiation within the household.

Many crops, tasks, tools and spaces have gender divisions: sowing and *tofa* (hand weeding), as well as storing crops are 'female' jobs, while ploughing and fence erection are broadly 'male'. These divisions often overlap and interact. Thus application of manure is a purely female activity, while ploughing is a male activity. Changes to the gender divisions of agricultural practices and spaces may have occurred under various pressures, such as women increasingly diversifying their off-farm activities and the increase in seasonal demands associated with domestic tasks.

While household labour dominates in the provision of the work-force, there is a range of labour institutions that facilitate access to labour. These include working groups, wage labour, church-based labour groups and task-specific labour groups. A household seeking to increase the labour invested in agriculture, or whose members plan to increase their involvement in diversification activities or migrate (and, so lose family labour) may call on additional labour. This labour may be from within its own household or from outside, through the labour related institutions described in the following section. As many of these institutions require reciprocity, those without access to sufficient labour within the household may not be able to participate in them. Others, such as sharecropping arrangements, do not require reciprocity, while those with a cash income can hire labour.

When work required more labour than intra-household could manage, cooperative arrangement between households were often resorted to. These arrangements could either use the obligatory help of close relative within a village or elsewhere, or could consist of be general work parties involving a cross section of the community. The reward was reciprocity and meals.

Traditional coping strategies that address this shortage of labour existed and relied on the reciprocal labour exchange through family, marriage and kin relations and an extensive social network. A number of traditional farmer groups existed that allowed farmers to work together on ones land without cash reward. The *toit/hoka* or co-operative group, for example, is a traditional group: local farmers would invite members of their extended families and other fellow villagers to work together on their farms (Ormeling, 1956, p. 77). The work included opening new areas, sowing, weeding and harvesting. The compensation was not wages, but in the form of supplying food during the process (Yuksel, Aoetpah, & Imo, 1999, p. 14). Today *toit*/*hoka* is not commonly practised, but still remains common for house building, rather than for farming activities.

Other means of accessing labour

Many of the labour institutions described above require reciprocity and so those without access to sufficient labour within the household are not able to participate in these institutions. In this case, if they have access to a cash income (for example household involved in trading), they may hire labour for cash, as a widow living in Raknamo does:

'I have got no one to help so I employ these two (young men) based on cash payment for 4-5 days work, and also give them food. I employ people to do digging…. About once or twice a year, I get the money from selling livestock'.

Sometimes, instead of cash being paid, if the work to be done is harvesting, the labourer may be paid a proportion of the harvest. Others who hire labour include households needing assistance for major 'one-off' pieces of work, such as repairing the fences.

Figure 7.8 Author Participating in Reciprocal Labour for Fence Construction

Source: Author's field survey, 2011

Figure 7.9 Author Participating in Reciprocal Labour for Paddy Harvesting in Research Site
Source: Author's field survey, 2010

The decline of social labour institutions

Recent evidence suggests that this practice of reciprocal labour exchange has been diminishing. In-depth discussions with key informants reveal that there have been considerable changes in the use of labour sources in recent years. The reciprocal labour exchange has decreased greatly in all villages under study, while the use of personal labour in non-farm activities increased. A growing concern was expressed by key informants that people are increasingly becoming individualistic in their attitudes when it comes to economic production. A tangible increase in the use of hired labour has been observed. Most of the rural population now believes that the organic social relations which formed the basis of economic performance in their households (through relying on the labour of relatives and work parties as the common means of coping with a shortage of agricultural labour) is no longer reliable.

7.4.4 **Credit**

Lack of access to credit institutions and financial services is one of the most important barriers to livelihood diversification in both regions. Credit constraints can hamper high initial investments as well as the attainment of assets that are vital to most non-farm income generating activities (Barrett, 1997; Reardon, 1997; Ellis, 1998). In the research areas, access to financial service institutions includes formal, non-formal, and informal institutions as well as government and non-government programs (see section 3.3.2. Access to credit). Most of these financial institutions operate mainly in Kupang city, the provincial capital. Only a limited number of branches operate in rural Kupang. In general, the provision of financial services in the regions is hampered by poor physical and communication infrastructure.

Access to formal financial institutions was found to be weak among the poorer households in both regions. Poor knowledge about credit institutions and the rigidity of loan requirements such as tight repayment schedules and high initial capital requirement (excessive collateral) were identified as important barriers by most of households to access. In addition, the schemes of formal institutions are limited to providing loans for agricultural-related activities, which in fact constitute the greatest demand among the poorer households. Given this, only better-off families or relatively richer groups can gain access to these formal sources of credit. This finding tends to support the general argument within livelihood diversification that the poor have less access to profitable livelihood activities than the better-off due to high barriers to entry associated with these activities (Barrett et al. 2001; Barret, Reardon et al. 2001, Abdulai & CroleRees, 2001, Woldenhanna & Oskam, 2001).

Other sources of financial assistance come through government programs and non-government organization interventions. Both regions have been the largest recipients of financial support, attributed to the region's chronic poverty. However, little evidence was found to suggest that population in the regions had better access to these sources of financial assistance. This is partly explained by the large size of Kupang district in terms of land area and population, and by Kupang city, the greater density of population and political units (villages). Moreover, growing concern was expressed over the rampant corruption in both districts. Few of the micro-finance and credit schemes available in both regions were known. However, those schemes could often only be accessed by those who had social networks with government officials and/or political connections with ruling parties. The marginal groups including ethnic minorities and the very poor are effectively excluding from these financial provisions. The most accessible sources of financial services for the poorer households in both regions are informal institutions such as *arisan* (rotating savings) and moneylenders (*rentenirs*). The new emerging informal lending institution known as 'daily banks' in Kupang city is another source of credit that is mostly accessible to the urban poor. Despite its high interest rate – as much as 20% a month and daily installment payments – a number of livelihood activities pursued by urban poorer centered on trading (petty trade, fishing, crops and small kiosks) have originated from this service.

7.4.5 **Development of Markets**

The sustainability of livelihoods is more likely to become a reality in places where population density is high and which are supported with good market access, due to the fact that a higher level and wider range of options are available within the local economy for people to pursue (Wiggins, 2000). In contrast, less opportunities are available for marginal areas due to poor market networks including road conditions that hamper people's mobilization either for selling produce or finding work elsewhere. The findings of this study among communities in both regions tend to support such an argument.

In the case of Kupang city, the high level of trade evident in both villages (Bello and Fatukoa) is obviously the result of high population density. Easy access to a large market town available at a close distance helps to generate a wide range of marketing opportunities for the inhabitants of these two villages. Because they enjoy good road conditions, involvement in casual labour is also high in these urban villages. People travel short distances to find job opportunities primarily in the construction sector and service sector such as shop assistants in the city.

This condition is in stark contrast to the situation in the remote villages of Kauniki and Poto in Kupang district, which are much more isolated from major markets. People from these villages have to travel several hours to reach the nearest weekly market. Poor road conditions make the cost of travel unaffordable and the income from produce sales often cannot compensate for the cost of travel. For this reason, marketing of crop and livestock is often through middlemen who regularly visit the village.

7.4.6 **Social or 'Family' Networks**

'Social networks' refers to the relationships of trust and reciprocity that enable individual households and community groups to act collectively (Woolcock & Narayan, 2000; Adger, 2003). Social networks play important roles in rural livelihoods through enhancing adaptive capacity and livelihood security, while reducing risk (Robards & Alessa, 2004; Tompkins & Adger, 2004). In this view, social networks have become more important for individual households in gaining access to resources. People have become more dependent on family and relatives and their 'normal' set of relations.

In order to assess the importance of social networks in the pursuit of livelihood security in the research region, I looked at family ties (paternal, maternal and in-laws) as a proxy for social networks, distinguishing them at three different geographical levels: local, regional, national and/or international. In my household survey, the respondents were asked whether they had relatives in the villages, in Kupang city, outside Kupang city and outside Indonesia (Malaysia, Singapore, Hongkong). The objective of examining these relations was to record inter-household transfers of food, money and labour. Obviously, these transfers can go in two directions. The household under survey can be a net receiver, a net giver or 'neutral'.

