Empowered lives.
Resilient nations.

COUNTRY REPORT
CLIMATE RISK MANAGEMENT IN TIMOR-LESTE

By Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES)

September, 2013

United Nations Development Programme

CRISIS PREVENTION AND RECOVERY

Supported by
United Nations Development Programme (UNDP)
Bureau for Crisis Prevention & Recovery (BCPR)-Bureau for Development Policy (BDP)
Under the
Climate Risk Management - Technical Assistance Support Project (CRM-TASP)

This report was commissioned by the United Nations Development Programme's Bureau for Crisis Prevention and Recovery (BCPR) under the Climate Risk Management – Technical Assistance Support Project (CRM-TASP)

This CRM-TASP report is authored by:

Arjunapermal Subbiah
Ramraj Narasimhan
J. Shanmugasundaram
Carlyne Yu
of Regional Multi-hazard Early warning System (RIMES) through a contract administered by Asian Disaster Preparedness Center.

Cite as: United Nations Development Programme (UNDP), Bureau for Crisis Prevention and Recovery (BCPR). 2013. *Climate Risk Management for Agriculture Sector in Timor Leste*. New York, NY: UNDP BCPR

Published by:
United Nations Development Programme (UNDP), Bureau for Crisis Prevention and Recovery (BCPR), One UN Plaza, New York-10017

UNDP partners with people at all levels of society to help build nations that can withstand crisis, and drive and sustain the kind of growth that improves the quality of life for everyone. On the ground in 177 countries and territories, we offer global perspective and local insight to help empower lives and build resilient nations. www.undp.org

CONTENTS

LIST OF ABBREVIATIONS AND ACRONYMS

ACIAR	Australian Centre for International Agricultural Research
BCPR	Bureau for Crisis Prevention and Recovery
BDP/EEG	Bureau for Development Policy / Energy and Environment Group
BOM	Bureau of Meteorology (Australia)
CRM	Climate Risk Management
CRM TASP	Climate Risk Management Technical Assistance Support Project
CRU	Climate Research Unit
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CCAM	Cubic Conformal Atmospheric Model
DM	Disaster Management
DRR	Disaster Risk Reduction
ENSO	El Niño Southern Oscillation
FAO	Food and Agriculture Organization of the United Nations
GCM	Global Climate Model
GDP	Gross Domestic Product
GNI	Gross National Income
IFRC	International Federation of Red Cross and Red Crescent Societies
IOD	Indian Ocean Dipole
MAFF	Ministry of Agriculture, Forestry and Fisheries
MJO	Madden – Julian Oscillation
NDES	National Directorate of Environmental Services
NDIEA	National Directorate of International Environment Affairs
NDMD	National Disaster Management Directorate
NDMG	National Directorate for Meteorology and Geophysics
RIMES	Regional Integrated Multi-hazard Early Warning System for Africa and Asia
SDP	Strategic Development Plan
TLSLS	Timor-Leste Survey of Living Standards
UNDP	United Nations Development Programme
WFP	World Food Programme

FOREWORD

Climate change has the potential to exacerbate conflict, cause humanitarian crises, displace people, destroy livelihoods and set-back development and the fight against poverty for millions of people across the globe.

For example, it is estimated that over 20 million people in the Mekong Delta and 20 million in Bangladesh could be forced to move as their homes are affected by saltwater incursion from rising sea levels. Entire populations of some low lying island states, such as Nauru or the Maldives may have to be relocated. In countries like Honduras, where more than half the population relies on agriculture, climate induced risks, such as hurricane Mitch in 1998, which caused over USD 2 billion in agricultural losses, will continue to pose a staggering potential for damage. Similarly, climate risk assessments in Nicaragua show that changes in rainfall patterns, floods and drought could put human health at risk by increasing the prevalence of respiratory and water borne diseases and malnutrition.

Long-term incremental changes will mean that people everywhere must learn to adapt to weather or rainfall patterns changing, or to shifts in ecosystems that humans depend upon for food. Perhaps more worrying however, is that climate variability and change will also bring unpredictable weather patterns that will in turn result in more extreme weather events. Heat waves, droughts, floods, and violent storms could be much more common in the decades to come. Climate change is "loading the dice" and making extreme weather events more likely. These disasters will undermine the sustainability of development and render some practices, such as certain types of agriculture, unsustainable; some places uninhabitable; and some lives unliveable.

As climate change creates new risks, better analysis is needed to understand a new level of uncertainty. In order to plan for disasters, we need to understand how climate change will impact on economies, livelihoods and development. We need to understand how likely changes in temperature, precipitation, as well as the frequency and magnitude of future extreme weather will affect any sector, including agriculture, water-use, human and animal health and the biodiversity of wetlands.

This report is a product of the *Climate Risk Management – Technical Assistance Support Project*, which is supported by UNDP's Bureau for Crisis Prevention and Recovery, and Bureau for Development Policy. This is one in a series of reports that examine high-risk countries and focus on a specific socio-economic sector in each country. The series illustrates how people in different communities and across a range of socio-economic sectors may have to make adaptations to the way they generate income and cultivate livelihoods in the face of a changing climate. These reports present an evidence base for understanding how climatic risks are likely to unfold. They will help governments, development agencies and even the communities themselves to identify underlying risks, including inappropriately designed policies and plans and crucial capacity gaps.

This series is part of a growing body of climate change adaptation resources being developed by UNDP. The Climate Risk Management – Technical Assistance Support Project has formulated a range of climate risk management assessments and strategies that bring together disaster risk reduction and climate change adaptation practices. The project is designing a common framework to assist countries in developing the necessary capacity to manage climate-induced risks to respond to this emerging threat. The climate risk assessments discussed in this report and others in the series will feed into a set of country-level projects and regional initiatives that will inform the practice of climate risk management for decades to come.

Addressing climate change is one of UNDP's strategic priorities. There is strong demand for more information. People at all levels, including small communities want to understand the potential impact of climate change and learn how they can develop strategies to reduce their own vulnerability. UNDP is addressing this demand and enabling communities and nations to devise informed risk management solutions. UNDP recognises that climate change is a crucial challenge to sustainable development and the goal of building resilient nations.

As the full effect of climate change becomes apparent, it is assessments such as these that will become the lynchpin of national responses and adaptation strategies for many years to come. Like the threat from many disasters, there is still time to prepare for the worst impacts of climate change in developing countries if we expand our understanding now.

This knowledge must be combined with real preparedness and action at all levels. Only then will we be able to stave off the worst impacts of climate change in the most vulnerable and high risk countries of our world.

Jordan Ryan
Assistant Administrator and Director
Bureau for Crisis Prevention and Recovery
United Nations Development Programme

Olav Kjorven
Assistant Administrator and Director
Bureau for Development Policy
United Nations Development Programme

ACKNOWLEDGEMENTS

The Report *Climate Risk Management for Agriculture Sector in Timor Leste* was commissioned under the Climate Risk Management – Technical Assistance Support Project (CRM-TASP), a joint initiative by the Bureau for Crisis Prevention and Recovery (BCPR) and the Bureau for Development Policy (BDP), UNDP and implemented by Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES) through a contract administered by Asian Disaster Preparedness Center.

The Project, its methodology and analytical framework was conceptualized by Maxx Dilley, Disaster Partnerships Advisor and Alain Lambert, Policy Advisor, Disaster Risk Reduction and Recovery Team (DRRT), BCPR with key inputs from Kamal Kishore, Programme Advisor, DRRT, BCPR and Ms. Bo Lim, Special CC Advisor, Environment and Energy Group (EEG), BDP.

Within BCPR, the Project implementation process has been supervised by Alain Lambert and Rajeev Issar who provided regular inputs to ensure in-depth climate risk assessments and identification of tangible risk reduction and adaptation options. From BDP, Ms. Mihoko Kumamoto and Ms. Jennifer Baumwoll provided their inputs and comments to refine the assessment and recommendations. The climate risk assessment has also benefitted immensely from the strategic guidance provided by Jo Scheuer, Global Coordinator, DRRT, BCPR and by Ms. Veerle Vandeweerd, Director, EEG, BDP.

The Project team would like to acknowledge and give special thanks to the main authors of the Report from RIMES.

For their valuable contribution to the project implementation and climate risk assessment process, the Project team and lead authors would like to gratefully acknowledge the unstinted support provided by colleagues from UNDP Country Office who provided regular inputs and anchored the process at the country level, officers from the national/state nodal department/agency and other stakeholders.

The climate risk assessments under the CRM-TASP project have been undertaken with the funding support of the Government of Sweden.

EXECUTIVE SUMMARY

Timor-Leste lies in the Lesser Sunda Islands at the eastern end of the Indonesian archipelago with an area of 15,007 square km of rough mountainous terrain with a narrow strip of coastal plains. Timor-Leste is the youngest and – in spite of the recent fossil fuel discoveries – one of the poorest countries in the world, with more than 50 per cent of its one million population living in poverty.

Some 40 per cent of the country is mountainous with slopes steeper than 40 per cent. Heavy rains in these areas during monsoon period (November to April) cause flash floods and landslides, which, along with droughts, are considered the main natural hazards in the country. Timor-Leste is also vulnerable to tropical cyclones and storms that could cause coastal flooding and wave damage. Climate change could aggravate severity and intensity of these hazards posing serious threat to the national development process.

Timor-Leste has a dual economy- with one activity group based on subsistence agriculture, and the other on petroleum. From 2006-07 onwards, Petroleum Fund reserves are being drawn on to drive development processes. The Strategic Development Plan (SDP) 2011-2030 prioritizes inter alia agriculture and infrastructure as key investment areas for developing the economy, considering that agriculture supports livelihoods of large section of the population, and infrastructure is a critical requirement for ensuring growth and all round development in the country.

Climate-related risks already exist while new forms of risks related to climate change are emerging. Risks affect sectors as wide as socio-economic, socio-environmental and eco-environmental by deterring investment and innovation at the livelihood level. Of the total one million population 80 per cent are rural and depend on subsistence agriculture for their livelihood. Climate shocks such as drought associated with El Nino and floods and landslides with La Nina, are aggravating food insecurity and malnutrition.

Traditionally, during lower than normal rainfall seasons, farming households in Timor-Leste have minimized risks from crop failures through inter-cropping and high seeding rates. To cope with difficult conditions, people have had to reduce consumption, substitute tubers for food grains and sell their livestock or borrow from relatives and friends. The poor and vulnerable have least ability to cope, necessitating substantial support from donors and national government.

Government of Timor-Leste has recognized agriculture as an important driver for economic growth, and a key element of poverty reduction in rural area. It has identified introduction of improved technologies and practices in addition to enlarged support services and better functioning markets as strategies to transform subsistence agriculture to a market economy and achieve food security. Increasing use of hybrid and high yielding crop varieties could be more sensitive to climate risks.

Considering the devastation due to the long-drawn conflict and the need for rehabilitation of the war-damaged infrastructure, the Government of Timor-Leste has also prioritized infrastructure development as one of the priority areas for investment. Around 90 per cent of the development funds are devoted to new infrastructure and rehabilitation of war-ravaged infrastructure. These developments could increase the exposure of large scale infrastructure assets to climate risks in a difficult mountainous terrain of Timor-Leste. For instance, it is possible that road constructions could be severely impacted by climatic parameters such as heavy-rain induced damages, dry-spell induced cracks and also heavy rainfall induced landslides in mountainous regions etc. In the coastal areas, because of the fragile nature of the soils, long dry-spells and heavy rains could shorten the life of the road construction.

Climate risk management is still in a nascent stage in Timor Leste. There is a significant need to integrate the three main frameworks that contribute to the climate risk management process in the country- development, disaster risk management and climate change adaptation. However, the Government lacks the institutional capacities and policy mechanisms to assess, prioritize and reduce climate risks in a systematic manner. Currently, Timor-Leste has resources from Petroleum Fund, and development partners that can be utilized for climate risk management interventions.

It is important to pay close attention to climate risks and reduce exposure of development assets added each year in the country and investments into agricultural sector. CRM TASP assessment revealed that a minimum investment in climate risk management could maximize gains in the form of protecting agriculture and infrastructure investments from recurring climate risks. It also underscored the need to develop institutional and capacity mechanisms to integrate climate riks management into all climate sensitive sectors through needs assessments and enhancing information sharing and partnerships among government ministries.

The following are the climate risk management actions identified by CRM TASP for agricultural sector:

- Utilizing climatic data and tools such as ENSO to anticipate inter-annual and intra-seasonal variability;
- Crop diversification;
- Building food and or fodder reserves during normal or above-normal seasons;
- Incorporating risk management measures into supply chain management by assessing climate impact pathways;
- Adopting agroforestry-based animal husbandry system.

While structural measures such as adoption bio-engineering and bio-remediation systems and inspection of drainage system capacity and non-structural measures like mangrove rehabilitation and planting of fire tolerant species were recommended to reduce potential impacts on infrastructures.

INTRODUCTION

BACKGROUND

Climate change exacerbates risks to sectors which are already vulnerable to climate variability. This and the changing nature of risks require stakeholders to delve into the identification of extant and emerging climate risks and subsequently of priority management actions as potential responses to such risks. Sustainable development calls for integration of risk management options into development programmes/initiatives. Hence, CRM is a must in countries like Timor Leste that are vulnerable to climate variability and impacts of climate change.

Climate risk management (CRM) is an inter-disciplinary, multi-stakeholder process that involves analysis of climate-related risks leading to consensus-based identification and prioritization of risk management actions to anticipate and manage both extant and emerging climate risks.

Climate Change can further alter the observed climate mean or cause changes in nature of extremes (severity, frequency, spread, duration and timing) as well as possible unforeseen events. The resultant climate risks could resemble current climate variability patterns, but with higher amplitude variations. Hence, the CRM approach suggests that patterns of risks could be anticipated and the experiences of present systems in dealing with these risks could be drawn upon towards building resilience to long-term climate change. For unforeseeable climate events, while past climate patterns may not provide any clue as to how they would unfold and manifest, human experiences in dealing with extreme climate events may provide guidance for dealing with uncertainties associated with climate change-related risks. Thus from a policy point of view, building the capacities of institutions and systems around managing current climate extremes and thereby a resilient development, could also assist in taking care of those events that are more challenging to anticipate.