Family networks at the local level

The inter-household flow of labour and food is common at the local level. These flows normally occur in two directions, and mostly between households of the same patrilineage. Rural dwellers help each other in various kinds of activities, ranging from farm work, house construction, to weedings and funerals. Most household heads reported inter-household transfers of food (prepared meals or grains). These transfers increase especially in February when the first early maturing crops (maize) are harvested. With regard to the transfer of food and labour, a majority of interviewees claimed to be both net receivers of labour and net givers of food, due to the fact that the respondents were predominantly househhold heads. Their answers did not represent all family members. Household dependents are most likely to work on relatives' *ladang* or *sawah*, and eat food from the granaries of these relatives just as often.

Few households reported occasional transfers of money between households. The amounts of money transferred at the village level are usually small. In the case of larger amounts are needed, inter-household transfer usually occurs in the form of loans. It should be noted, however, that most transfers of money between households within this geographical level only occur in exceptional circumstances such as illness of family members and paying school fees. Only household heads having access to cash incomes or formal employment in the sample gave money to relatives in such circumstances.

The inter-household transfers are vital for enhancing food and livelihood security through reducing the variability in the availability of labour, food and money at household level. The shortages of labour and food are thereby smoothened. Transfers of these resources between households usually occur on request. One local household explained the 'rule of this game' as follows:

> *'When your close relative comes and tells you about his difficulties (short of food, labour or cash), you must help him if you have the resources. But if a more distant relative comes to ask for something, you have the option either to help or not. If he is a hard worker, you should help him since you know that he has been unlucky. Otherwise, if the person is a lazy man, you don't have to help him. The only person whose request you cannot turn down is your direct brother or sister'.*

Family networks at the regional level

Inter-household transfers of labour and food also occur at the regional level such as between villages in both Kupang district and Kupang city, and between villages in Kupang district and relatives in Kupang city, as reported by most household heads. Sisters and daughters (often accompanied by their husbands) who married within neighbouring villages or in Kupang city often visit their paternal home during the farming season, to help on the farms of their father and/or brothers. This visit can only occur provided that no labour is needed on their own household's farm. When visiting their paternal relatives, also outside the farming season, these women usually get a basket with grains or an *ikat* of maize, before they return to their husband's house. In times of a food shortage, inter-household transfers of food usually occur based on kin relations. The transfer can be effected several times in a period of extra-ordinary hunger, provided that the food situation in the relatives' households is better.

Therefore, one could expect that the secure households are more likely to be net givers at the local and regional level than vulnerable households.

Family networks at the (inter-) national level

The most important family networks for securing the transfer of food and cash are those that include cyclical or permanent migrant relatives in cities such as Kupang city and other cities in Indonesia as well as abroad. The remittances from relatives at (inter-) national level are important additional sources of access to food and money. If the inter-household transfers between households on the local and regional level go two ways, then transfers with migrant relatives at (inter) national level are usually in one direction only. The households in the studied villages are net receivers. The transfer of money from relatives not only helps households to buy food but also contributes to the future livelihood security by paying fees (for example, for school and hospital). However, it should also be noted that access to remittances usually requires frequent contacts with close relatives. In such cases, when households have lost contact with their relatives at national and/or international level, remittances were no longer received from them.

Trends in family networks

'In the past, when your granary was empty, you could rely on your relatives. Nowadays, when you face food shortage,the local market is the only way where you can purchase food from' (A widow from Poto).

'People often helped one another in the past, but nowadays people tend to increasingly ask for help at any time. As such, I refuse to assist very often since if I do it for one, then others will come to me for help' (Anonymous government employee).

The above citations clearly point to some changes in the views of local support mechanisms. More specifically, the changes in inter-household support networks at community level are associated with the advent of the money economy. In this sense, local households are more likely to convert excess production (above subsistence level) into consumer and other goods, when the opportunities for monetary exchange exist.

7.5 **Conclusion**

This chapter has discussed the key factors and processes that shape local vulnerability in the face of climate variability and change in the research regions. Based on an integrated vulnerability approach, the analysis of climate related risks in this study confirmed that the constant vulnerability in the research regions is not caused by climate variability and/or climate change alone. It is true that climate events in the research regions, particularly drought and rainfall unreliability, trigger frequent crises – sharply increasing the incidence of crop failures, annual hunger (ordinary and extra ordinary hunger), livelihood disruption, and so forth. However, the social consequences of climatic impacts in the research regions, such as forced sales of household assets or land, contribute to further ecological losses such as soil erosion and deforestation due to the heavy reliance on the remaining natural resources as one of the coping strategies. In addition, speculative price rises that drive food prices beyond the ability of the poorest households clearly demonstrate many factors and processes that can explain the ability of local households to adapt and cope with climate related risks.

The people's vulnerability to climate related events in the research region can be explained from three main issues, namely environmental degradation, poverty and access to key resources. In the face of the ever-escalating environmental degradation, the ability of households to cope with and adapt to climate variability and change is diminishing greatly. Among the groups in the communities, the poorer households are more vulnerable than the relatively better-off households. Moreover, the ability to cope and adapt is also related to the ability to access necessary resources in times of crisis. Those who have access to credit, seeds, livestock, land and other key resources including active and wide social networks are more likely to rebound quickly from climate related risks. Understanding these multiple causes clearly will provide a sound basis for policy, if the vulnerability in the research regions is to be redressed.

In the next chapter, I will conclude the thesis by summarizing the key research findings relevant to my research objectives, and then discuss the research implications with regard to theoretical and policy issues.

Chapter 8 Conclusion

8.1 **Introduction**

As set out in Chapter 1, the main objective of this thesis is to assess people's vulnerability and the configuration of forces that shape people's ability to cope and adapt to climate variability and change in semi-urban and rural Kupang, in the East Nusa Tenggara province of Indonesia. This objective has been addressed through answering the following research questions:

1. How has such climate variability and change affected social vulnerability in the research areas?
2. How have households and community groups coped with and adapted to the risks?
3. What are the root causes of social vulnerability in West Timor, Indonesia?

The first question was mainly addressed in Chapter 4; the second was examined in Chapters 5 and 6; and the third was covered in Chapter 7.

The central conclusion of the thesis is that '*social vulnerability to climate variability and change in the research areas encompasses disruption to livelihoods and social entitlement decline, reflecting in economic failure, food shortage and hunger; and such vulnerability is shaped by environmental degradation, poverty and access to key resources'*.

In this concluding chapter, I first summarize in Section 8.2 the three key findings that emerged from this study. In Section 8.3, the implications of these results for the understanding and addressing of social vulnerability to climate variability and change are briefly discussed and recommendations for future research are drawn.

8.2 **Main findings**

8.2.1 **Climate Variations have Diverse Socially Defined Manifestations**

Chapter 4 shows that the study sites are very vulnerable to extreme variations in their relatively scant seasonal and inter-annual precipitation. Analysis of time series and qualitative interview data displayed these variations in four main features. *First*, the patterns of rainfall are highly irregular from year to year, especially with regard to both the date of onset and duration of the rainy period. Such erratic rainfall is also associated with false starts for the rains and the occurrence of drought spells. *Second*, the regions are also subjected to high spatial variability of rainfall or so-called ‘micro climate diversity’ as suggested by Ormeling (1956). *Third*, persistent (both meteorological and agricultural) drought is the most common phenomenon of climate variability in the research areas. *Fourth*, El Niño and La Niña events have tended to increase in occurrence and magnitude as well as duration. In short, erratic rainfall and persistent drought, El Niño and La Niña are the most common types of climate-induced events that pose significant risks to the agricultural sector in the research sites. Disruption of livelihoods, in particular loss of crops and harvest failures, leading to food production decline, are the physical impacts of these events.