The CRM framework has been adopted to assist countries to develop capacity to manage risks associated with climate variability and change. It is developed by the United Nations Development Programme (UNDP), through its Bureau for Crisis Prevention and Recovery (BCPR), responsible for assisting countries to develop capacity to better manage disaster risks, and Bureau for Development Policy's Energy and Environment Group (BDP/EEG), responsible to assist countries to develop capacity to adapt to climate change. Climate Risk Management Technical Assistance Support Project (CRM TASP) has been evolved to facilitate operational of CRM framework by integrating CCA and DRR. The Regional Integrated Multi-hazard Early Warning System for Africa and Asia (RIMES) in collaboration with Asian Disaster Preparedness Center has been tasked with implementing the CRM TASP framework in assessing risk management priorities and capacity needs into development planning in six countries in Asia, including Timor-Leste.

APPROACH AND METHODS

CRM TASP was introduced in Timor Leste through an inception meeting on 9th February 2011. It was conducted back-to-back with the Forecast Briefing which was intended to share the seasonal forecast to stakeholders in climate sensitive sectors and obtain their feedback on the same. The inception meeting introduced the project, its key components, and participation of stakeholders. Initial information, on initiatives implemented in Timor-Leste and gaps in Climate Risk Management were also obtained from stakeholders. The Project involved the National Directorate for Meteorology and Geophysics (NDMG), the Ministry of Agriculture, Forestry and Fisheries (MAFF), and the National Disaster Management Office (NDMO) through the implementation process outlined in Table 1.1 (see below).

In addition to the baseline data used for this report, attention is drawn to Volume 2 of the Scientific Assessment and New Research on the Climate Change in the Pacific published by the Australian Government (AusAID, 2011), which also covers Timor Leste.

In this assessment, projections relative to 1990 are given for surface air temperature, sea surface temperature, rainfall, extreme weather events (including temperature, rainfall, drought and tropical cyclone), ocean acidification and sea level. In particular, he models centred on 2030, 2055 and 2090 anticipate:

- wet season rainfall to increase over the course of the 21st century;
- dry season rainfall to decrease over the course of the 21st century;
- little change in total annual rainfall over the course of the 21st century;
- a rise in sea-level of between approximately 5-15 cm by 2030, with increases of 20-60 cm indicated by 2090;
- surface air temperature and sea surface air temperature to continue to increase, and;
- the intensity and frequency of days of extreme heat to increase.

The GAIN Index, a project of the Global Adaption Institute (GAIN), summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. It aims to help businesses and the public sector better prioritize investments for a more efficient response to the immediate global challenges ahead. According to this index, Timor-Leste is the 19th most vulnerable country and the 24th least ready in terms of natural hazards. It has, both, a great need for investment and innovations to improve readiness and a great urgency for action. (see URL: http://index.gain.org/country/timor-leste).

TABLE 1.1 PROJECT STEPS AND METHODS.

PROJECT STEP & PURPOSE		SPECIFIC STEPS APPLIED IN TIMOR-LESTE
1. Initiation	Introduce CRM TASP	• Inception meeting and discussions with key stakeholders
2. Climate risk assessment	Participatory risk assessment involving stakeholders	• Participatory data analysis (National Directorate of Meteorology and Geophysics, Ministry of Agriculture, Forestry and Fisheries, National Disaster Management Office) and field level validation
3. Development of CRM programme	Identify stakeholder needs to integrate CRM into sectoral planning and practices	• Assessment of sectoral needs and existing gaps in applying CRM approach, and ways to address the gaps • Conduct of National and Local Forecast Briefings, a dialogue between NDMG, MAFF, NDMO, and other information user sectors, including stakeholders from district level (Baucau) intended to catalyze the application of climate information for enhanced management of risks
4. Institutionalisation of climate risk management	Integrate CRM process into development planning processes	• Meetings with stakeholder departments on integrating initiatives into annual regular programmes
5. Evolution of applied research programme for capacity building	To build capacities for CRM among stakeholders	• Consensus-based identification of applied research programme focusing on capacity building.
6. Documentation & Report writing	Documentation and finalisation of CRM TASP report	• Review of the report by country stakeholders

REPORT STRUCTURE

This report is inclusive of six chapters. The contents of each chapter are summarized in the Table 1.2

TABLE 1.2. SUMMARY OF CHAPTER CONTENTS

CHAPTER	CONTENT
Chapter 1	Process steps and methodology
Chapter 2	Development context and trends in Timor-Leste and the rationale for prioritization of a climate sensitive sector
Chapter 3	Geo-physical environment and past, present and future climate risk features of Timor-Leste
Chapter 4	Assessment of climate threats to development in the context of past climate risks and anticipated climate change projections
Chapter 5	Current climate risk management processes, policy and institutional systems to address the threats identified
Chapter 6	Ownership of CRM within the country stakeholders, assessment of capacity needs for an applied research programme and recommendations for future actions

DEVELOPMENT PROFILE

This chapter looks into key development conditions in Timor-Leste and the trends observed over the past decades to facilitate better understanding of how development conditions in the country relate to vulnerability to climate hazards. This chapter sets the cornerstone of this country report through a summary of key development conditions, trends, as well as vision for the future.

CURRENT DEVELOPMENT CONDITIONS, TRENDS AND CHALLENGES

Timor-Leste is one of the youngest and arguably one of the poorest countries in the world, although the recent discoveries of petroleum might change this status. Having gained independence only in 2002, the country strived to attain economic stability in the aftermath of decades of struggle for independence. The country also grappled to attain peace and order after the unrest that broke out and pervade the country in 2006.

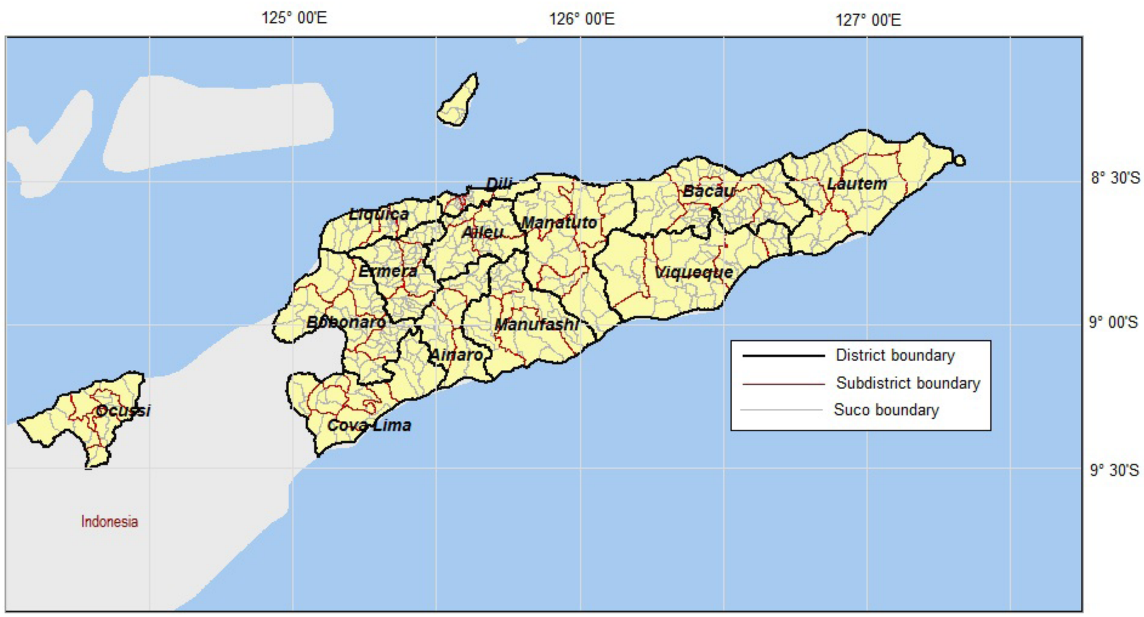


Figure 2.1. District Map of Timor-Leste

(Source: Timor-Leste Human Development Report, 2011)

Covering a modest land area of about 15,000 square kilometers, Timor-Leste is a small country. It has a population of around 1,069,409, more than half of which is under the age of 19 (NSDP, 2010)[1]. The population is spread into 184,652 households. Of the population, 544,199 are males and 522,210 are females. Annual population growth rate is estimated at 2.41 percent. About 29.6 percent of the total population resides in urban areas *(NSD, 2011)*[2].

The country is located in the eastern part of Timor Island in the Indonesia Archipelago. The county's territory extends to the island of Oecussi, an exclave in Indonesia's West Timor. Timor-Leste is bounded in the North by the Ombai and Wetar Straits, is separated by the Timor Sea from Australia in the South, and in the West by Nusa Tenggara Timur, a province of Indonesia[3]. It is located between 8°50'S and 125°55'E.

Timor-Leste has 13 administrative districts namely Aileu, Ainaro, Baucau, Bobonaro, Covalima, Manufahi, Oecussi, Dili, Ermera, Lautem, Liquića, Manatuto, Viqueque. The country is further subdivided into 65 sub-districts, 442 *sucos* (villages), and 2,225 *aldeias* (hamlets) *(NSD, 2011)*. It is semi-arid and mountainous.

Poverty and Human Development

Timor-Leste's economy in 2010 was one of the poorest in the world. World Bank classifies Timor-Leste as having a lower-middle-income economy. By Human Development Index (HDI), it is ranked 147th.

Being a young country, Timor-Leste is facing numerous developmental issues. Foremost of which is the rampant poverty and inequality in the country, with about 41 percent of the population living daily on less than USD 0.55 (Barnett, 2007)[4]. In 2010, Timor-Leste's GDP per capita was USD 623.4. More than 70 percent of the population reside in the rural areas and most engage for their livelihoods in subsistence agriculture.

Education: Though significant improvements in the education system have been recorded since Timor-Leste's independence in 2002, establishing a pool of skilled workers remains a major concern in the country. This is mainly due to the prevalent problems in the education system. These public educational problems are rooted on many factors including the following:

- Budget share for the education system remains insufficient, estimated at around 10 percent of the total government budget in 2009;
- There is insufficiency of well-trained teachers. The National Education Support Strategy of UNESCO pegs the need for 1,500 additional teachers to attain 30:1 student-teacher ratio. Because of the insufficiency of well-trained teachers, quality of education is one of the issues;
- Language, as medium of instruction in the education system, remains a problem. Local language is used in the early primary years, while the medium of instruction for higher years is Portuguese. Many of the textbooks are in Bahasa (Indonesian);
- Poor health, among children in the primary level, is an impediment on attendance. Especially in remote areas, the considerable distance to schools, and hence costly transportation expense, additionally constraints the education system at the secondary level. Per the 2007 Household Survey, an average of 30 minutes travel time is required to reach primary schools. On the other hand, an average of 70 minutes is required to reach secondary schools;
- Another prevailing impediment is the low interest, among the youth, in education as indicated in the 2007 Household Survey. Lack of interest was the main reason provided by students between 6 and 17 years for non-attendance in schools. Likewise, 49 percent of the 15 to 24 age group indicated the same reason.

In 2007, literacy rate (in Tetun language, for population 15 years and over) is around 56.1 percent.

Per the Strategic Development Plan 2011-2030 the country's existing education facilities include 180 pre-school infrastructure, 1,309 basic education facilities, and 80 secondary education facilities. By 2011, higher education (Technical and university) institutions dropped to 11 from 17 before 2004. Approximately, 27,010 students are enrolled in higher education, with significant improvement in female enrolments.

Health: Timor-Leste's mortality rate (infant and children under 5 years) remains one of the highest in Asia. Malnutrition is prevalent and in 2003, almost 50 percent of children under five years were stunted while about 46 percent were underweight. Communicable and other diseases like malaria, dengue fever, acute respiratory infections, etc. are likewise rife.

Progress in the health sector has been recorded in the past ten years. According to the SDP, 78 percent of children are already treated for basic illnesses; 86 percent of mothers already receive antenatal care; and a decrease of 29 percent in the incidence of malnourished women has been penned in the past decade. About 85 percent of tuberculosis patients were successfully treated. According further to the SDP, fertility rate fell to 5.7 in 2010 from 7.8 in 2003. Despite such progress, chronic malnutrition remains very high. Anaemia is prevalent in approximately 1/3 of children under five (5) years and 1/3 of women. As of 2011, there are a total of 291 public and private health facilities in the country including health posts, community health centres and hospitals.

Gender and Equality

According to the UNDP's Human Development Report (Timor-Leste) of 2011, there remains a high percentage of women who are illiterate, and who are experiencing high fertility and maternal mortality rates. Mostly, women's livelihoods are in subsistence cultivation and small-scale trading and home-based industries. Women's capacity to engage in productive livelihood is hampered by the time spent for domestic tasks. Traditional patriarchal practices are dominant in the country, especially in rural areas.

Literacy rate among women remains lower compared to men. As indicated in the 2007 Timor-Leste Survey of Living Standards (TLSLS), 59 percent of men above 18 years could read and write without difficulty, as opposed to only 43 percent of women.

Economy

Agriculture and fisheries are the main gears of Timor-Leste's economy. Significant contributions come from the coffee plantations. Meagre harvest in 2007 resulted in starvation and deaths in various areas in the country. Food supplies from international institutions were required.

As mentioned in the outset, Timor-Leste's GDP per capita was placed at USD 623.47. The SDP pens the Gross National Income (GNI) per capita at approximately USD 2,560 (NSDP, 2010). The economy's structure is shaped by the country's dependence on agriculture sector, economic policy on nation building and building stability and security in the country.

Currently, Timor-Leste's oil and gas industry is developing. Earnings from oil and gas pumped up to approximately USD 2.28 billion by 2008 from USD 175 million in 2004. In 2010, oil and gas earnings are estimated at around USD 2.73 billion (ibid).

Environment

Destruction of the environment was rampant especially during the occupation period. Hazards like chronic erosion and landslides have resulted from over-logging and setting fire to forests. Wild life was likewise threatened and food sources decreased.

For constituents who depend on forests for household needs, more stress was rooted on the state of degradation of the environment, especially in the rural areas. Steep terrains made up about 44 percent of the country. Despite the unsuitability of steep terrains for cultivation, many farmers, with poor management practices, resorted to slash and burn agriculture. Forest degradation is further exacerbated by free grazing of livestock, bush burning, and unregulated collection of firewood, among others. These factors contributed to steady depletion of soil cover, erosion and deforestation. Ground water is also diminishing. Table 2.1, below indicates the declining forested area in Timor-Leste.

TABLE 2.1. DECLINING TREND OF FORESTED AREAS IN TIMOR-LESTE

FRA CATEGORIES	AREA IN 1000 HA			
	1990	2000	2005	2010
Forest	966	854	798	742
Other land	521	633	689	745
Total	1487	1487	1487	1487

Source: FAO, 2010[5] (Estimated change in forested area is based on partial study, hence annual loss of forest may be underestimated)

It should be noted though that the annual loss of forests may be underestimated, as the information provided in Table 2.2 above is based on partial study by the Forest Department of the Food and Agriculture Organization of the United Nations (FAO). Pollution is a major concern in urban centers. Effective waste management systems are not in place. Illegal dumping results in accumulation of waste materials which in turn pollutes ground water.

NATIONAL DEVELOPMENT VISION, OBJECTIVES AND PRIORITIES

The Fourth Constitutional Government Program for 2007-2012 has been set out by the government to guide the country's development strategy for the indicated five (5) years. The Fourth Constitutional Government Program focuses on short-term development goals in the areas of a) economic growth through developments in various livelihood sectors; b) state management reforms through enhanced government programs in civil service, administrative organization, management of public finances, and fight against corruption; c) skills development of the youth and national human resources; d) solidarity, health and social protection; e) enhanced infrastructure and living conditions; f) promotion of equality and tolerance, internal security and strengthening of democracy; and g) national defense and foreign policy.

On the other hand, the SDP 2011-2030 sets national priorities for a 20-year period. This provides attention to long term goals targeted at reducing poverty and pushing forward equitable growth. The SDP, embodying visions included in Timor-Leste 2020, Our Nation Our Future, aim to bridge Timor-Leste to being an upper middle income country by 2030. The SDP framework is presented in Figure 2.2, below.

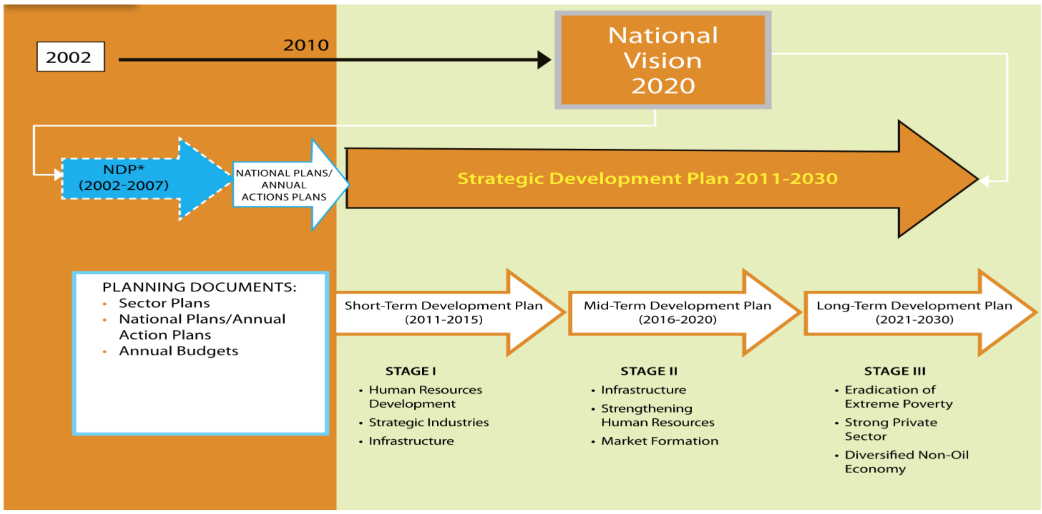


Figure 2.2. Strategic Development Plan Framework (SDP 2011-2030)

The SDP covers three (3) areas namely: social capital, infrastructure development, and economic development. The following outcomes are targeted by the SDP:

- Extensive investment in key and prolific infrastructure for robust and growing market economy, drawing in investors both domestic and international in nature, and providing buttress for successful local businesses;
- Agriculture sector development to catalyze regime shift from subsistence farming to commercial smallholder agriculture;
- Food self-sufficiency coupled with progressive export trade involving products in agricultural, livestock, forestry and fisheries, among others;
- A sizeable industrial base anchored by petroleum sector, including oil and gas production and downstream industries such as petrochemicals;
- A growing number of light industries such as food processing, apparel manufacturing, handicrafts, and cultural items, and furniture making;
- A strong and thriving tourism and hospitality industry backed by improved infrastructure, support for local tourism business and skilled local workforce;
- An expanded services sector providing employment in health care, education, trade, entertainment and public administration;
- Deep penetration of broadband internet and the latest telecommunication technology, underpinning and supporting a more connected and innovative economy;
- A high number of sustainable small and micro businesses in growing industry sectors such as tourism, small scale manufacturing and high value crops;
- An increasingly educated and skilled workforce, supporting a more diverse economy and giving the Timorese people many opportunities to increase their incomes and improve their lives and well-being.

CONDITIONS, TRENDS AND PRIORITIES OF PRIORITY SECTOR

About 80 percent of the Timor-Leste's population is engaged in agriculture as a main source of livelihood – albeit on a subsistence nature. Of the country's total area, only around 600,000 hectares can be exploited for crops and livestock. Arable land is estimated to be around 174,000 hectares and another 124,000 hectare with bush cover. However, agricultural productivity is low due mainly to crude farming practices, subsistence farming, and limited utilization of arable land.

Most crops are dependent on rainfall, hence agricultural activities in the country start in November, when the Northeast Monsoon season onsets. In the upland areas, agricultural activities during the Northeast Monsoon season include land preparation and planting of maize. The most important food supply in Timor-Leste is Maize, as it is the most accessible and abundant crop. Maize is usually harvested from February to April.

Per volume, rice is placed as the second most important crop. Rice is planted in lowland areas, mainly in the southern part of the country. Harvest season in the Southern areas is with August to October. The Northern areas produce less rice. Regular harvest season for areas in the North is from July to August.

TABLE 2.2. AGRO-CLIMATIC ZONES AND MAJOR CROPS

ZONE (PERCENTAGE OF LAND AREA)	ALTITUDE (M)	RAINFALL (MM/YEAR)	LENGTH OF GROWING SEASON (MONTHS)	MAJOR CROPS
North coast lowlands (10)	\100	\1000	4–5	Rice, maize, cassava, coconut
Northern slopes (23)	100–500	1000–1500	5–6	Maize, cassava, rice, sweet, potato, cowpea
Northern uplands (19)	500–2000	[1500	6–7	Red beans, coffee, maize, rice, cassava
Temperate uplands (2)	[2000	[2000	9	Potatoes, wheat, barley, arrowroot
Southern uplands (14)	500–2000	[2000	9	Maize, cassava, rice, sweet, potato, cowpea
Southern slopes (21)	100–500	1500–2000	8	Maize, cassava, rice, sweet, potato, cowpea
South coast lowlands (11)	\100	\1500	7–8	Rice, maize, cassava, coconut

Source: Molyneux, et al., 2012

For rain fed areas, the planting season is limited to once every year, only during the Northeast Monsoon Season. In the Southern part of the country and in areas with available facilities for irrigation, second planting is viable. This area however that is feasible for second planting is only 10 percent of the total production area. Cassava is intercropped with maize, usually planted in December. Other crops in the country include coffee, sweet potatoes, potatoes, cowpeas, yam, mungbean, kidney beans, soy beans, taro, squash, cabbage and onion, peanuts, sago, coconuts, vegetables, fruits and tobacco, among others.

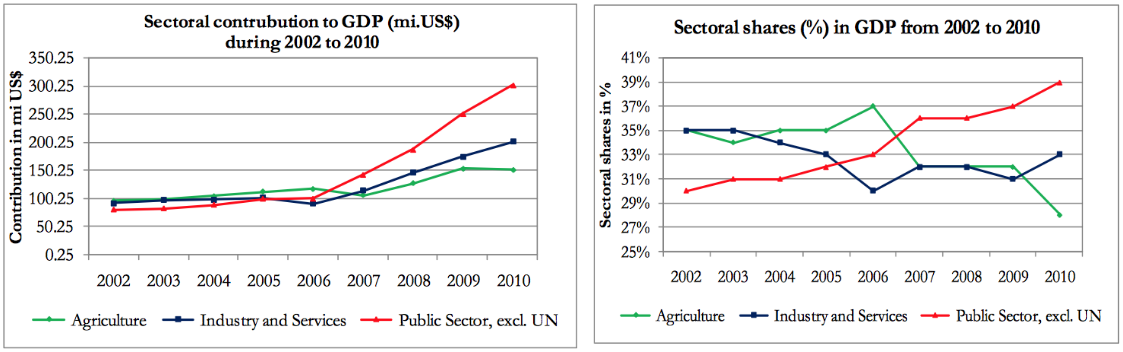


Figure 2.3 . Sectoral contribution to GDP (in Million USD at constant prices, 1998-2002)

Though most of the population engage in agriculture, this sector only contributes around 25-30 percent in the country's GDP. According to the FAO-WFP Crop Assessment Report (2003), this is mainly attributed to the agricultural practices which are still very crude in Timor-Leste and low-input-low-output subsistence system. Figure 2.3 indicates the sectoral contribution to Timor-Leste's GDP from 1998-2002.

According to FAO (2011), each year, approximately 70,000 hectares are planted with maize and about 38,000 hectares with rice. Sweet potato counts for about 7,000 hectares while cassava is planted in about 9,000 hectares. On the other hand, peanuts occupy an estimated 4,000 hectares of farm land.

Due to non-availability of irrigation facilities in the upland areas and steep slopes, there is high vulnerability of maize to drought and deficient/irregular rainfall. Timing of planting is affected by the uncertainty of rainfall. Wastage of seeds can result when planting is done too early.

Irrigation is a major concern in agriculture in Timor-Leste. According to Barnett (2007), only 286 of the 498 sucos in the country have some facility for irrigation. These however mostly operate only during the wet season due to deficient rainfall during the dry season and the absence of facilities/systems for water storage.

In terms of cash crop, the most important is coffee. Barnett indicates that coffee accounts for about 90 percent of foreign exchange. Over the years, the price of coffee has slumped to only about 25 percent of the prevailing price in 1960 due to overproduction however. Hence, commodity dependence, and increasingly, coffee production become limited to a few players in trading, marketing and retail.

Coffee grows in the highlands, both in the Northern and Southern parts of the country. Average annual rainfall of 2000 to 3000 mm; 70 to 90 percent relative humidity; and distinct dry season are required in coffee production.

Farmers widely practice the "slash and burn' agriculture system in Timor-Leste. This is characterized by a cycle which includes cropping and fallowing.

KEY MESSAGES (DEVELOPMENT PROFILE)

- Timor-Leste is one of the youngest nations with a population growth of four percent. Timor-Leste has a small population with estimates ranging from one to 1.2 million. 80 percent of the population live in rural areas. Rural population mostly depends on subsistence agriculture.
- The economy of Timor-Leste has a predominant services sector with agriculture sector contributing 30 percent. Discovery of petroleum offshore in Timor-Leste has brought in a dual economy and 90 percent of development resources comes from Petroleum fund.
- After devastation due to war and conflict, Timor-Leste is on the verge of rehabilitating the war-ravaged infrastructure and also pushing ahead the development process encompassing human development, poverty reduction, etc.
- There is a possibility that with the massive development in the next ten years through the Petroleum Fund, Timor-Leste could graduate from its least developed country status to a middle-income country.
- Government of Timor-Leste has prepared a Strategic Development Plan for the period 2011-2030 to guide the development trajectories during this period.
- Agriculture in Timor-Leste is highly vulnerable to current climatic variability and future climate change. This holds true in particular for subsistence based agriculture on which many livelihood and employment functions still depend.

CLIMATE PROFILE

This Chapter provides baseline information on current and future climatic and related trends at national level.

NATIONAL WEATHER AND CLIMATE CONTEXT

Timor-Leste extends from 124°E to 127°30'E longitude and 09°40'S to 08°00' S latitude. The country has a tropical monsoon climate characterized by wide seasonal variations in rainfall, high temperatures, and high humidity. Regional climatic differences are substantial in the country because of the varying elevation and coastal effects. The country has two main seasons, the dry season from June to October and the wet season from November/December to May/June.

Rainfall

The spatial distribution of annual rainfall in Timor-Leste is presented in Figure 3.1. Northern coast receives less than 1000mm; central and elevated areas receive 1500 to 2000mm; and western high altitude areas receive relatively higher rainfall with more than 2500 mm/annum (Barnett, 2003). The Northern area of the country is influenced by a single rainfall season where a wet season prevails from December to April/June and the peak is during the period of December to January. On the other hand, the bimodal rainfall pattern influences the Southern part of the country where the wet season lasts for seven to nine months. There are two rainfall peaks – one from December to January and another from May to June. The dry season, in the Southern part of Timor-Leste, is experienced for about three to five months.

Timor-Leste receives greater rainfall intensity during the Northwest Monsoon period and less intense rain during the Southeast Monsoon period. But rainfall during the Southeast Monsoon period is more reliable for agriculture than during the Northeast Monsoon period (Keefer 2000)[6].