These physical events have eventually caused social consequences for human welfare, exhibited in food insecurity and hunger (ordinary and extra-ordinary), and have manifested themselves in terms of widespread uptake of coping strategies in the research sites. As food production declines, households employ a number of coping strategies to address their production loss. For example, reducing household consumption and forced sale of household assets (land, livestock and jewellery) have been evident during drought years (see Chapter 5). In addition, curtailing household expenditure on medical treatment and children’s education were most associated with drought events. Child malnutrition and child labour are among the social consequences of climate induced events in both study sites, in addition to a decline in livestock production especially through death and/or theft.

The degree of exposure to the physical dimension of climate variation affects the population’s ability to cope and adapt. In general, the most vulnerable are the marginalised households or community groups in terms of geographical condition, wealth status, access to resources, social relationships, gender and ethnicity / minority status.

Based on a rural-urban perspective, households living in the rural area of Kupang district are more vulnerable to climate variability than their counterparts in Kupang city. People in the latter group have greater access to income generating activities than the former. Within the rural population, agro-ecological settings have contributed to higher vulnerability to highlanders than to low-coastal or plateau inhabitants. Highland areas are bound by undulating, rough terrain and steep hills that impose heavy constraints on the population. Despite its relatively higher rainfall level as compared to low-coastal and midland areas, such topographical characteristics cause the area to be under developed, leaving the population with poor access to credit, market, education, health care and so forth. Such structural constraints may explain their high exposure to any climate and/or non-climate stressors.

Within the income / wealth groups, the low income group– as characterised by limited assets and land holding size, low human capital, high family dependency, living in poor housing materials, is much more vulnerable than the higher income families – composed of the employed (permanent, fixed monthly income earners), the traders, holders of larger capital assets including livestock and parcels of land, the local elites and clan leaders. This latter group is mostly engaged in diverse livelihood activities, as compared to the former. This finding is relevant to the view that the most vulnerable groups to both climate and non-climate stressors are the poor (Adger, Kelly, & Ninh, 2001; Ericksen & O'Brien, 2007**;** Anh, 2010).

The climate stressors, as discussed in Chapter 4, are rainfall deficiency leading to prolonged droughts, micro-climate diversity, the El Niño and La Niña events, tropical cyclones and floods, resulting in seasonal food shortage (‘ordinary hunger’) and recurrent food insecurity. The socio-economic variations in coping and adaptation strategies, as discussed in Chapters 5 and 6, highlight the fact that the poor have fewer choices of coping strategies and have less adaptive capacity, and as a consequence, are more vulnerable compared to the better-off. This finding emphasises that poverty associated with lack of livelihood opportunities, poor access to common property resources (valuable resources) and government services are together considered as non-climate stressors that cause these climate trigger events to be greater for the poor.

This study has also found that vulnerability is linked to social relations and identity. The former refugees from East Timor who have settled in Raknamo Village represent an ethnic minority group that is more vulnerable than the indigenous ethnic groups (the Rotenese and Atoni). Their vulnerability lies in the inequality of access to common property resources. Most of them are landless, relying on share-cropping and labour wages to support their livelihoods.

Another key finding in this study is that women, children and the elderly are more vulnerable than men and adults. Women in particular, occupied with domestic tasks and affected by a patrilineal system of inheritance and social domination, have limited control over and access to assets and livelihood activities. Rural women, as compared to urban ones, are afforded less adaptive capacity due to their access to markets and credit institutions. They remain engaged in traditional and low value-added activities with limited economic incentives. Children, in a similar vein, are taken out of school in cases of family emergency. Their early involvement in the labour force has detrimental effects on their future, resulting in the development of limited human capital. The elderly are constrained by age and their health may explain their high level of vulnerability.

In conclusion, the study clearly shows that the food shortages induced by climate variations have caused pervasive impacts on human welfare, and that these vary greatly according to gender, ethnicity, socio-economic and political conditions. It is not only place but also socially specific factors which indicate that any adaptation measures have to be specific in nature, according to the pattern of vulnerability.

8.2.2 **Coping and Adaptation Observed**

8.2.2.1 Traditional knowledge is an important resource in coping and adaptation strategies

The results of investigations presented in Chapter 5 indicated the importance of traditional knowledge employed by households and community groups in coping with their vulnerability. Apparently there is no principal coping strategy, as most households employed a wide range of complementary strategies. Taking the example of soil fertility decline, it was found that most farmers employed local knowledge of soil classification together with fallowing, application of crop residues, crop rotation and inter-cropping in order to maintain and restore soil productivity. Likewise, in dealing with climate anomalies that pose high risks of harvest failure leading to food shortages, a number of complementary traditional responses were employed such as community seed selection practices to ensure good germination. Such knowledge also informed farming practices in the use of traditional weather forecasting, relying on atmospheric, astronomic, plant and bird indicators in making ‘serious’ farming decisions such as clearing new fields, setting planting dates and selecting appropriate varieties.

It is worth noting that the importance of these traditional responses derived from the fact that they were accessible to most households; many of these were learned through social networks and/or passing on from one generation to the next, and thus provided a means of survival, or safety net. This is especially the case of those who could not access other sources of information to reinforce coping strategies such as meteorological weather forecasts.

8.2.2.2 Drought coping mechanisms are socially diverse, but not always economically sustainable and environmentally viable

As is shown in Chapter 5, coping mechanisms in times of drought vary considerably across the two regions. Individuals, households and community groups employ different strategies, depending on the set of mechanisms available to them and the opportunities for recovery. Wealth and status play an important role in peoples' ability to mitigate drought related risks. The poorer households have a limited range of coping strategies, as compared to the relatively better-off families. Likewise, differences in mechanisms are also found according to age group and gender. Children and women are found to be more vulnerable than other groups (older individuals and especially men). The adjustment of food intake as a coping mechanism in times of food shortage results in children and women suffering most from malnutrition and other health problems.

Many households' responses were short-term, such as making adjustments to crop management practices, household consumption and expenditure. In fact, many of these responses depleted the resource base by 'mining' the environment (through the collection of forest-related products and mining manganese) and by the disposal of household assets. Such responses may not actually be economically and environmentally sustainable, and thus most likely would increase people's vulnerability if another shock occurs.

8.2.2.3 Livelihood diversification is closely tied to access to key resources

Livelihood diversification has been the main strategy for living with climate variability in the dry land of Timor. Subsistence farmers cultivate staple and cash crops for their household consumption, but they also sell part of what they produce in the local market. In general, rural households diversify their sources of incomes by complementing crop production with livestock rearing and/or *paronisasi*, and also by engaging in income generating activities on other peoples' farms or in the off-farm sector. Most households rely on natural resources to cater for their subsistence needs in addition to earning cash income. Forests and their related products (timber, charcoal, and bricks) provide a supplementary means of living for rural population. It is clear that diversification aims at creating a portfolio of livelihoods with different risk attributes.

However, differences in livelihood diversification can be observed between urban and rural sites, and between households. Such differentiation can be attributed to a variety of factors including the availability and access to land and common property resources such as forest, grazing land and water sources, as well as access to credit, markets, transport, services and related infrastructure.

It is true that each household in both rural and urban Kupang has its own range of options about types of livelihood activities. However, it is the bundle of capital to which households have access or entitlement that basically determines whether members of the households will diversify out of choice or necessity away from farm-based activities to non/off-farm activities in coping with climate variability related risks. Differences between households that determine certain types of livelihood activities are associated with ethnicity, household size, gender, as well as wealth group, ownership and access to assets. Social and/or kin-based networks, and household status and position within the village based on rights and claims to control access to key resources are also influential.

8.2.3 Social Vulnerability Occurs at a Conjuncture of Physical, Social and Political-economic Factors

The main findings of this study confirmed that the social vulnerability in the research area is shaped by a wide range of factors that are inter-related and reinforce each other. These are not only due to climate variability and extreme events, but also to social, economic and political factors. Three main issues emerged from this study that can explain the social vulnerability and adaptability in the research regions of Kupang, namely environmental degradation, poverty and differential access to resources.