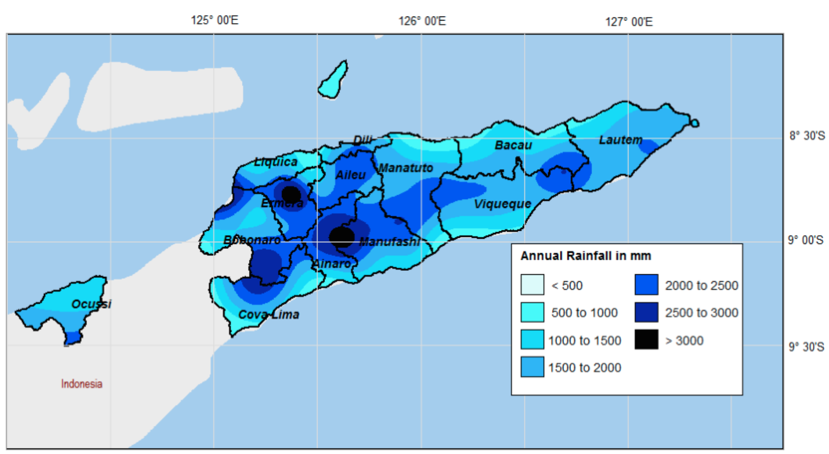


Figure 3.1: Annual rainfall distribution in Timor-Leste

Temperature

Timor-Leste's annual mean temperature fluctuates from 19°C to 28°C (Figure 3.2) with huge variations in the country spatially. The coastal regions are having higher temperature with more than 27°C. Central and high altitude regions have annual mean temperature less than 21°C. The variation of maximum and minimum temperature at any location is about 1-3°C. The minimum temperature is observed during the months of July and August and maximum is observed during October-December. The lowest mean monthly minimum temperatures were recorded at Ainaro (13.4°C) and Ermera (14.4°C). The diurnal variation is up to 13°C during the Southeast Monsoon and 7-9°C during the Northwest Monsoon season. *(Keefer, 2000).*

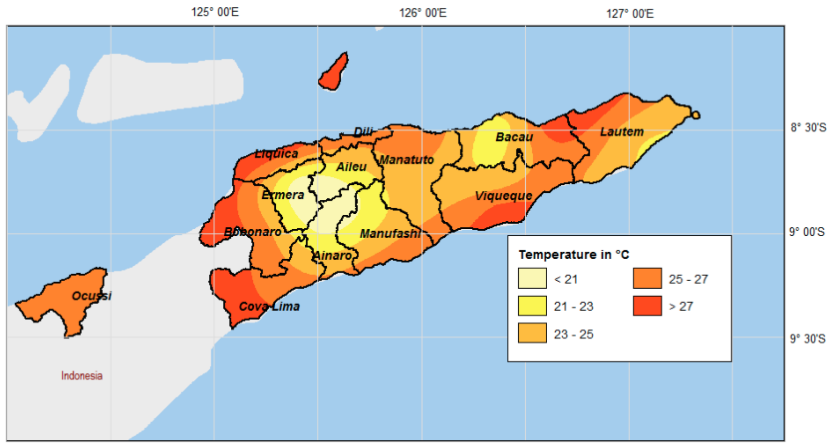


Figure 3.2: Annual Mean Temperature over Timor-Leste

Extremes

The extremes in Timor-Leste are not known clearly because of a lack of climate-focused datasets. However the highest daily rainfall data at various stations are: Dili (275mm-Northern coast), Los Palos (398mm), Suai (217mm-Southern coast) and Lolotoi (267mm). *(Keefer, 2000)*

CURRENT CLIMATE VARIABILITY AND CLIMATE EXTREMES

Climate drivers

Timor-Leste's rainfall is controlled by the Asian Monsoon, El Nino, La Niña, Indian Ocean Dipole (IOD), Madden–Julian Oscillation (MJO), altitudinal, and coastal effects. The El Niño Southern Oscillation influences variability on inter-annual rainfall over Timor-Leste and a strong association between the dry season rainfall and Southern Oscillation Index (SOI) has been reported. (Barnett et al. 2007). Timor-Leste's climate is influenced by West Pacific Monsoon and driven by large differences in temperature between the land and the ocean (NDMG, 2011[7]).

The following are the climate drivers in Timor-Leste:

- **Monsoon:** Very active between November and April with rainfall regimes differing between Northern and Southern regions of Timor-Leste. Strong year-to-year variability of rainfall during wet season with pronounced dry season in between;
- **El Niño & La Niña:** The El Niño Southern Oscillation (ENSO) strongly affects the wet seasons over Timor-Leste. During El Niño the monsoon onset is delayed and the wet season ends earlier leading to overall less rainfall. During La Niña the wet season is extended bring increased rainfall and floods to large areas in Timor-Leste;
- **Indian Ocean Dipole:** The warming pattern in the Indian Ocean also affects rainfall over Timor- Leste. During the positive phase of the Indian Ocean Dipole (IOD) there is less rainfall compared to the negative phase.Tropical Cyclones: Tropical Cyclone (TC) activity is generally low with more TCs during La Niña compared to El Niño;
- **Madden–Julian Oscillation (MJO):** The MJO affects rainfall on intra-seasonal time scales such as during the monsoon onset and active and break periods during the wet season. (*Source: Silva & Moniz, undated[8]).*

Rainfall variability

Figure 3.3 shows inter annual rainfall deviation from 1953 to 1998 at Dili station. This indicates that year-to-year variability in rainfall is huge - as much as -50 percent to 70 percent. In West Timor, the average annual rainfall is 1357 mm but fluctuates from 785 to 2462 mm (Monk et al. 1997[9]). In addition, rainfall is not equally distributed even in wet months and intensity varies considerably (Keefer, 2000).

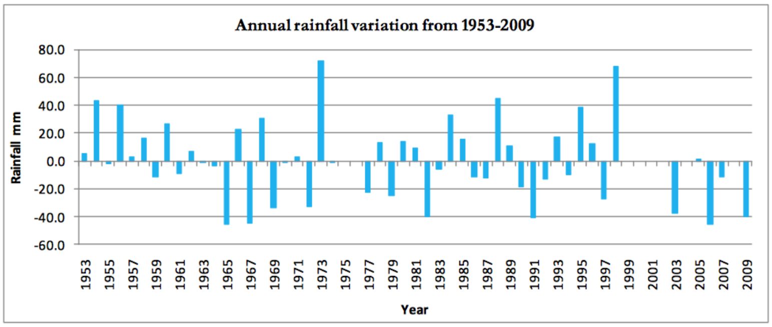


Figure 3.3 Annual variation of rainfall in Timor-Leste 1953 to 1998 (Data Source: NDMG)

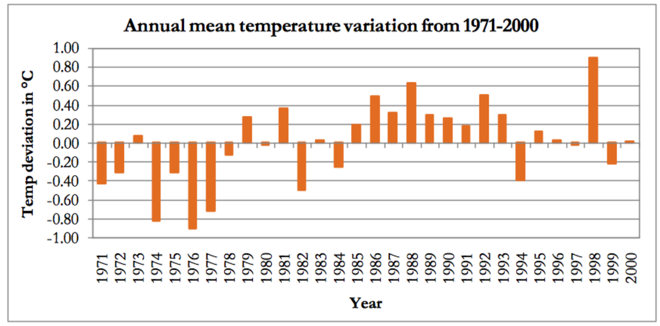


Figure 3.4 Annual variation of maximum and minimum temperature in Timor-Leste (Data Source: Climate Research Unit)

Temperature

Inter annual variation of mean temperature for Timor-Leste from 1971 to 2000 is presented in Figure 3.4. This inter annual variation graph depicts that mean temperature fluctuates between 23.5 & 25.5°C. While year to year variability is present, it is minimal.

Climate hazards

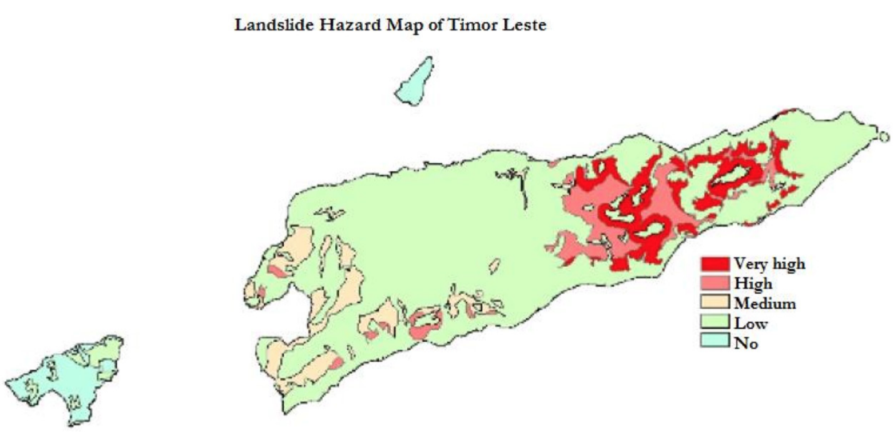
Timor-Leste is exposed to climate hazards such as flood, flash flood, cyclone, drought, storm surge and heavy rainfall.

Flood

Heavy rainfall during the monsoon season increases water in catchment basins and usually results in rapid discharges that can in turn lead to flooding in low lands and also to upland floods. La Niña years bring more rainfall, stronger winds, flooding and landslides across the country. The typical flood season in Timor-Leste is from December to March, with most of the previous floods in past occurring during January and February.

Landslides

Landslides in Timor-Leste are often triggered by heavy rainfall and/or runoff. Figure 3.5 shows the landslide hazard risk (very high, high, medium, low and no-data) over the country. Eastern zone is more prone to landslide hazard. *(UNDP, 2010)*

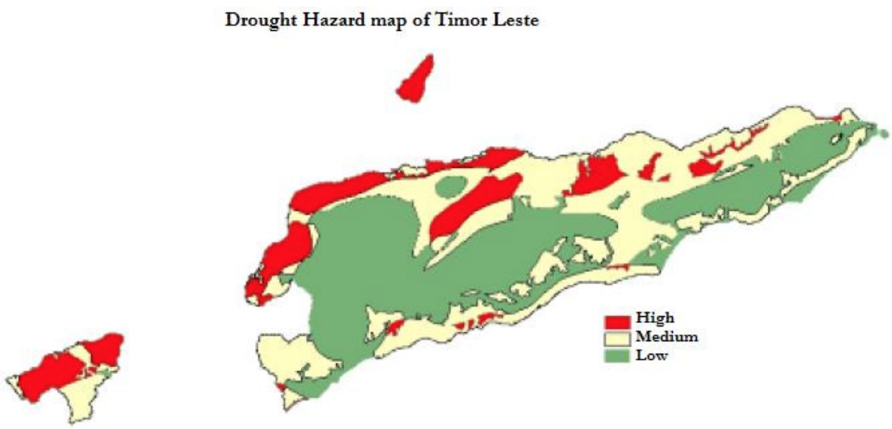


Source: UNDP, 2010

Figure 3.5 Landslide hazard map of Timor-Leste

Drought

Drought is a recurring phenomenon in Timor-Leste when rainfall in dry years is much lower than normal years. The Northern coast of Timor-Leste and Ocussi are more prone to drought. Figure 3.6 shows three classifications of drought affected areas within Timor-Leste; high, medium and low. El Niño years are strongly associated with droughts in Timor-Leste. (*UNDP, 2010*)



Source: UNDP, 2010

Figure 3.6 Drought map of Timor-Leste

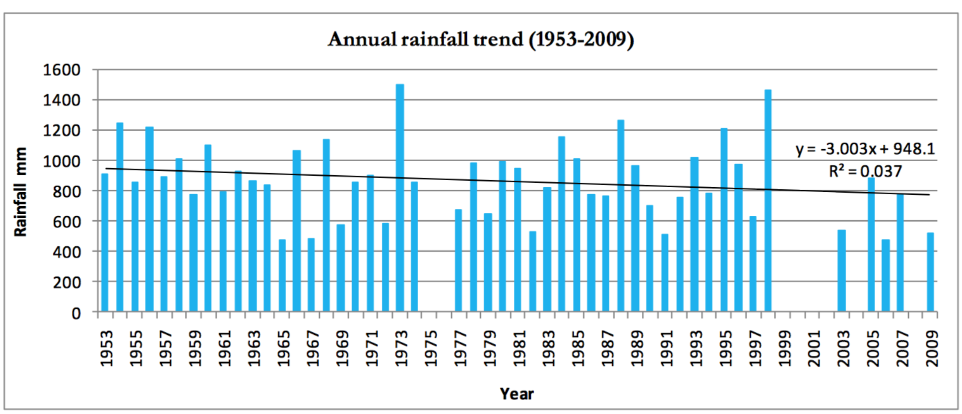
Other Hazards

Though Timor-Leste is situated in the cyclone belt, cyclone hazard frequency is very low- once in a decade *(Natural Hazards Potential Map of the Circum-Pacific Region, 1995)*. Tropical storms occur annually and bring strong wind and heavy rainfall to Timor-Leste. Therefore, if risk reduction measures are not implemented over time the consequences from such an event will remain extremely high. *(UNDP, 2010)*

OBSERVABLE CHANGES IN CLIMATE VARIABLES AND HAZARD

Rainfall

Analyses of the rainfall data at Dili station from 1960 to 2008 show a decreasing rainfall trend over the years of measurement. Overall there is a decreasing trend in annual rainfall of around 40mm per decade. The main weakness of the commonly accepted graph in figure 3.7, consists in its lack of data in recent years, notably on the strong 1999 and 2010/2011 la-Nina-events. If the missing data was added, the overall indicated trend would change slightly.



Source: NDMG, 2011

Figure 3.7 Annual rainfall for Dili Airport.

Temperature

Obtained from the Climate Research Unit (CRU), the gridded dataset shown in Figure 3.8 below indicates a long-term (1971-2000) trend of mean temperature. The increasing trend is clearly visible. One should keep in mind however that the underlying data set is in fact too short to eliminate normal decadal temperature variability and needs therefore careful interpretation.

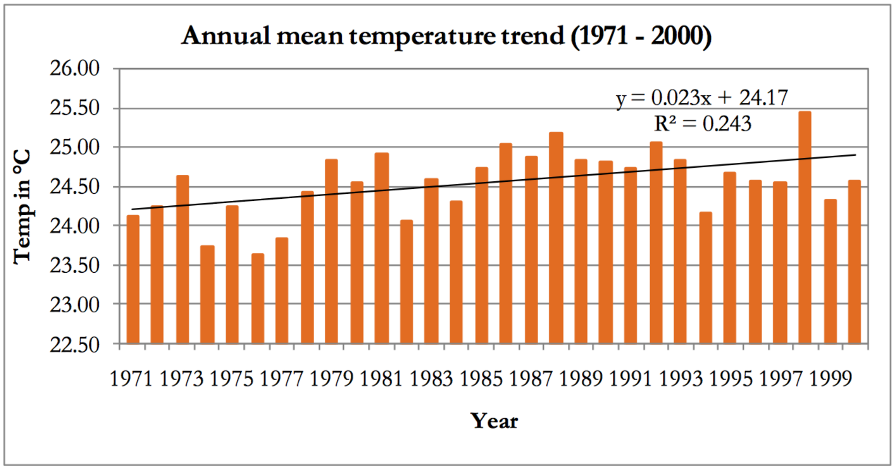


Figure 3.8 Mean temperature trend over Timor-Leste

PROJECTED CLIMATE TRENDS

Rainfall

Rainfall projections show increasing trend of 2 percent, 4 percent and 6 percent by 2020, 2050 and 2080, respectively. Also, projections indicate seasonal differences with mild drying effect for Timor-Leste over the June-August period by 2080 (AK-2010[10]). Table 3.1 below provides the median estimate of projected rainfall for Timor-Leste based on AK-2010 projection with extreme daily rainfall (99th percentile) projections that are derived from 15 climate models (CSIRO and BoM, 2007[11]). It shows an increase in rainfall during the months of December to May, whereas some decline is seen from June to November during three time slices.

TABLE 3.1 RAINFALL PROJECTIONS FOR TIMOR-LESTE

PERIOD AVERAGE	PROJECTED CHANGES			RAINFALL INTENSITY PROJECTIONS
	2020	2050	2080	
Annual	+2%	+4%	+6%	+1-2%
December to February	+3%	+5%	+6%	+2-4%
March to May	+4%	+5%	+5%	+2-4%
June to August	0%	0%	-5%	+6-8%
September to November	0%	0%	-1%	+4-6%

Temperature

The temperature projections from all emissions scenarios indicate that the annual average air temperature and sea surface temperature will increase in the future (Table3.2). The likely increase of mean temperature is 0.3-1.2°C in 2030s, 0.5-2.1°C in 2050s and 0.8-3.5°C in 2080s. Another study indicates a change of 0.8°C in 2020s, 1.5°C in 2050s and 2.2°C in 2080s (AK-2010).

TABLE 3.2 PROJECTED ANNUAL AVERAGE AIR TEMPERATURE CHANGES FOR TIMOR-LESTE FOR THREE EMISSIONS SCENARIOS AND THREE TIME PERIODS

SCENARIOS	2030	2055	2090
Low emissions scenario	0.3–1.1	0.5–1.7	0.8–2.2
Medium emissions scenario	0.4–1.2	0.9–2.1	1.4–3.2
High emissions scenario	0.4–1.0	1.0–1.8	2.1–3.5

Values represent 90 percent of the range of the models and changes are relative to the average of the period 1980-1999.
Source: NDMG, 2011

Extreme events

The climate model projections show extreme rainfall days are likely to increase and increasing average temperatures might lead to rise in the number of hot days and warm nights, and a decline in cooler weather (NDMG, 2011). Most of the study indicates that extreme temperature events are expected to increase. The AK-2010 analysis of the CSIRO-CCAM regional simulations models indicates that by 2050, 7-day or 30-day heat wave events can be expected to increase by up to 2.3°C and that the length of such events can be expected to increase by two days (Katzfey et al., 2010[12]).

Sea level rise

NAPA 2010 document indicates that sea level rise for Timor-Leste is expected to be same as global averages, with a variation of only minus 0-1cm after analysing 17 global climate models (O'Farrell, 2008[13] cited in GoT, 2010). Another study indicates that sea level rise is likely to be 3.2 to 10 cm by 2020, 8.9 – 27.8cm by 2050, and 18-79cm by 2095 (CSIRO,2010[14] and Hunter, 2010[15]). There is a possibility that sea level rise could be larger than the 0.5 – 1.0 m range by 2100 (Steffen, 2009[16])

STATUS OF CLIMATE AND HAZARD INFORMATION AT NATIONAL AND REGIONAL LEVELS

Historical climate data is lacking in Timor-Leste especially in basic parameters such as maximum, minimum temperatures. Only one station has long term records with few missing values. This data limitation hinders the extent of understanding of past climate. Observation network coverage in terms of geographical extent is also very limited. Data collection, data archival process are still at developmental stage, hence quality information availability is an issue. The short and medium term weather forecast applications for generating location user specific information are also limited.

Climate projections rely on global circulation models and are always associated with uncertainties. Various initiatives have been undertaken in Timor-Leste to understand the climate change projections using GCM and some high resolution downscaled datasets such as WORLDCLIM. However validation of climate change modeling becomes difficult due to limitations of the available climate datasets.

KEY MESSAGES (CLIMATE PROFILE)

- Climate of Timor-Leste is governed by the tropical monsoon system. Rainfall period is mostly confined to the October-November and March- April episodes.
- The northern coast of Timor-Leste receives lesser rainfall while the southern coast receives larger rainfall with two monsoon peaks.
- El Niño and La Niña are the key climate drivers for determining monsoon rainfall pattern in Timor-Leste.
- Observed trends indicate that while temperature is increasing, precipitation patterns do not follow any set direction.
- Climate Change models show heavy, concentrated rainfall and longer dry-periods with the implication of more droughts and floods.
- The southern coast of Timor-Leste is also affected by cyclonic storms and climate change may impact this process in terms of increasing their frequency and intensity.
- Sea level rise is considered to be a major threat in both northern and southern coastal regions.

CLIMATE IMPACTS AND RISKS FOR AGRICULTURE

PAST CLIMATE IMPACTS

In Timor-Leste, analysis of disaster impacts from 2001 to 2011 show that more than 20,000 people were affected and more than 10,000 houses were damaged. Among all disasters, climate related hazards lead to most severe impacts in Timor-Leste, particularly flood and droughts which are very frequent. Most of the impacts are on agricultural sector and livelihood activities, which in turn affect food security in the country. The climate related hazards that can affect the agricultural sector such as strong winds, floods, and drought, and their impacts are discussed in succeeding paragraphs. Further research could explore the extent to which hazards turn into disasters whenever the impacted livelihood may already be struggling with other stressors.

Flood

Major floods occurrences in Timor-Leste have been compiled from various articles found in Reliefweb from 2001 to 2010. Floods have resulted to varying degrees of damages in different districts such as destruction of houses and livelihoods, damages on crops and livestock, damages on infrastructure like roads, bridges and telecommunication facilities and health impacts. A total number of 15, 544 people have been affected and 4 people died from flooding. The affected districts are shown in Figure 4.1.

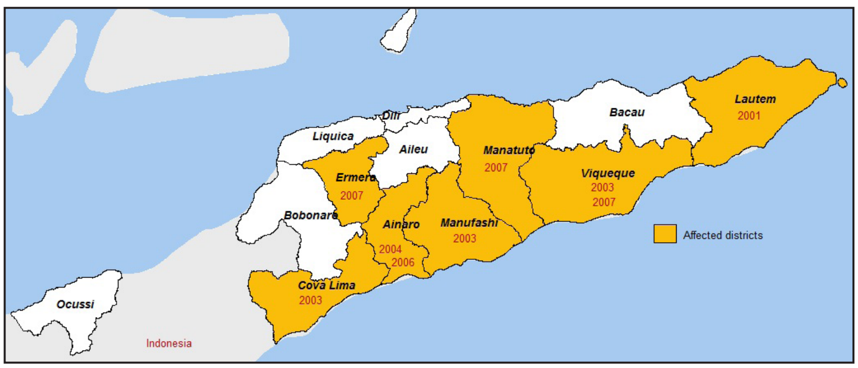


Figure 4.1: Districts affected by flood in Timor-Leste

Drought

Aggravating the food security issues already existing in Timor-Leste, droughts impact the crop production significantly and further increase the number of people under food insecurity threat. The effects of two consecutive years of drought in 2011 and 2002 have led to severe food shortage in highland areas. The people's high dependency on agriculture for subsistence made them more vulnerable. Due to exhaustaion of cereal stocks and lack of purchasing power, the most drought-affected communities resorted to "hunger season" coping strategies such as limiting and replacement of meals, selling of livestock and increase in sale of vegetable products and other essentials.

Similar condition was also observed in 2007 wherein erratic rainfall pattern and dry spells impacted agricultural production in Timor-Leste. 2007 production of creals, cassava and other tubers, in cereal equivalent, was forecast at about 123, 500 tons, a modest level reflecting adverse weather conditions, especially in the northern coast, and the outbreak of locusts in the western part. Output of maize was estimated to have declined by 30 per cent forcing the Government to import up to 200,000 tons of food grains to ensure food security. It was also estimated that about 220,000 vulnerable rural people required emergency food assistance for a period of six months.

Landslides

Landslides in Timor-Leste damage the houses and properties thereby significantly affecting the population and forcing them to relocate. Every year, a number of areas in Timor-Leste are impacted by landslides. From 2003 to 2011, there were about 17 cases of landslides recorded with a total of 234 damaged houses and 222 affected people.

Strong Wind

Strong wind often damages vulnerable housing structures and thereby affects the people. From 2002 to 2011, there were about 19 strong wind events experienced in the country that affected a total of 2015 individuals and damaged 1863 houses. The cyclonic winds from Tropical cyclone "Daryl" in 2006 for example, destroyed more than 500 houses and corn and rice crops in at least 4 districts. The destructive winds blown off roofs, over turned houses and knocked down infrastructures such as power lines. A similar case occurred in 2012 where heavy rain and strong winds wrecked more than 20 homes in the District of Oe-cusse including some public buildings. The strong winds also brought down electricity poles and damaged rice and corn crops.

FUTURE CLIMATE IMPACTS

Temperature

The projected temperature change is likely to impact various sectors in Timor-Leste to varying extent. The details of likely impacts are presented in Table 4.1.

TABLE 4.1 PROJECTED IMPACTS DUE TO INCREASING TEMPERATURE

SECTOR	IMPACTS
Agriculture	• Reduction in crop yields, rice yields might decrease by as much as ten percent for every one degree Celsius increase in minimum temperature during the growing season. • Increased frequency of water shortages for agriculture as well as rising demand through increased evapotranspiration, coupled with rising water needs for livestock. • Increased incidence of damaging pest populations. • Reduced livestock productivity.
Water resource	• Increase in evaporation leading to rapid runoff and limited water surface in water bodies. This will limit the availability of water supplies for irrigation and watering of crops, and for livestock and fish-ponds.
Biodiversity	• Reduced surface water (rivers, wetlands, lakes) and de-oxygenation of water leading to temporary or permanent loss of aquatic ecosystems, increased stress and/or local extinction of species, impacts on productivity. • Stresses on forest ecosystems & species causing the reduction of overall health, diversity and productivity. • Loss or destruction of coastal vegetation, species and habitats. • Loss of health, diversity and productivity of inshore marine systems and fisheries.

Source: MED, 2010[17]

Rainfall

The rainfall change could impact key sectors in Timor-Leste in several ways of which details are presented in Table 4.2.

TABLE 4.2 PROJECTED IMPACTS DUE TO CHANGING RAINFALL

SECTOR	IMPACTS
Agriculture	• Increased degradation and loss of agricultural land and of soil fertility. • Decreased agricultural productivity caused by storm damages to seeds, changed pattern of crop pests and diseases. • Increased damage to infrastructure used by the agriculture sector and community. • Reduced dry season flows affecting inland fisheries
Water resource	• Limited water infiltration to the soil due to the steep terrain, shallow and thin soils and sparse vegetation, increasing risk factor with climate change. • Potential contamination of domestic water sources (springs, wells, storages and treatment tanks, piping). • Increased flooding will damage land, crops, infrastructure (including homes, schools and roads) and irrigation systems - reducing farming viability, profitability, employment, livelihoods and food security; and will increase food prices, malnourishment, poor health, poverty and urban migration.

TABLE 4.2 CONTINUED

SECTOR	IMPACTS
Biodiversity	• Direct damage by floods and increased sedimentation reducing aquatic reproduction, productivity, habitat area and causing local extinctions. • Increased contamination and pollution by runoff from human settlements, industry and roads impacting on aquatic biodiversity. • Stress on freshwater ecosystems and species causing the reduction of overall health, diversity and productivity. • Temporary or permanent increases in surface and ground water leading to increased aquatic productivity, including fish. • Destruction of freshwater and shallow marine habitats and species by increased river flows, run-off, flooding and sedimentation. • Smothered sea-bed habitats by siltation. • Damaged coastal saline habitats including wetlands and mangroves due to flooding.

Source: MED, 2010

Sea Level Rise

Sea level rise is a global threat also persisting for Timor-Leste. The details of its likely impacts are presented in Table 4.3.

TABLE 4.3 PROJECTED IMPACTS DUE TO SEA LEVEL RISE

SECTOR	IMPACTS
Agriculture	• Salt-water intrusion and seawater flooding of coastal lands reducing crop yields as well as viable cropping area.
Water resource	• Increased ground water contamination by salt-water intrusion.
Biodiversity	• Loss or destruction of coastal vegetation, species and habitats. • Reduced health, diversity and productivity of offshore marine ecosystems, fisheries and marine megafauna. • Reduced survival of many species due to loss of plankton productivity (base of food chains). • Impacts on reproduction and survival of young. • Salinization of soil, freshwater, coastal lands, infrastructure and agriculture by seawater intrusion. • Reduced health and survival of many marine species due to increased acidity of seawater

Source: MED, 2010

CLIMATE SENSITIVITY

a) Crops

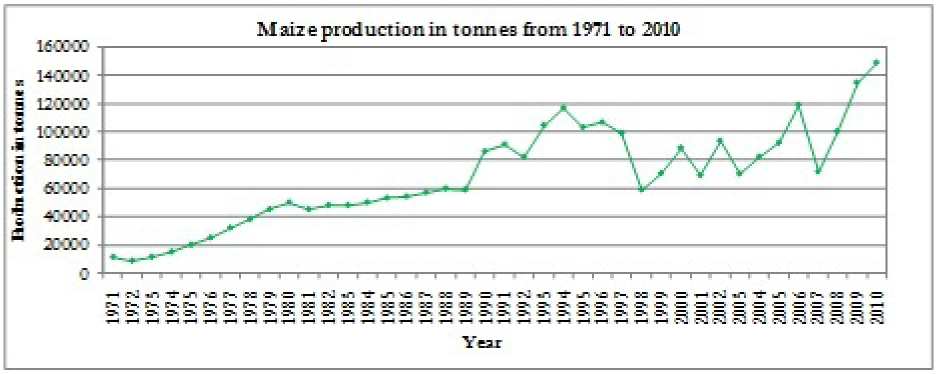
Crop production is a key livelihood sector in Timor-Leste as it engages about 85 percent of the working population in the country. The main crops include maize, rice, cassava and coffee, coconut and vegetables.

In terms of overall production, maize has the highest rate with almost 55 percent followed by cassava with 50 percent, vegetables and coconut with 40-42 percent, coffee with almost 28 percent and rice with 24 percent. *(Source: SDP 2011-2030)*

Maize

Based on production figures, maize is the most important crop in Timor-Leste. About 121,000 hectares are devoted to maize production. Under normal conditions, yield is estimated at around one (1) metric ton per hectare.

In the different stages of its growth, maize can be affected by climate hazards like heavy rain, strong wind, and drought. Maize is mostly cultivated in steep slopes, where irrigation facilities are generally non-existent hence, survival of maize depends largely on good rainfall during the Northeast Monsoon season (wet season). This dependence on rainfall makes maize vulnerable to deficient rainfall and drought. On the other hand, extreme and untimely rainfall can equally impact maize cultivation as slopes are prone to erosion. During the sowing season, heavy rainfall can wash away sown seeds, thus putting more stress on subsistence farmers. Strong wind can topple maize plants, especially if the soil is saturated after heavy rain.