Environmental degradation in the research regions can be clearly seen in the forest depletion, land degradation, soil erosion and diminished water resources. In times of drought, local populations rely heavily on the forest and its related products such as timber, firewood and charcoal making, mat-and-rope making, building material and sago (*putak*). Shifting cultivation with its use of fire burning is an example of the use of traditional coping strategies in dealing with unfavourable climate and ecological constraints in the region. Coupled with population pressure and land use change that decrease the availability of farmland and shorten the fallow period, the continuation of traditional adaptation practices has resulted in forest depletion and land degradation in the region. An extensive grassland area is now present, replacing the dense monsoon forests as an anthropogenic consequence (Ormeling, 1956; Monk *et al*., 1997). The practice of repeated burning also gives rise to the problem of soil erosion in the regions in times of extreme climate events. High wind speeds during the dry season and high rainfall intensity during the rainy season exacerbate the rate of soil erosion especially on bare and unprotected land. Degradation of land cover and soil in the research regions is therefore closely linked to social vulnerability through agricultural productivity decline that further reduces the value of natural assets available to the local population.

In addition, this study finds that poverty is an important barrier to adaptive capacity. The poor possess the least adaptive capacity to cope with climate related hazards, as compared to the relatively better-off group. The main feature of poverty that affect households' capacity to cope and/or adapt to environmental changes in the regions is the lack of financial, technological and human assets. Strict credit requirements such as collateral were found to be the main constraint for the poor to take up credit. The poor could not afford, for example to buy and use fertilizer and other agricultural inputs, in dealing with the declining soil quality. Lack of savings prevented them from repeated sowing (*soni*) in the wake of rainfall deficiency. A lack of human capital is another constraint that prevents the poor from taking up more remunerative employment, especially skilled jobs. Their livelihood options are limited to mostly wage or casual labour in the agricultural sector, which is very sensitive to climate-induced events.

Access and control over productive resources also shape social vulnerability and adaptability in the research regions. Households' ability to generate a livelihood depends on their access to productive resources (land, livestock, labour, credit, market and social networks), and also their ability to control and use these resources effectively. This study finds that access to these key resources is always based on social and economic relations, and mediated through institutional arrangements.

A wide range of institutional arrangements is prevalent that enable those who do not have resources to gain access to them. In general, intra-household arrangements such as through inheritance are the initial step for accessing productive resources such as land and livestock. Inter- household arrangements, kin-based relations, and social networks also serve as important channels of access to productive resources, in addition to material wealth and market transactions. Likewise, the role of government programs is very critical for the very vulnerable groups including the poor to have access to key resources of education, health, land, agricultural inputs, credit, market, capacity building, capital / asset accumulation.

The available institutional arrangements do not imply that access to resources is equally distributed among households, individuals and community groups. In fact, wide social differences in access and control over resources are found among households and community groups in the study site for reasons related to history, power relations and social and cultural settings. For example, the combination of cultural practice and precedence in residence in Poto Village are the main reasons for the social difference of access and ownership of land between the Rotenese and the Atoni. Power relations may explain why the *usif* and *amaf* in Kauniki Village have more access to land, forest and livestock among the community groups. For cultural reasons under a patriarchal system, women are often denied the right to inherit land, and generally have less control over income generating activities. Normally their access to productive resources is inferior to that of men. Likewise, the newly settled East Timorese in Raknamo village have no access to land, forest and livestock production due to cultural and social identity, as well as power relations. For the above reasons (history, power relations and social and cultural setting), some community groups and households/individuals are better able when negotiating access to resources which in turn, make them better able to secure certain livelihood strategies than others in the context of climate variability and change.

8.3 Implications of the Research Findings

8.3.1 The contribution of the Research to Understanding Social Vulnerability

In general, this study advances our understanding of vulnerability to climate change in two ways. First, it extends the area of study from a focus on the issue of climate change to the present problems of climate variability. The advantage of focusing on vulnerability to climate variability is that it reduces dependence on the uncertain results of climate models and at the same time points out the many potential ways to reduce impacts of climate variations both today and in future (Liverman, 2001). Second, it expands our knowledge from understanding the physical impacts of climate change to include social consequences and its impacts on human welfare. The findings of this study conclude that the impacts of climate variability and change vary greatly according to geographical, social, economic and cultural conditions. It suggests that building adaptive capacity is imperative to address peoples' vulnerability to climate variability. However, the nuances of local vulnerability and capability must be understood clearly. Any measures taken to mitigate vulnerability have to be place-sensitive, if adaptation policies are to be effective.

Building on this finding, another significant contribution of this research is that understanding and conceptualization of vulnerability in the study of climate change have to be drawn from an integrative perspective. One single event, such as food shortage, has multiple causes. An integrative approach, building on an inter-disciplinary perspective, is considered as an appropriate approach to discover a wide range of determining factors that explain how local communities and individuals are vulnerable and how they cope with the impacts of climate variability and change.

In addition, this study has shed light on a wide variety of traditional responses at community and household level. Coping and adaptation strategies employed by the vulnerable themselves are important resources, and thus provide useful insights toward building a community adaptive capacity, not only in the study sites, but also elsewhere. In this regard, this research draws two distinct implications. One is that engaging community groups and individuals is imperative, not only for assessing their own vulnerability but also to help them enhance their own adaptive capacity in dealing with the physical impacts of climate change and variability. The other important implication of this research is that it helps to generate original insights into the process of building a community adaptive capacity. In other words, it provides local resources and knowledge to guide the policy process in climate change adaptation.

Although the scope of this study is limited to two districts of East Nusa Tenggara in Indonesia, this analysis also sheds light on related fields of inquiry. In particular, it contributes to practical efforts towards enhancing adaptive capacity in the face of changing climate and other conditions, both in the study area and elsewhere, by illustrating the sorts of conditions under which any climate adaptation measures would have to work. It also supports and enhances the main argument in the literature that any response to enhance adaptive capacity in dealing climate variability and change needs to be directly linked to the root causes of vulnerability.

8.3.2 **The Contribution of the Research Findings to Policy**

The main implication of research findings for policy is *the importance placed on directing adaptive responses to its root causes of vulnerability rather than solely to its physical impacts of the climate induced events.* Understanding causality does matter for developing appropriate policy responses since it is only through responding to its causes that vulnerability can be redressed.

As vulnerability is clearly the result of the configuration of forces (social, economic, political and cultural factors), any approach to setting up adaptive responses must take into account all of these issues. In addition to being ‘place-sensitive’, any adaptive response to reduce vulnerability must be *adaptive, integrative, multi-sectoral, inclusive, and participative*. It is not only spontaneous adaptive measures that are required to create a certain degree of innovation and locally suitable responses, but also deliberate adaptive measures on the part of community groups including government institutions. Many of these responses must have some degree of flexibility to increase households' and individuals' access to key resources. Such measures also need to include forward looking strategies to ensure the availability and sustainability of markets, institutions, and infrastructure.

Adaptive measures must also be multi-sectoral and integrative. This study shows that one single event has multiple causes. Food shortage, for instance, is not solely due to drought. Likewise, individuals/households tend to engage in a wide range of livelihood options simultaneously. Focussing on one sector in isolation is insufficient to address the vulnerability of people in dealing with climate stressors. Therefore, any adaptive measures targeted at enhancing the vulnerable groups may also need to be multi-sectoral. More specifically, multi-sectoral measures need to address the socially determined constraints that prevent households from engaging in different livelihood activities, rather than focusing on improving the productivity of any one single sector. The findings of this current study exemplify this case well.

It is worth noting that adaptive measures should not only include a multi-sectoral approach, but must be formulated through inclusive and participative processes that involve the entire affected population, especially the most vulnerable groups such as the subsistence farmers and the landless. This policy formulation will help assure that adaptive measures match the resources and the local needs and conditions of the affected population. Policy formulation should include economic and social measures that promote peoples' participation in adaptive policies by effecting their access to key resources.

Of particular relevance for the study sites of Kupang is the necessity to address the root causes of social vulnerability. This is more associated with the state of development of the region. For that reason, integrating / incorporating Climate Change Adaptation (CCA) together with Disaster Risk Reduction (DRR) into development planning at all levels is imperative. Vulnerability to climate variability and change, disaster management and adaptation must be incorporated into long-term sustainable development planning in the research sites and throughout Indonesia, as well as other vulnerable countries in the world. There is little evidence that people adapt to climate change as a separate stimulus (see Pouliotte, Smith, & Westerhoff, 2009**;** Berrang-

Ford, Ford, & Paterson, 2011). The main findings of this study show that climate is only one among other factors contributing to social vulnerability in the research regions. Local populations are exposed to a wide range of factors, including physical, social, economic, political and cultural processes and events. This finding implies that focusing on one single event – a climate induced event – instead of addressing many vulnerability drivers would not adequately address the development concerns of communities (Mercer, 2010). In saying that, adaptation actions and strategies are likely to have little success in promoting social resilience unless they are embedded in sustainable development planning.

Another important policy implication for addressing climate variability and change is that *emergency responses*, no matter how well adapted a region or community groups are to climate variability and change, can occur to a point where they exceed adaptive measures. Therefore, emergency responses have to be in place in order to anticipate those events. Significant advances with regard to climate forecasting and early warning mechanisms have been made at national and regional levels. However, lack of coordination and communication among the institutions is often the reason for ineffectual responses to a crisis. Therefore there is a need to have well-established mechanisms to link climate forecasting institutions and local agencies responsible for taking up emergency responses.

8.3.2.1 Implications for future research

This thesis has offered an enhanced understanding of social vulnerability to climate variability and change. However, there are still many approaches and areas of research that need to be investigated in order to gain a better understanding of how vulnerability can be reduced and adaptive capacity enhanced. This study was inter-disciplinary in nature, using two case studies in order to approach social vulnerability. A number of issues could be studied in more detail to gain a better understanding of how vulnerability can be reduced in practice, particularly in the case study sites and in Indonesia.

First, further investigation is required to assess the environmental consequences of particular coping strategies in order to improve the environmental viability of such strategies. In fact, certain coping strategies employed in the research regions, such as the collection of forest related products, manganese mining and disposal of household assets, are associated with depleting the resource base. These coping strategies may not necessarily lead to either an economically viable solution in the short term or an environmentally sustainable one in the long term. In this view, a comprehensive assessment of the environmental consequences of such coping strategies is urgently needed through conducting a socio-economic and environmental assessment. This socio-economic study would involve observing and interviewing a sample of households and/individuals who engage in specific resource use during droughts, while environmental impact assessment could include a combination of conservation status surveys of locations where natural resources are exploited, collecting information on vegetation changes from key informants, using available satellite data and so forth.

Second, the ways in which policy recommendations can be implemented need to be identified. This thesis identified general measures likely to make the policy framework work in dealing with social vulnerability in the research sites. Further studies are needed to show how specific adaptive measures work to address coping strategies and household vulnerability. Thus, the focus of future research could be on several aspects of policy implementation. Specific policy responses identified by this research, such as improving access to key resources (land, labour, market, and credit), can be examined in more detail through community and household analysis in order to figure out how those measures can effectively reduce vulnerability. Also, a broader assessment of national and local policies being implemented and the extent to which they are making a difference can be undertaken. The current policies, at national and local level of governments that can be derived from policy documents, including government budget allocations and community projects, need to be examined in more detail.

Third, social vulnerability to climate variability and change that is likely to occur in the future needs to be assessed in advance. This study has provided a review of the current state of social vulnerability that may be considered as a starting point to effect this. As climate together with non-climate stressors remain the determinant factors of social vulnerability, the projections of climate change scenarios should not be ignored in conducting the assessment of social vulnerability in the future.

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Appendix 1: Household Livelihood Questionnaires

Kupang: Social Adaptability and Vulnerability across an urban rural continuum in West Timor

SARYASKUS PAULUS LIU

This research will study Social Adaptability and Vulnerability to climate variability and change in rural areas in two districts of East Nusa Tenggara Province in Indonesia. The study will investigate the nature of vulnerability, and the adaptive capacity and coping strategies that have been employed by the local communities in the research sites.

Your participation in this research will be completely voluntary. If you do agree to participate, you can withdraw at any time. If you withdraw from the research, you do not have to explain why, and your record of your involvement will be destroyed. Participation or refusal to participate will not impair any existing relationship between participants and any other institutions or people involved. Information gathered by this survey will be treated as confidential, and it will used be solely for research purposes. This survey will be approximately about 45 minutes.

Interviewer's Name	………………………	
Village	Raknamo/Poto/Kauniki/Belo/Fatukoa	
Sub-district		
District		
Head of the HH	Male	Female
Age of both if applicable	Age:	Age:
Ethnicity		
Number of people in the HH?		

Is the head working?	Yes	No	Temporary	Fixed
Did the head work before?	Yes	No	Temporary	Fixed
Is the spouse working?	Yes	No	Temporary	Fixed
Did the spouse work before?	Yes	No	Temporary	Fixed
Are there other people working in the household?	Yes	No	Temporary	Fixed
If yes, how many:	….			

A. GENERAL HOUSEHOLD INFORMATION

A.1. Household and close family characteristics[1]

	Relation to head of HH	Age	Gender (m/f)	Marital status	Educational Attainment	Occupatio n/activity	Where does he/she stay?
A.1.1.	Head of the HH						
A.1.2.							
A.1.3.							

A.2. Were you born in this community or are you there because of marriage or immigration?

…………………………………………………………………………………………
…………………………………………………………………………………………

A.3. When and how did you get access to this residential site? Did you buy it? Do you rent it?

…………………………………………………………………………………………
…………………………………………………………………………………………

A.4. Do you have title deeds for this residential site?

………………………………………………………………………………………....

[1] As household we'll define all the persons registered on the same residential site. Children (even when older than 18) not staying at home anymore, but being registered at their parents' address should be considered.

B. PROFESSIONAL INFORMATION

B.1. What else did you do as a professional activity? When? Why did you stop? Please, give a precise image of the activities you practices during your life, by starting with your first activity.

Professional activities (Please, give details: type of work, place, professional status).	Where?	When started?	Till when?	Briefly, what were your working conditions at this time? - Revenue per month? - Professional status? - Social benefits?	What were the reasons for stopping or changing?

B.1. What did your spouse or other members of your household do as a professional activity? When? Why did you stop? Please, give a precise image of the activities you practices during your life, by starting with your first activity.

Professional activities (Please, give details: type of work, place, professional status).	Where?	When started?	Till when?	Briefly, what were your working conditions at this time? - Revenue per month? - Professional status? - Social benefits?	What were the reasons for stopping or changing?

C. FARM CHARACTERISTICS AND LAND TENURE

1) Do you own land? .... Yes / No
2) If yes, what is the size of the plot of land owned by the household?

Type of Land	Acre / Ha
Irrigated	
Dry-land	
Household garden	
Mixed garden	

3) Do you farm? ……………. Yes / No
4) Do you also farm land that you do not own? Yes / N
5) If yes, what is the size of the land not owned by the household, but used for livelihood?

Type of Land	Acre / Ha
Irrigated	
Dry-land	
Household garden	
Mixed garden	

6) Under what arrangement do you use this land?
7) Do you farm all the land you own? ….. Yes / No
8) What do you do with the land you own and do not farm? ……..
9) When and how did you or your household first acquire the land? Purchase/land distribution/inheritance/usufruct/being part of the community?
10) Has there been a change to the household's land-holding size in the last five to ten years?