Source: FAOSTAT

Figure 4.2 Maize yield in Timor-Leste from 1971-2010.

Climate events like droughts and the delayed onset of the Northeast Monsoon triggered by El Niño conditions in 2002-2003 and 2006-2007 prompted a decrease in maize production. In 2003, decrease in maize production was approximately 34 percent. Assistance in terms of food had to be provided to affected districts in the aftermath of the drought event. During the 2006-2007 planting season, El Niño triggered the delay of the monsoon season onset for over a month. When the monsoon made its onset, rainfall was irregular and interspersed with dry spells. Planting of maize was delayed, and some farmers had to resort to second sowing. Dry spells further aggravated this condition, resulting in reduction of yields. Maize production in 2007 was only 11,281 metric tons compared to 2009 when a production of about 18,883 metric tons was achieved. Notable decrease in production was recorded in 2003 and 2007, following drought events associated with El Niño (Figure 4.2).

Changes in rainfall pattern in the future may exacerbate soil erosion in steep slopes, thus affecting the cultivable area for maize. Further, more irregular rainfall can reduce maize production. El Nino/La Niña events may have more intense manifestations, hence increased risks for floods, droughts and other related hazards which are expected to impact negatively on maize production.

Rice

Rice is next to maize in terms of production volume. Rice cultivation is concentrated on the plains in the Southern part of the country. Rice is also planted in Northern Timor-Leste, although production is much less compared to that in the South. Rice has very high water requirement. Although irrigation facilities are in place in about 57 percent of the sucos, these are mostly crude and do not have the capacity to store water during the rainy season. Hence, most of the irrigation systems are only functional during the main monsoon season.

Rice production in Timor-Leste is quite low, ranging from around 1.2 to 1.5 tons per hectare. In areas with sufficient water supply, the rice production reaches up to 1.8 tons per hectare. The already low production of rice is further stressed by unfavourable climate conditions. During the 2006-2007 planting season for example, irregular rainfall triggered infestation of pests. Locust and rodent infestations had been notable in various districts.

The impacts of climate change are likely to cause more stress on rice production, with projected reduced rainfall during the main monsoon season. Due to irregular rainfall, flood risks may be higher in low-lying areas, thus the likelihood of reduced rice production is increased.

Temperature averages are projected to be warmer, calculated to increase by 0.8°C by 2020; 1.5°C by 2050; and 2.2°C by 2080[†]. Warmer temperature is likewise expected to affect paddy production, as this would likely result in more rapid water evaporation, thus adding stress to water availability for paddy production.

Cassava

Cassava ranks third in terms of production volume. Families in Timor-Leste usually cultivate cassava in areas close to their houses or in their backyards. In the country, the average yield of cassava is only about four (4) tons per hectare compared to the average yield of 12 tons per hectare in neighboring Indonesia.

Though survival of cassava during drought/dry season is generally robust, two (2) or more consecutive drought events can significantly lower cassava production.

Coffee

In Timor-Leste, coffee is a key cash crop. According to Barnett (2007), about 90 percent of foreign exchange is attributed to coffee. Coffee contributes to income of approximately 40,000 families in the country.

Coffee is mainly grown in the highlands in both the Southern and Northern parts of the country. Good coffee production requires specific climate conditions: rainfall of about 2000 to 3000 mm per year and relative humidity of around 70 percent-90 percent. Aside from these, a pronounced dry season is required for the flowering stage and for the beans to ripen. Heavy rains at the flowering stage could reduce the yield drastically.

Projected climate change scenarios may exacerbate coffee's climate sensitivity. Higher temperature, irregular rainfall, and altered humidity may decrease coffee production in the future.

b) Livestock and Poultry

Livestock production, in particular poultry-raising is generally practiced on small-scale or household basis in Timor-Leste. Raising of poultry and pigs is usually intended to address family consumption, or exchanged for cash or other purposes. As traditional farming is typical across the country, buffalos are used in farming for activities such as plowing. Families regard buffalos and other livestock like cattle, sheep, and goats with utmost importance, hence are only sold as a last option. Most families raise chickens, followed by pigs.

Generally, animals survive through grazing, thus contributing largely to erosion and land degradation. Livestock raising is usually a fallback mechanism for farmers in Timor-Leste when stress is experienced in crop production. However, most livestock and poultry farmers need to be capacitated in management aspects of animal raising as well as in dealing with health of animals, particularly in view of the impacts of threatening climatic events.

As mentioned in the outset, livestock farmers generally depend on free grazing of their cattle for the survival of livestock and other animals. This dependency on free grazing may be stressed further by future climate patterns where more and intense hazards may occur, and soil cover may decrease due to increased risk of soil erosion, landslides and other factors. Animal health, both livestock and poultry, is also likely to be affected by changes in climate patterns and increased hazard risks.

Noting that a significant percentage of the population derives income from livestock farming, which constitutes 22 per cent from the overall distribution of livelihood groups in the country next to farmers with 42 per cent (FAO, 2007). This shows how climate change-induced risks are very likely to negatively impact the affected sectors in the country.

† Based on AK-2010 projections by CSIRO-CCAM

c) Fisheries

Timor-Leste has a coastline of approximately 700 kilometers. 11 of the 13 districts in Timor-Leste are coastal. The country is situated at the center of a 648 million-hectare Coral Triangle, known for its exceptional marine life diversity. Though marine fisheries are rich, these are also unregulated as yet, which is due to the incapacity of the country for effective monitoring and management of this resource. Though numerous laws were legislated and issued, enforcement of the same is weak.

Small village ponds are usually used for inland fisheries in interior and mountainous areas. Aquaculture products like fish, seaweed and shrimp are harvested in small amounts. This sector, although constituting a potential, is not yet fully developed in the country. Climate change is likely to impact significantly on the fisheries sector due to the altered rainfall regime and the warmer temperature.

d) Infrastructure

The impacts of climate change are foreseen as increasing stress even on infrastructure. Baseline thresholds in temperature alterations, rainfall variability, sea level rise and extreme events, which could pose threat to regular undertakings and infrastructures. These are identified as critical climate change (CCC) parameters. CSIRO Australia (2006) further identified various climate change impacts and the degree of risk to different infrastructures as shown in Table 4.4.

TABLE 4.4 CLIMATE CHANGE EXPOSURE AND INFRASTRUCTURE SENSITIVITY MATRIX

	Climate Change Impacts											
Infrastructure Type	Increased Solar Radiation	Decrease in Available Moisture	Increased Variation in Wet/Dry Spells	Increased Temperature & Heatwaves	Decrease in Rainfall	Increase in Extreme Daily Rainfall	Increase in Frequency and Intensity of Storms	Increase in Intensity of Extreme Wind	Increased Electrical Storm Activity	Increase in Bush Fires	Sea-Level Rise	Humidity
Water	Negligible	Definite	Definite	Definite	Definite	Definite	Definite	Negligible	Negligible	Definite	Negligible	Negligible
Sewer	Negligible	Definite	Definite	Negligible	Definite	Definite	Definite	Negligible	Negligible	Negligible	Definite	Negligible
Stormwater	Negligible	Definite	Definite	Definite	Negligible	Definite	Definite	Negligible	Negligible	Negligible	Definite	Negligible
Electricity	Definite	Definite	Definite	Definite	Definite	Definite	Definite	Definite	Definite	Definite	Negligible	Negligible
Gas and Oil	Negligible	Definite	Definite	Negligible	Negligible	Definite	Definite	Negligible	Negligible	Definite	Definite	Negligible
Fixed Line Telecom Network	Definite	Negligible	Negligible	Definite	Negligible	Definite	Definite	Definite	Definite	Definite	Definite	Negligible
Mobile Network	Negligible	Definite	Negligible	Negligible	Negligible	Negligible	Negligible	Definite	Negligible	Negligible	Negligible	Negligible
Roads	Definite	Definite	Definite	Definite	Negligible	Definite	Definite	Negligible	Negligible	Negligible	Negligible	Negligible
Rail	Negligible	Negligible	Negligible	Definite	Negligible	Definite	Definite	Negligible	Definite	Negligible	Negligible	Negligible
Bridges	Definite	Negligible	Negligible	Definite	Negligible	Definite	Definite	Definite	Negligible	Negligible	Negligible	Negligible
Tunnels	Negligible	Negligible	Negligible	Negligible	Definite	Definite	Definite	Negligible	Negligible	Negligible	Definite	Negligible
Airports	Definite	Definite	Definite	Definite	Negligible	Definite	Definite	Definite	Negligible	Definite	Negligible	Negligible
Ports	Negligible	Negligible	Negligible	Negligible	Negligible	Definite	Definite	Definite	Negligible	Negligible	Definite	Negligible
Buildings and Structures	Definite	Definite	Definite	Definite	Definite	Definite	Definite	Definite	Definite	Definite	Definite	Definite
Urban Facilities	Definite	Definite	Definite	Definite	Negligible	Definite	Definite	Definite	Definite	Definite	Definite	Negligible

Table Legend

(green)	Negligible Risk – Presents "negligible" risk within the probability of natural variation
(orange)	Definite Risk – Presents "definite" risk within the probability of natural variation

Source: CSIRO Australia, 2006

This section discusses the sensitivity to climate of three (3) key infrastructures in Timor-Leste: roads, telecommunications, and irrigation.

Roads

The road network in Timor-Leste connecting the capital, Dili, to 13 districts, and their succos and aldeais in the country is generally in poor condition. The poor condition of roads hampers the transportation of agricultural production to markets due to costly transport expenses.

An annual fund for regular maintenance of roads is a necessity to keep them in good condition, especially in the light of the damages brought by hazards. However, the annual allocation for road maintenance remains very low, placed at USD 5.3 million in 2011. For a six-year period (2004-2010), an annual average of less than two million US Dollars for road maintenance was recorded. This amount falls short of the required amount of USD 20-30 million, per 2009 prices, for annual road maintenance of approximately 1,600 kilometers of road network in the country as indicated by ADB (2008).

World Bank, in its online brief on the Timor-Leste Road Climate Resilience Project, cited that hazards like landslides frequently render key roads impassable. Road structures are poor and capacity for drainage is nil. This condition gives rise to increasing transportation expense and lengthened travel time, among others. As a result, communities and villages are increasingly hard to reach.

Climate change is expected to alter climatic patterns and hence, may influence the increased and more intense occurrence of hazards that may impact/deteriorate further road conditions. Relative to the projected climate change scenarios for Timor-Leste, the ADB Climate Change Assessment indicates possible impacts on roads due to sea level rise. In particular the inundation of roads in low lying areas and reduced drainage system effectiveness and soil bearing capacities could represent problems.

Also, drought is likely to deform roads due to dropping water table levels and sinking road foundations and subgrade. Further, erosion may be exacerbated by reduced groundcover as a result of deficient moisture.

Telecommunications

In Timor-Leste, an estimated 32 percent of the population do not have access to telephone communication facilities. Partly due to deficient communication facilities, communities are increasingly becoming isolated and problems in governance are encountered. Internet access is currently very limited especially in rural areas. The highly limited telecommunication infrastructure impedes the government from effectively coordinating initiatives and responding to hazard events.

As indicated in the SDP 2011-2030, a single company would provide telecommunication services to the country until 2017. The monopoly of telecommunication services is not able to address the increasing demand for such services, particularly in rural areas.

Irrigation

Irrigation is a very important part of the infrastructure in Timor-Leste, considering that agriculture provides about 85 percent of the population's livelihoods. Per 2007 data from MAFF, only around 47 percent of the total irrigation area of approximately 71,258 hectares is under operation. Irrigation systems in Timor-Leste do not have water holding capacities. Hence, these are functional only during the rainy season. Damages of various nature and extent prevail in the irrigation facilities, of which most were spawned by the pre-independence conflict.

Initiatives for the rehabilitation of irrigation facilities have been implemented in the country since its independence. However, such initiatives are largely inadequate. In some areas, irrigation facilities are supplemented by small water impounding stations. The inadequacy of irrigation facilities is cited as one of the factors that give rise to low agricultural productivity. More investment is required to ensure that the irrigation facilities are functioning and provide necessary support to farmers.

The projected reduced rainfall during the monsoon season is expected to put more stress on the agriculture sector. To contribute to meeting the challenges of water availability for agriculture vis-à-vis climate change, irrigation facilities have to be fully rehabilitated and extended.

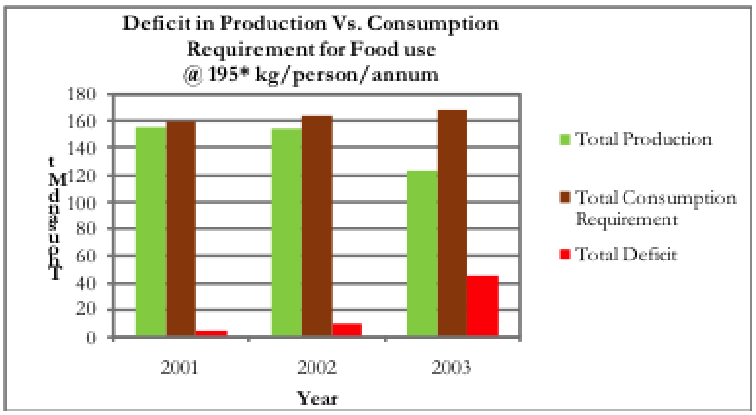
ADAPTIVE CAPACITY

This section discusses the adaptive capacity both at the national and household levels, in the face of climate variability and change.

National adaptive capacity

The degree of people's vulnerability to climate change is defined by alterations in climate, degree of dependency of people on sectors which are climate-sensitive, and the society's capacity to adapt to or assimilate the changes.