	X	Reason
No, it remained much the same		
Yes, it has decreased (by how much)		
Yes, it has increased (by how much)		

Farm Plots

Plot no.	Size (acres)	Use (past year) (a)	Location		Soil type (c)	Fertility (d)	How acquired? (e)	Tenure situation (f)	Crops (in order of importance)	Sowing moment	Harvest moment	Harvest Quantity (g)	
			Distance to compound	**'Distance to water table'**									
1									1				
									2				
									3				
									4				
									5				
									6				
2									1				
									2				
									3				
									4				
									5				
									6				
3									1				
									2				
									3				
									4				
									5				
									6				

A. Use (past year)

1) Food crop
2) Cash crop
3) Grazing
4) Fallow
5) Not used
6) Given out
7) Other (specify)

B. Distance to water table

1) Valley bottom
2) High
3) Medium
4) Low
5) Other (specify)

C. Soil type

1. Black clay / valley soil
2. Reddish soil
3. Light coloured soil
4. …

D. Fertility

1) Describe per plot
2. Rank plots

E. How acquired

1) Inherited
2) Permission asked
3) Purchased
4) Gift
5) Newly occupied
6) Rented
7) Other (Specify)

F. Tenure situation

1) Usufruct from clans
2) Privately owned
3) Other (specify)

G. Harvest Quantity

1). Describe (good, bad, failure, etc)
2). Number of bags/bowls

D. LIVESTOCK

1. Do you own animals?
2. How did you first acquire animals / cattle?

Source	Rank
Non/off farm income	
Crop sales	
Inheritance	
Given by father	
Herding payment	
Bridewealth	
Government program	
Other (specify)	

3. Under what arrangement do you have access to animals?
   a. Share ownership
   b. Share-rearing arrangements
   c. Profit sharing arrangements

4. If no, why? Did you have livestock before? What happened?
5. Which of the following livestock does your household keep? Please indicate numbers owned.

Type	Who is the owner?	People taking care of them	Number owned	Number owned five years ago and reason for change
Cattle				
Water Buffalo				
Horses				
Goats				
Pigs				
Chickens				

6. What did you do with the production of livestock during the year?

Type	Use of production (quantity)				Reason	To whom / where
	Own consumption	Sell	Exchange	Other (detail)		
Cattle						
Water Buffalo						
Horses						
Goats						
Pigs						
Chickens						

7. Are you sometimes forced to sell animals in order to buy grain to feed your family?
   ………………………………………………………………………………………
   ………………………………………………………………………………………

E. FARM ORGANIZATION, LABOUR, MARKETS AND EQUIPMENT

1. Do you hire labour? If yes, for what duties? What is his/her relationship to household? What costs does this imply?

What duties/tasks	Number of people hired per duty	Relationship to the household	How long? Full-time/half-time? When?	Costs

2. If there is a need, could you please detail how you organize your activities and labour? Do you keep stock with other people, for example? Do you keep stock from other people?

   ……………………………………………………………………………………
   ……………………………………………………………………………………

3. What agricultural inputs do you purchase? Where do you purchase them?

Agricultural inputs	Quantity/costs per year	Where purchased?

4. How do you plough and harvest? Do you use implements? If yes, what costs does this involve?

Activity	Equipment used	Costs		
		Hire	Petrol	Other?

5. Which of the following factors are important constraints concerning your farming activities (Rank if possible)?

Constraint	Rank	Explain
Crop production		
Erratic rainfall		
Lack of farm inputs (fertilizers, seeds, pesticides, labour, etc.)		
Lack of farm implements (tools, plough, tractors, etc.)		
Crop destruction by pests and diseases		
Natural disasters		
Animal/birds destroyed crops		
Poor infertile soils		
Lack of agricultural training/extension services		
Livestock production		
Drought related loss		
Lack of water		
Animal diseases		
Lack of fodder		
Other (specify)		

F. OTHER INDEPENDENT ACTIVITIES

1. If the household is NOT engaged in farming activities, why are you not farming or engaged in farming activities?
   …………………………………………………………………………………
   …………………………………………………………………………………

2. Are you or your household engaged in other independent activities?

1	Yes	2	No

3. If no, why are you not engaged in such activities?
   …………………………………………………………………………………
   …………………………………………………………………………………

4. If yes, specify.
   …………………………………………………………………………………
   …………………………………………………………………………………

5. Where did you develop these activities? Why?
   …………………………………………………………………………………
   …………………………………………………………………………………

6. How did you develop these activities? Where did the money to invest come from?
   …………………………………………………………………………………
   …………………………………………………………………………………

7. Please, detail a bit more these activities. Where is your main market (for selling your products or delivering your services)? What is your price per unit? How many products/services do you sell per day, per month?
   …………………………………………………………………………………
   …………………………………………………………………………………

8. Who deals with these activities?

		X	What type of duties
Are you dealing with it yourself?			
Is your spouse doing it?			
Other relatives of your household (specify)?			

9. Do you hire labour for these activities? If yes, for what duties? What is his/her relationship to the household? What costs does this imply?

What duties/tasks	Number of people hired per duty	Relationship to the household	How long? Full-time/halftime? When	Costs

10. What are the constraints you encounter to develop these independent activities?

	Explain
Access to finance	
Communal property	
Other? (specify)	

G. PERCEPTION OF CHANGES IN LAND DEGRADATION

1. During the past seven years of cultivation, have you noticed any changes in **soil fertility**?
   a. Increase, because ………
   b. No change
   c. Decrease, because …….

2. During the past seven years of cultivation, have you noticed any changes in **soil moisture?**
   a. Increase, because ………
   b. No change
   c. Decrease, because …….

3. During the last seven years of cultivation, have you noticed any changes in **depth in upper part of plot?**
   a. Increase, because ………
   b. No change
   c. Decrease, because …….

4. During the last seven years of cultivation, have you noticed any changes in **ease of ploughing?**
   a. Increase, because ………
   b. No change
   c. Decrease, because …….

5. During the last seven years of cultivation, have you noticed any changes in **moisture in lower part of plot?**
   a. Increase, because ………
   b. No change
   c. Decrease, because …….

6. During the last seven years of cultivation period, have you noticed any changes in **weed occurrence?**
   a. Increase, because ………
   b. No change
   c. Decrease, because …….

H. FINANCIAL SITUATION OF THE HOUSEHOLD

1. What are the non-agricultural sources of income available to your household? State the amount you receive from every source per month or year.

	Source		**For who?**	**Amount per month**	**Amount per year**
1	Employment				
2	Non agricultural independent activities				
3	Remittances	Cash			
		In-kind			
4	Welfare	Pension			
		Allowances for children			
		Allowances for health			
5	Other				

2. How important are the side incomes compared to your major income? How do you assess the trend in level of income from these different activities?
   ………………………………………………………………………………………

3. Are you or somebody in your household looking for another job? Why?
   ………………………………………………………………………………………

4. Do you want to develop another independent activity? Why, when, where and how?
   ………………………………………………………………………………………
   ……………………………………………………………………………………..

I. ACCESS TO MARKETS, INSTITUTIONS AND SUPPORT

1. **Access to shops and markets**
   a. Name shops and market centers you use (in order of importance)

Name and type of the market center (market, auction, co-ops, shops, etc)	One-way distance from the village and means of transport	Problems with access to these markets? Please explain

   b. Please indicate what you bought from the market including village market, other than agricultural inputs last season, including amount spent on each item if possible.

	Shop/Market?	Amount per month?
Food items (list) …………………. …………………		
Non-food consumption goods ……………………………… ……………………………..		
Other ……………………………… ……………………………….		

2. Access to financial services

a. Do you have a bank account? Do you/your household have any access to formal banks?

1	Yes	2	No

b. Do you/your household save money? How much per month? Where?
…………………………………………………………………………………
…………………………………………………………………………………

c. Have you ever borrowed?

1	Yes	2	No

d. If the answer is yes, please indicate the amount you borrowed, when you borrowed, purpose for borrowing, sources, form of repayment and term of credit

Amount borrowed	When?	Source	Purpose	Term of credit*	For of repayment*

* Terms of credit: Short-term (one year or less), Medium (2-3 years) and Long-term (if should be repaid within more than three years); form of repayment = in-kind or cash or both.

e. Do you have any problems accessing formal financial institutions? Why do you have a bank account? Can you have one?
…………………………………………………………………………………
…………………………………………………………………………………

f. Do you have difficulties in getting credit you need? If yes, what are the difficulties?
…………………………………………………………………………………
…………………………………………………………………………………

3. Access to educational services, training and extension service

a. Do you have the necessary knowledge and skills?

	Yes/No	Specify. How did you acquire them? Is it enough?
Technical farming skills		
Management skills		
Financial management skills		
Other, specify ………………………….……..		

b. Do you have access to courses/training services?

1	Yes	2	No

c. If yes, through whom? What does it cost you?
………………………………………………………………………………
………………………………………………………………………………

d. If you are farming, do you have regular contact with any extension agent? How frequently does the extension agent visit you during cropping season?
………………………………………………………………………………
………………………………………………………………………………

e. Indicate the kind of training service and advice you expect from extension in the future
………………………………………………………………………………
………………………………………………………………………………

4. Access to other organizations/institutions

a. What other organizations/institutions do you have access to or do you know that exist (A=Access, E=Exist)

Type of organization	**A/E**	**Location of organization**
Farmer's association		
Farmer cooperative		
Trade union or labour union		
Village committee		
Religious groups		
Political groups or movements		
Cultural associations		
Etc…….		

5. Problems and constraints

a. In general, what are the main problems while living here, developing your activities?

	Yes/No	**Specify**
Financial?		
Land?		
Information?		
Social cohesion?		
Access to inputs		
Lack of incentives		
Other, specify ………………………… …………………………		

b. Do you have anything to add to this questionnaire? Remarks? Questions?
………………………………………………………………………………
………………………………………………………………………………

J. FAMILY NETWORKS

1) Do you have relatives in the village? …… Yes/No……. if 'no': Go to 2
   ……………………………………………………………………………………
   …………………………………………………………………………………….
   a) Do you help each other with farm-and/or other **work**? ….. Yes / No
      ……………………………………………………………………………
      ……………………………………………………………………………
   b) Do you give or receive **food** to/from these relatives? ……. Yes / No
      ……………………………………………………………………………
      ……………………………………………………………………………
   c) Do you give or receive **cash** to/from these relatives ……… Yes / No
      ……………………………………………………………………………
      ……………………………………………………………………………
   d) Have these forms of mutual aid increased, decreased or stayed the same over time? ………….
      ……………………………………………………………………………
      ……………………………………………………………………………

2) Do you have relatives outside the village? ……. Yes / No …. if 'no': Go to 3
   ……………………………………………………………………………………
   …………………………………………………………………………………….
   a) Do you help each other with farm-and/or other **work**? ….. Yes / No
      ……………………………………………………………………………
      ……………………………………………………………………………
   b) Do you give or receive **food** to/from these relatives? ……. Yes / No
      ……………………………………………………………………………
      ……………………………………………………………………………
   c) Do you give or receive **cash** to/from these relatives ……… Yes / No
      ……………………………………………………………………………
      ……………………………………………………………………………
   d) Have these forms of mutual aid increased, decreased or stayed the same over time? …………
      ……………………………………………………………………………
      ……………………………………………………………………………

3) Do you have relatives outside Kupang city (but in Indonesia)? …. Yes / No …. If 'no': Go to 4
   ……………………………………………………………………………………
   …………………………………………………………………………………….
   a) Do you help each other with farm-and/or other **work**? ….. Yes / No
      ……………………………………………………………………………
      ……………………………………………………………………………
   b) Do you give or receive **food** to/from these relatives? ……. Yes / No
      ……………………………………………………………………………
      ……………………………………………………………………………
   c) Do you give or receive **cash** to/from these relatives ……… Yes / No
      ……………………………………………………………………………
      ……………………………………………………………………………

d) Have these forms of mutual aid increased, decreased or stayed the same over time? ………….
………………………………………………………………………………
………………………………………………………………………………

4) Do you have relatives who live outside Indonesia? ……. Yes/No
a) Do you receive help from them (money, consumer goods, explain trend)?

END OF QUESTIONNAIRE

Appendix 2: Drought Coping Mechanism Survey

A. How do farmers perceive drought?

1) What do you understand by Drought?
   ……………………………………………………………………………………
   ……………………………………………………………………………………

2) Would you say your village is experiencing drought at present? Yes / No
   ……………………………………………………………………………………
   ……………………………………………………………………………………

3) Has this place always experienced drought?
   ……………………………………………………………………………………
   ……………………………………………………………………………………

4) How often does this place experience drought?
   ……………………………………………………………………………………
   ……………………………………………………………………………………

5) How many times has this area experienced drought since you started living here? Please list the years if possible.
   ……………………………………………………………………………………
   ……………………………………………………………………………………

6) In which year did you experience the worst drought?
   ……………………………………………………………………………………
   ……………………………………………………………………………………

7) When do you expect the next drought?
   ……………………………………………………………………………………
   ……………………………………………………………………………………

8) How severely has your household been affected by drought? Please explain.
   ……………………………………………………………………………………
   ……………………………………………………………………………………

9) How does drought influence employment and jobs?
   ……………………………………………………………………………………
   ……………………………………………………………………………………

10) How does drought affect family and social life?
    ……………………………………………………………………………………
    ……………………………………………………………………………………

11) What measures has your household taken to reduce the damage caused by drought?
    ……………………………………………………………………………………
    ……………………………………………………………………………………

12) What long-term measures has your household taken to adapt to drought?

…………………………………………………………………………………
…………………………………………………………………………………

13) What measures are the most important in your households? Please rank them in the order of importance.
…………………………………………………………………………………
…………………………………………………………………………………

14) Are there any changes in the way you deal with drought today compared to the past? Yes… No… If yes, please explain.
…………………………………………………………………………………
…………………………………………………………………………………

15) Who has been most affected by drought?
…………………………………………………………………………………
…………………………………………………………………………………

16) Does the community take any action to deal with drought? Yes …. No …..
If yes, what actions?
…………………………………………………………………………………
…………………………………………………………………………………

17) Are you able to tell when a drought will come? Yes … No …
…………………………………………………………………………………
…………………………………………………………………………………

18) If yes, how can you tell?
…………………………………………………………………………………
…………………………………………………………………………………

19) What problems do you experience that prevent you from coping with drought?
…………………………………………………………………………………
…………………………………………………………………………………

B. Crop Management Adjustments

1) Did you adjust crop establishment methods?

1	No	2	Yes

Explain:
…………………………………………………………………………………
…………………………………………………………………………………

2) Did you adjust sowing date?

1	No	2	Yes	
			a.	Early sowing
			b.	Late sowing

Explain:
…………………………………………………………………………………
…………………………………………………………………………………

3) Did you adjust seeding rate?

1	No	2	Yes
		a.	High seed rate
		b.	Low seed rate

Explain:
……………………………………………………………………………………
……………………………………………………………………………………

4) Did you adjust seed variety?

1	No	2	Yes
		a.	Early maturing
		b.	Drought resistant
		c.	Traditional variety

Explain:
……………………………………………………………………………………
……………………………………………………………………………………

5) Did you change timing of inorganic fertilizer application?

1	No	2	Yes
		a.	No dose
		b.	Reduce
		c.	Apply only at flowering time if rainfall arises

Explain:
……………………………………………………………………………………
……………………………………………………………………………………

6) Did you change the amount of fertilizer?

1	No	2	Yes
		a.	Decrease
		b.	Increase

Explain:
……………………………………………………………………………………
……………………………………………………………………………………

7) Did you perform re-sowing or replanting?

1	No	2	Yes
		a.	No germination
		b.	Poor germination
		c.	Seedlings died after germination

Explain:
……………………………………………………………………………………
……………………………………………………………………………………

8) Did you change manual weeding?

1	No	2	Yes

Explain:
……………………………………………………………………………………
……………………………………………………………………………………

9) Was there any change in pest infestation?

1	No	2	Yes	
			a.	Decrease
			b.	Increase

Explain:
………………………………………………………………………………………
……………………………………………………………………………………….