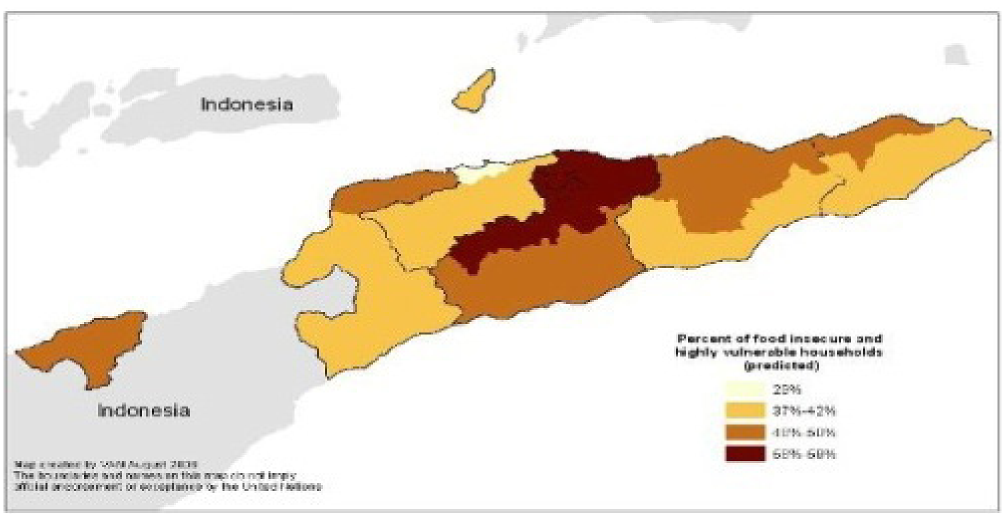
Timor-Leste, a country prone to various climate hazards, is listed by WFP (2005) as among the countries in Asia with the highest percentage of national population exposed to chronic food security. Over 40 percent of the Timor-Leste population is chronically food insecure.



(Source: WFP, 2005)

Figure 4.3. Deficit in production versus consumption requirement per person per annum

Crop losses and damages occur often and regularly in the country, thus deficiency in food is an annually recurring problem which is exacerbated by climate-related hazards and shocks. From 2001 to 2003, food deficit of more than 100,000 metric tons per year was recorded. This is reflected in Figure 4.3, while the percentages of food insecure population per district are shown in Figure 4.4.



(Source: WFP, 2007)

Figure 4.4. percentage of food insecure and highly vulnerable households

Although monetary resources are available at the national level primarily because of the Petroleum fund, the Timor-Leste Human Development Report 2011 identifies a lack of institutional capacity of the government to manage and ensure efficient spending of that Fund. This is largely due to the employee skills and administrative procedures. For 2012, a budget of USD 194.2 million is allocated for "Transfers". This amount is broken down into the following: USD 69.9 million for National Liberation Combatant payment; USD 30 million as subsidies to the elderly; USD 63 million for local development thrusts; and USD 20 million for community initiatives geared at enhancing road conditions and creation of employment in the rural areas. Large-scale transfers of money in a very short time could aggravate inflation. This could endanger purchasing power of large number of population in rural areas and set in motion a Dutch disease in the economy.[18] This trend could marginalize agriculture and other non-petroleum based manufacturing sectors.

There is likewise lack of capacity in integrating climate risk management or disaster risk management into development planning. Hence, coping strategies to prevailing and emerging risks are not assimilated into annual budgets to address the recurring and projected impacts of climate variability, extremes and change.

Household adaptive capacity

As already mentioned earlier in this report, agriculture is by far the most important economic sector in Timor-Leste in view of its absorption of a massive percentage of the active population for work. Because of the subsistence nature of agriculture, climatic hazards and shocks would usually lead to food insecurity. In rural areas, an estimated 3.8 months' duration, annually, is a food insecure period. The discussion of household adaptive capacity focused on food shortage due to failure in crops is thus an important one to intensify with foresight to increasing global warming.

In view of food shortages, coping mechanisms at the household level include the reduction of the meal frequency, reduction of food quantity and the substitution of rice and corn with other food items such as fruits, vegetables, and cassava, among others. Alternative sources of income are explored, and most households rely on trade with forest products like firewood in order to procure food.

Food distribution revamping is another coping mechanism at household level. Children are prioritized, followed by the patriarch and other men in the family, and women are least prioritized. In many instances, women are only entitled to a meal per day. In turn, malnutrition and diseases becomes a concern among infants due to the inadequate nourishment of mothers.

Depletion of food prompts people to resort to consumption of wild plants and animals. People in some areas consume animals like dogs, rats and frogs when food shortage is extreme.

Selling and consumption of poultry and livestock become a fallback mechanism for most people in times of food shortages. Prices of poultry and livestock however, during the lean season for crops, plummet because of the low demand. In this case, most animal owners resort to distress selling, thus getting much less from the sale than the regular price. This situation is compounded by the escalation of the price of rice and corn.

When the seasonal rainfall onset is delayed and potential for plantation is low or nil, migration to urban areas occurs among working population to find temporary jobs or seek support from relatives. These temporary jobs are usually in the fields of manufacturing and construction. However, manufacturing and construction activities are not regular hence alternative jobs are scanty most of the time. Having no other option, people take on whatever jobs are available and are paid unreasonably low. The younger population go to Dili in the hope of finding better-paid jobs. Availing of loans for the procurement of food is limited to a few areas.

Children belonging to families experiencing tremendous stress quit school to cut expenditure related to education. Children either work to earn wages or assume households activities. Other coping mechanisms include illegal activities like unlicensed selling of liquor.

THREATS TO DEVELOPMENT

The severe droughts witnessed in previous years have set back development and impacted the economy, forcing increased imports and causing health problems among other problems. The increased malnutrition levels resulting from these events, increasing from the usual 42 percent to the exceptional 55 percent, also are a threat to the people's health and productivity. Both of these indicators reveal that climate is a threat to development. Further on, Timor-Leste being a dual economy, could marginalise other sectors till sections of the population acquire the skills to be able to transfer to other sectors of the economy, thereby posing a threat to development.

KEY MESSAGES (CLIMATE IMPACTS AND ITS RISK)

- Majorly droughts are frequently affecting mostly the northern coastal regions and also northern slops and northern highlands. Southern coasts are also affected, but less severely.
- As Timor-Leste has a mountainside elevating as high as 2,986 meters with areas that are very steep and slopes of 40 percent, heavy rainfall events cause landslides and flash floods in these areas. As the mountain is very steep and very close to the sea, some of the river systems are prone to flash floods particularly in the southern region.
- Most of the droughts are associated with El Niño and most of the floods and landslides with La Niña. Considering the fragility of the geo-physical location and also the subsistence nature of agriculture, which is the main livelihood; crops such as maize and rice are more sensitive to climate variations. Occasionally during consecutive droughts tuber crops are also affected.
- Since 80 percent live on subsistence agriculture, these climate shocks aggravate food insecurity and malnutrition. As the country has only recently re-commenced the development processes after the conflict, it has very low capacity to withstand the impacts of these periodic shocks. However, there is a ray of hope in that the government has access to a stable Petroleum Fund to drive the development process. There is a possibility that the capacity of the country could increase in due course.
- Though it has a large fund of around one billion US Dollars each year, there are huge institutional and policy gaps for investing this large resource in a systematic manner and draw benefits. Lack of capacities, policy instruments, and vast petroleum resources could possibly result in marginalisation of agriculture that supports 80 percent if not utilised systematically.
- Till systematic development is institutionalised, periodic climate shocks such as El Niño-driven droughts and La Niña-induced floods, landslides, heavy rainfall and storms could aggravate poverty, food insecurity and malnutrition.

CURRENT CLIMATE RISK MANAGEMENT

This chapter examines the current capacities for CRM, particularly in the form of institutional and policy arrangements for CRM. It considers frameworks of development planning, disaster risk management and climate change for this purpose. A capacity assessment for CRM is also undertaken for the key functions of assessment, prioritization, coordination, information management and climate risk reduction.

INSTITUTIONAL AND POLICY ARRANGEMENTS FOR CRM

In Timor-Leste, three distinct frameworks – development planning, disaster management and climate change adaptation could address climate risk. However there is no integration of climate risk management process. The status of three domains is discussed in the succeeding paragraphs.

Development Planning Framework

The Timor-Leste Parliament adopted the Strategic Development Plan 2011-2030. This Strategic Development Plan (SDP) covers social capital, infrastructure development and economic development as key thematic areas. This plan has its distinct time frame of 2011-2015 to commit resources for implementing programs. From 2015 to 2020, focus is to expand and deepen the program implementation based on the lessons from the 2011-2015 phase. While the period 2020-2030 consolidates the development programs and achieve development goals and objectives. This is the most ambitious program envisioned or undertaken in the development history of Timor-Leste.

Climate change concerns have been recognized in the SDP with regard to its vulnerability to climate change. The plan recognizes that natural resources like water, soil, coastal zone could be susceptible to changes in climate and sea level rise and possibility of increasing climate risk in the form of extremes like flooding, forest fires, and food shortages. The strategy of development plan is to develop a national climate change center by 2015 to conduct research on climate change to address climate change adaptation and mitigation issues.

Disaster Risk Management Framework

The National Disaster Management Directorate (NDMD) under the Ministry of Social Solidarity is the focal point for DRM in Timor-Leste. In March 2008, the government formulated national disaster risk management policy and this policy provides general framework for all issues connected with natural disaster management.

The National Disaster Risk Management policy provides institutional arrangements to establish a disaster operation center and department of preparedness and mitigation. This department is also responsible for emergency response and recovery. NDMD has yet to update its systems, procedures and programs to deal with hazard reduction. Currently, there are only 8 staff supporting the agency.

NDRM policy provides institutional arrangements at the national level in the form of an inter-ministerial commission for disaster management with participation of 12 ministries as well as representatives from Red Cross, UN and the civil society. The NDRM policy also provides for institutional arrangement for disaster management from national to district to sub-district levels. There are specific policies for disaster risk reduction, which are as follows:

- Hazard and Vulnerability Monitoring and Analysis;
- Regional Early Warning Monitoring and Analysis;
- Emergency Disaster Reporting and Communication to the Public;
- Principles and Responsibilities for Effective Early Warning.

Climate Change Adaptation

The ministry of Economy Development has two wings to address environmental and climate change issues. The National Directorate of Environmental Services (NDES) and National Directorate of International Environment Affairs (NDIEA). The NDES consists of six units: (i) Environmental Awareness and Education Unit; (ii) Environment Impact Assessment Unit; (iii) Precaution/Law Unit; (iv) Biodiversity and Convection Unit; (v) Laboratory and Pollution Control Unit and (vi) Database Unit.

NDIEA was established in Jan 2008 and started focusing on climate change programs. This directorate deals with National Adaptation Program of Action (NAPA) and the initial National Communication preparations.

Climate Change Programs: NAPA is the first program that directly addresses climate change adaptation. The UNDP Project on "Strengthening Disaster Risk Management in Timor-Leste" has been initiated to enhance capacities in: (i) National Risk and Vulnerability Assessment conducted to inform decision making, (ii) DRM/CRM mainstreaming in Government planning (iii) Establishing and strengthening of institutional and operational mechanisms needed for the implementation of the DRM policy (iv) Community based disaster risk reduction expanded with special emphasis on promoting women's participation and needs. Other climate change related programs include the (i) the Timor-Leste Road Resilience project by the World Bank and (ii) Australian funded Climate Change Adaptation program.

However there are large numbers of developing projects in the area of natural resource management, rural development, agriculture and infrastructure development that could contribute to climate change adaptation. In addition UNDP provided program support on preparation for initial National Communication and preparation for NAPA.

CAPACITY ASSESSMENT FOR CLIMATE RISK MANAGEMENT

A capacity assessment for CRM has been undertaken by deploying the National Adaptive Capacity Framework of the World Resources Institute (WRI 2009). The assessment results are as described in the following section.

Assessment function

The climate risk assessment capacity in Timor-Leste is nonexistent as the National Department of Meteorology and Geophysics lacks capacity in data collection, compilation and analysis of climatic data and its connectivity to socio economic systems.

Historical data of Timor-Leste is available from a few stations for the period of 1914 to 1975, but data is incomplete. Recently, datasets from 1975 to 1999 are available for two stations. From 2000 onwards, few more data sets have been collected manually through new stations installed with support by AUSAID. Currently, there are three automatic stations installed by Australia Bureau of Meteorology. Considering high spatial and temporal variability of climate, there is a need to establish dense network of weather stations that could be used to assess of climate risk at a level that could be relevant for adaptation planning.

There is a huge challenge to not only build capacity to assess current climate risks but to also develop the needed capacities to respond to emerging risks that result from an aggressive development model and its growing exposure to climate risks. For instance, difficult mountainous terrain and vulnerable coastal zones are undergoing tremendous development process in the form of infrastructural expansions with investment of around US$ 1 billion every year in next fifteen years. In addition, US $ 147 million are undertaken by development partners without subjecting these programs to climate risk assessment.

Prioritization Function

Due to the lack of a systematic climate risk assessment system, the public sector investment has not been guided by climate risk dimensions to development.

i) Agriculture

The resources allocated to the agricultural sector are insignificant considering the challenges and capacity gaps in attempting to address the risks. For example, out of a US $ 1.8 billion national budget in 2012, less than US $ 14 million are allocated to agriculture.

ii) Rural development

An increasing allocation is being made by the Central government to the districts each year, increasing from US $ 89 million in 2011 to US $ 134.5 million in 2016. Much of these funds are committed towards rural infrastructure development in the districts. However, in the absence of adequate capacities at the district level institutions to incorporate climate risks into development process, this may lead to maladaptation in the districts. Early improvements in addressing climate change adaptation might be brought about by the USD 4.6 million LDCF grant supported by UNDP. The annual budget allocation for Capital and Development Expenditure for districts and government ministries have increased from US $ 89 million in 2011 to US $ 134.5 million in 2016.

iii) Infrastructure Development

Out of the US$ 1 billion capital development for 2012, only around US$ 2 million are allocated to climate risk management purposes in the agricultural sector. US$ 7.5 million is allocated for infrastructure development. No resources have been allocated to assess climate risks regarding infrastructure. An assessment of climate risk with regard to infrastructure is being adapted to a World Bank-assisted road construction project with estimated fund of US $ 20 million. Except these small commitments, other systematic efforts have not been made to develop policies. Hence, institutional capacities are lacking to undertake climate diagnostics and inform policy and program or to make systems to prioritize program as per climate risk concerns available.

iv) NAPA

NAPA has prioritized various climate change adaptation measures related to (i) food security, (ii) water resources, (iii) human health, (iv) natural disasters, (v) forests, biodiversity and coastal ecosystems, (vi) livestock production, and (vii) physical infrastructure. It has also been supporting the ambitious national poverty reduction target in relation to the expected increased storm intensity at sea by improving the capacity to forecast and adapt offshore oil and gas infrastructure to withstand strong storms and waves. A ninth priority area, focuses on developing National Institutional Capacity for Climate Change through which overarching programme level coherence will be ensured (MED, 2010).