C. Production loss and Consumption adjustments

1) How has drought affected your household food production?
2) How have you managed to cope with the impacts of drought?
3) Did you reduce the quantity of maize and rice sold to the local market? If yes, by how much?
4) How was the quantity of grain retained during the drought period, as compared to normal years?

1	Decrease	2	Increase

Explain:
………………………………………………………………………………………
……………………………………………………………………………………….

5) Did you seek new sources of food (not normally eaten), like wild fruits and animals during drought period?

1	No	2	Yes

Explain:
………………………………………………………………………………………
……………………………………………………………………………………….

6) Were there any changes in household consumption behavior between normal and drought years?

a.	Number of meals per day: *(circle one per now)*	
	Normal year	0
		1
		2
		3 or more
	Drought year	0
		1
		2
		3 or more

D. Expenditure Adjustments

1. Did you make any adjustments to household expenditure?

Expenditure adjustments	**Please tick**
Spending on new clothes curtailed	
Medical treatment postponed	
Social and religious functions curtailed	
Children’s education curtailed	

E. Asset depletion

1. Did you sell or pledge household assets to cope with drought?

1	No	2	Yes

2. If yes, what kinds of asset did you sell?

Type of asset sold	Please tick
Large animals/livestock	
Small animals (pigs, sheep, local chicken, etc)	
Farm tools	
Household items (electronic and white goods)	
Gold	
Land and building(s)	
All of the above	

3. Was it able to achieve the aim of the sale?

1	No	2	Yes

Explain: Why, or why not?
…………………………………………………………………………………
………………………………………………………………………………….

F. Seeking employment

1. Were you forced to seek employment elsewhere during the drought period?

1	Yes	2	No

Explain:
…………………………………………………………………………………
………………………………………………………………………………….

2. Did you obtain employment within your locality or did you have to migrate?

1	Within	2	Migrate

Explain:
…………………………………………………………………………………
………………………………………………………………………………….

G. Reliance on social networks and government relief programs

1. Did you and your family received help from relatives during drought periods?
2. Did you receive any help from the government during drought years? Yes… No …. If yes, what kind of help?

…………………………………………………………………………………………
………………………………………………………………………………

2. For how long does the government provide help?
…………………………………………………………………………………………
………………………………………………………………………………

3. Do you find the government help adequate? Yes… No…

4. Please provide more details.
………………………………………………………………………………………
……………………………………………………………………………

END OF QUESTINNAIRE

Appendix 3: Information Sheet for the study, as approved by Research Ethics Committee of the ANU

– INFORMATION SHEET –
(translated into *Bahasa*).

Title of Project

Kupang: Social Adaptability and Vulnerability across an urban-rural continuum in West Timor

This project has been designed to examine social vulnerability and adaptability as well as the configuration of forces that shape the people of West Timor to adapt and cope with environmental and social changes. More specifically, this project will investigate the nature of vulnerability, the adaptive capacity and coping strategies that have been employed by local communities and local governments in West Timor.

Period of Investigation: June 2010 – June 2011

Investigator:
Saryaskus Paulus Liu, Environmental Management & Development Program, Crawford School of Economics and Government, ANU. The research is being conducted toward a Doctor of Philosophy degree, and is conducted independently by the researcher.

Supervisor
James J Fox is a Professor in the Resource Management in Asia Pacific Program, Crawford School of Economics and Government at the Australian National University. His research interests include the history and anthropology of Indonesia and East Timor, rural development and resource management, study of social organizations and symbolic systems, linguistic anthropology and comparative Austronesian ethnology. In particular, he has conducted considerable research in West Timor, Indonesia on the issues of livelihoods and social change in rural and maritime populations in the region.

Why am I carrying out this research?
To date, research on vulnerability and adaptation to climate change has heavily focused on impact assessments with the purpose of estimating the physical impacts of climate change and variability. Adaptations were then considered as an end cost of climate change. However, it is now becoming increasingly recognized that initiatives to identify adaptation needs and to improve adaptive capacity start with an assessment of vulnerability of the system of interest. This draws on insights from the political ecology literature which shows that access to resources, equity, livelihoods and the political and socio-economic conditions are important considerations in the assessment of adaptive capacity, and therefore vulnerability.

In response to this recognized need, this research has been designed to examine adaptability and vulnerability of local communities in West Timor region with respect to the social and environmental changes. In addition to social change, West Timor is highly vulnerable to climate variability and change due to its geographical location and the strong dependence of its population on rain-fed agriculture and livestock in addition to fishery. The primary sector employs more than 75 % of the active population and contributes 40% of the Gross Domestic Product (GDP) of the region. Rainfall variability, land degradation and desertification are some of the factors that combine to make life extremely difficult for the people of West Timor. The recurrent El Nino related drought that occurs almost one in every three years causes massive losses of agricultural production and livestock, loss of human lives to hunger, malnutrition and diseases, and other economic shocks / loss.

It is expected that this research will increase knowledge about social vulnerability and adaptability in semi-arid regions like West Timor and also will contribute to the current understanding of how various social factors shape people's vulnerability and adaptive capacity. In addition, the research will also generate policy and program-relevant knowledge about challenges and strategies for enhancing social adaptation and resilience. Therefore, the proposed research has policy implications for social welfare benefit. More specifically, it will help the local government of West Timor by informing appropriate adaptation actions that are suitable to local problems. For local communities, it will help them to understand their own vulnerability and adaptive capacity. By understanding their state of vulnerability, it is expected that they can take necessary actions to scale up their adaptive capacity at individual and community level, independent of government actions.

What does this research involve?

This research will involve semi-structured interviews with local government employees, the representatives of NGOs and members of local communities. Participants for local governments and NGOs are mainly selected due to their involvement in community adaptation programs, while members of local communities are chosen due to their experiences and perceptions in dealing with climate variability and livelihood vulnerability. I would like to invite you participate in the research. If you agree to participate in this research, I will ask you to attend an interview which will last up to 1 hour. This will involve signing a consent form and answering questions. The interview will be conducted in *Bahasa*. It will be based on your experience and knowledge of social vulnerability and adaptability. With your permission, I may also record the interview on an audio cassette.

Participation in this project is purely voluntary and there will be no adverse consequences if you decide not to participate. You may withdraw from participation in the project at any time, and you are not required to provide any reason for doing so. If you choose to withdraw, any information you provide will be completely destroyed.

The results of this research will be reported in a doctoral thesis and may be published in academic journals or books. The names of individuals or their position titles will not be reported in connection with any of the information collected during interviews, unless they have explicitly consented to be identified. Once published, the results of this research will be made available upon request.

Are there any risks if you participate?

The interview instrument has not been designed to elicit any information that is confidential, sensitive or potentially incriminating in nature. It is important to stress that you may refuse to answer any given question without consequence. Should you have any further concerns about confidentiality, please raise the issue during the course of the interview or prior to the publication of findings, so that assurances can be made that specific information is not reported or published.

Contact names and phone numbers

Any questions about this project may be directed to the investigator, Saryaskus Paulus Liu, of RMAP Program, Crawford School of Economics and Government, Australian National University, In West Timor, Indonesia, you can contact me on 081339042446, or email: paulus.liu@anu.edu.au.

In West Timor, Indonesia, you may contact, Jermi Haning, MA, the head of Transform Institute, email: jermi.haning@yahoo.com, Mobile: 081339327132, Address: Damai St, Kel. Oebufu, Kupang, West Timor, Indonesia.

If you have complaints or queries that I, or [Local Contact Name], cannot answer to your satisfaction, you may contact the research supervisor, Prof. J.J. Fox, RMAP Program, Crawford School of Economics and Government, Australian National University, on (61) 02 6125 0192 or email james.fox@anu.edu.au.

If you have any concerns regarding the way the research was conducted you can also contact the ANU Human Research Ethics Committee:

Human Ethics Officer
Human Research Ethics Committee
The Australian National University
Tel. 02 6125 7945
Email. Human.Ethics.Officer@anu.edu.au