NAPA's prioritizations are based on isolated project interventions on the above mentioned items. A more systematic program-based approach needs to be evolved and institutionalized within the stakeholder institutions of Timor-Leste. The currently ongoing GEF project to strengthen 'the Resilience of Small Scale Rural Infrastructure and Local Government Systems to Climatic Variability and Risk' is likely to entail improvements. This currently ongoing project is entirely in line with NAPA priorities and relates in particular to aquatic resources, infrastructure, forest coverage, biodiversity and the capacity of national institutions.

Coordination Function

Institutions that work on climatic issues, such as the Department of Meteorology and Geophysics, Ministry of Economy and Development, Ministry of Social Solidarity, Ministry of Agriculture Forestry and Fisheries and the Ministry of Infrastructure are directly concerned with climate risk management, but have not evolved a coordination arrangement to integrate climate change adaptation domains in to CRM practices. The inter-ministerial commission is expected to coordinate government activities and DRM. The NAPA development process is centered on the ministerial level and the secretary of state level. Adding to this, are a project steering committee and six sector working groups on food security, water, health, disasters, biodiversity and infrastructure[1].

The effectiveness of these arrangements for coordinating an inter-institutional process is yet to be established, in particular so, considering low capacity and resource commitments. This process may take considerable effort as there is no institutional mechanism for effective coordination of CRM. The planning budgetary process would also take time.

Information Management

Availability of Long-Term Climate Data

Recorded rainfall and other meteorological data from 1914 do exist. Data from period of 1914-1975 are with Portugal while 1975-1999 data are with Indonesia. The meteorology department could acquire these data sets through WMO. In 2000, MAFF installed 50 rain gauges around the country, funded by AusAID. This network is no longer operational however, due to a lack of maintenance.

__Current Infrastructure for Hydro-Meteorological Observation and Monitoring__

The planned meteorological network consists of 56 stations. The meteorology department currently has two portable automatic weather stations, located in Dili. These were established by the Bureau of Meteorology of Australia. About five more stations will be established by the Ministry of Natural Resources, Minerals and Energy Policy.

MAFF has four automatic weather stations. An additional 14 stations, which can record data hourly, are being established under the agricultural rehabilitation project. Data transfer, however, is done monthly. MAFF plans to involve district agricultural offices and communities in data collection and station maintenance. Data from these stations would be received by ALGIS, through the 13 district and four regional offices of the Ministry. A project that would electronically connect district, regional and national MAFF offices is nearing completion.

The hydrology department plans to establish a hydrological network consisting of 50 stations; twenty of these are targeted to be completed this year. Data (rainfall intensity and runoff for river gauges) are to be collected every end-of-month and by relying on the sub-district and district administrations.

The Ministry of Agriculture collects rainfall data and its mode of collection of data is still manual. The Department of Meteorology and Geophysics have limited capacity to provide forecasts. This department depends on Bureau of Meteorology of Australia and RIMES inputs for generating routine forecasts. No systematic cyclone monitoring, tidal monitoring, water resource monitoring or observation network exists. Hence Timor-Leste needs huge capacity developments for climatic information management and decision making purposes. RIMES has established under CRM TASP a short term weather forecasting system and provides information on two pilot locations.

A well-functioning meteorological department needs to have robust capabilities with regard to an observation system, a communication system as well as information management and processing systems. In addition, concerning numerical weather prediction capabilities in particular, it would be necessary to generate accurate forecasts with computational facilities and establish communication linkages to access global and regional data. However, the Department of Meteorology and Geophysics in Timor-Leste is practically is not yet fully established. It has only five staff for undertaking routine functions of the department. There is no capacity for collection, collation and analysis of meteorological data. The Department acknowledges the need for establishing forecasting capabilities. This effort would involve re-establishing a meteorological network involving the provision of training to observers, data recovery- digitizing and analyzing and archiving data and developing skills for meteorological information generation and communication.

Climate Risk Reduction function

Despite a significant need to reduce climate risk, no capacity exists in Timor-Leste to integrate climate risk in to development planning process.

i) Agriculture Risk Management

Opportunities for Climate Forecast Applications

Timor-Leste has six agro-climatic zones: the northern lowlands, northern slopes, northern highlands, southern lowlands, southern slopes and southern highlands. The northern areas, with normal annual rainfall below 1,000 mm, are prone to drought. The 30 percent drops in production in 2012 have been attributed to drought. Recent drought years 1997-98, 2002-2003, 2004-2005 and 2006-2007 were all associated with ENSO. Considering the high correlation of ENSO, there is a possibility of generating reliable forecasts well ahead and thus to manage drought risks better.

CRM for Agriculture Risk Management

Application of downscaled seasonal climate forecast at demonstration sites need to be undertaken to address food insecurity at household level. During moderate to weak El Niños, where spatial and temporal variability is huge, seasonal climate forecast may be downscaled and provided in the demonstration sites. This would guide farmers in deciding whether to proceed with rice planting upon arrival of the first rains (which is commonly practiced), wait, or change crops with a forecast of less than normal rains.

Farmers interviewed in Leorema (an upland village in Bazartete sub-district, Liquica district) identified the following opportunities for using forecast information:

- Seasonal forecast would be used in making decisions whether to rely on coffee production, or switch to maize or cash crops (e.g. vegetables). Information would be needed by June/July, before the land preparation for maize in August/September. Farmers understand that the information that may be provided in August may be very coarse. They, however, are willing to accept the information, compared to not receiving any at all;
- A ten-day forecast of heavy rains will be used for decisions for early harvest of coffee and for public safety, particularly in areas close to streams (to prevent flash flood risk) and slopes (to better prepare for landslide risk);
- A ten-day forecast of dry spell would help to better anticipate drought events.

Locust early warning

The western districts experienced a locust outbreak in mid-March. Locusts that otherwise would have died in the dry season, migrated from Nusa Tenggara Timur to the western river valley. Farmers already observed the hoppers in January, but reported only in March when the locust population was already huge and has covered a considerable area. FAO observed that this area usually gets a locust outbreak during mild to moderate El Niño years. A climate information-based early warning and monitoring system may be developed, along with awareness and education campaigns, in collaboration with FAO, MAFF, Indonesia's Ministry of Agriculture and the local governments of the border districts. Specific activities can include locust monitoring, an alert system, and joint operation for locust control.

ENSO events provide for the possibility of predicting extreme weather events rather well in Timor-Leste. There is thus potential to develop capacities in a way to downscale and localize ENSO forecast for agricultural risk management for six agro-climatic zones (Benevides, 2003[20]):

TABLE 5.1: AGRO ZONES AND CROPPING SYSTEM

AGRO ZONES	CROPPING SYSTEM
1.Northern Lowlands: Coastal land and valley floors below 100 m (mean annual rainfall <1000 mm, four to five months wet season from November to March	Irrigated rice dependent on river water: (a) rice then fallow (seasonal irrigation) (b) rice-rice (irrigated by underground springs) Dryland farming: (a) maize then fallow (b) maize followed by cassava, beans, pigeon pea, sweet potato, or pumpkins (c) maize, peanut then fallow (d) peanut followed by maize, pumpkins
2. Northern Slopes: Northern hills between 100 and 500 m (mean annual rainfall of 1000–1500 mm, five to six months wet season, October to March)	(a) rice-rice (in irrigated areas, e.g. Baucau) (b) maize followed by cassava, sweet potato or pumpkins (c) mixed crops of maize, cassava, long beans, pigeon pea, peanuts, sweet potato, pumpkins (d) peanut then fallow
3. Northern Highlands: Northern hills and mountains above 500 m, (mean annual rainfall >1500 mm, six to seven months wet season, October to April)	(a) rice-rice or rice-fallow depending on source of water (b) maize then fallow (c) maize followed by cassava or sweet potato (d) mixed crops of maize, cassava, sweet potato, taro, beans, pumpkins (e) red beans + white beans then fallow (f) peanut then fallow

TABLE 5.1 CONTINUED

AGRO ZONES	CROPPING SYSTEM
4. Southern Highlands: Southern hills and mountains above 500 m, (mean annual rainfall >2000 mm, nine months wet season, November to April; May to July)	(a) maize then fallow (b) red beans + white beans then fallow (c) maize followed by red beans + white beans (d) red beans + white beans followed by another beans crop (e) maize + cassava or maize + sweet potato
5. Southern Slopes: Southern hills between 100 and 500 m (mean annual rainfall 1500–2000 mm; eight month wet season, November to April; May to July)	(a) maize then fallow (b) red beans + white beans (sometimes with maize) then fallow (c) maize followed by red beans + white beans (d) maize or beans followed by upland rice followed by mungbean (e) maize + cassava or maize + sweet potato (f) upland rice + cassava or sweet potato
6. Southern Lowlands Coastal land and valley floors below 100 m, (mean annual rainfall about 1500 mm, seven to eight month wet season, November to March; May to July).	(a) irrigated rice then fallow (b) irrigated rice followed by dry season rice (c) maize then fallow (d) upland rice then fallow (e) mixed cropping of maize, cassava, sweet potato, taro (f) maize followed by mungbean

Source: Benevides, 2003 (The specific adjustments during El Niño and La Niña forecasted seasons need to be identified through consultations)

TABLE 5.2: CRM OPTIONS FOR AGRICULTURE RISK MANAGEMENT AT NATIONAL LEVEL & CONSTRAINTS IN IMPLEMENTING OPTIONS

CLIMATE RISK MANAGEMENT OPTIONS	THE ROLE OF CRM	EXPECTED OUTCOME	STAKEHOLDERS	POLICY & INSTITUTIONAL CONSTRAINTS
Application of seasonal forecasts for enhancing rice and corn and other crop production in favorable zones and favorable seasons and reducing crop losses in unfavorable areas and seasons	There is a possibility of using ENSO index-based and other indicators as climate forecast. This could serve to institutionalize CRM to manage crop system in favorable areas (areas that have agric. potential due to long wet season) to maximize potential gains and minimize losses in other areas	Forecast result (timely, accurate) could be made available, understood, easily accessed, by users at all levels and at no cost	Intermediary institutions to translate and communicate info from NDMG to local levels by involving Universities, Local institutions, Farmer groups, research institutes, civil society; MAFF, MWR and NDMG	1. There are no institutional, policy and technical capacities to generate and apply forecast information. These capacities need to be developed

TABLE 5.2 CONTINUED

CLIMATE RISK MANAGEMENT OPTIONS	THE ROLE OF CRM	EXPECTED OUTCOME	STAKEHOLDERS	POLICY & INSTITUTIONAL CONSTRAINTS
Strengthen Climate Field school program (established by RIMES) based on constraints and shortcomings in collaboration with MAFF, NDMG, MWR, and agricultural research institutions	Seamless integration of weather/ climate forecast for risk management. Improve training curriculum for application all districts where CFS is on-going	Flexible Crop Calendars in Anticipatory risk management options extended to Agriculture Cooperatives Improved curriculum is implemented considering local conditions. Recommended operational decisions (crops, calendar) are fully implemented by farmers, Capacity to adapt to new sources of income, greater awareness on use of climate information and networking	NDMG, MAFF MOE, MOSD , NGOs, Universities, research institutions, community based institutions, farmers' groups, the parliament, mass organisations, women's organisation and religious organisation	1. Current institutional arrangements under NDMG needs reform 2. Policy to adapt and adopt CFS for fisheries, animal husbandry and other user groups (at all levels)
Integrate decision support tools for food logistics management relating to ENSO & other indicators' forecasts into MAFF with involvement of NDMG	Incorporation of climate information into food availability estimation model of, MAFF, M/Planning, M/ Transportation and related ministries and a distribution model according to specific requirement of districts	Food availability estimation model integrating climate information is pilot tested and integrated into operations	MAFF, Planning, NDMG, Trade, Transportation, local governments, local NGOs, NDMD	There are no institutional, policy and technical capacities to facilitate generation and application of forecast information. These capacities need to be developed

ii) CRM for Infrastructure Risk Management

Around USD one billion is invested in to the rehabilitation of infrastructures and with the declared intention to establish new infrastructural facilities. Recurring climate risks and weather threats could reclaim at least 10-15 percent of that investment if needed to cover damages and losses thus caused. Investments into climate-sensitive infrastructure designs can be small and yet serve, as explained in Chapter 5, to minimize later diversions of developmental resources into mere rehabilitation. Vast capacities are yet to be developed at the level of NDMG and other infrastructure-focused institutions to generate and apply climate risk information. This report acknowledges the innovative UNDP-supported LDCF project on climate resilient rural infrastructure that tackles challenges along these lines.

KEY MESSAGES (CURRENT CLIMATE RISK MANAGEMENT)

- CRM is still in a nascent stage in Timor-Leste. There are three domains or frameworks that directly or indirectly contribute to the CRM process - the development, the disaster risk management and the climate change adaptation domains. There is a need to integrate these three domains into a holistic CRM strategy, programmes and projects.

- The country has low capacity for assessing climate risks because the institutions have not yet established themselves even to address their mandated functions. As there is no capacity for risk assessment, prioritization of development and climate risk management are still to be institutionalised and a vast capacity development measures needs to be decided.

- Considering the very weak and dysfunctional Meteorological services, the climate information system is not yet established. There is a huge coordination weakness in institutionalising CRM among the climate sensitive stakeholder institutions.

- There is a vast potential in reducing climate risks both in the sector that support large population, i.e., agriculture and also the infrastructure sector which is prioritised by the Government for maximum use of the Petroleum Fund. Even though there is a vast potential to make use of CRM tools and practices, the Government of Timor Leste lacks capacity to realise these potential advantages of CRM.

RECOMMENDATIONS FOR CLIMATE RISK MANAGEMENT

Under Chapter 5 the report identified current capacity gaps for implementing climate risk management options. This chapter provides recommendation for addressing barriers in realizing potential climate risk management options in the agricultural sector.

INSTITUTIONALIZATION OF CLIMATE RISK MANAGEMENT

As noted in earlier sections, agriculture and infrastructure – both of which are governmental priorities – are sensitive to climate risks, and require an institutionalized Climate Risk Management system at the Ministry level to proactively facilitate risk reduction. An institutional mechanism with capacities for Climate Risk Management could be developed through a system coordinated by the National Directorate of International Environment Affairs, which would be well-placed to assume such a responsibility, although it is possibly still too weak. To improve existing institutional arrangements, the most concerned ministries could focus in a first phase on what can typically be achieved in these sectors. In the short-term, the Ministry of Economy could try to enhance the sharing of information, which could lead to a coordination function in the longer-term. Also as a start, the key climate sensitive sectors and ministries such as the Ministries of Agriculture, Infrastructure and Social Solidarity could be involved in the establishment of a system to integrate Climate Risk Management into the sensitive sectors that they look at. A policy mechanism to institutionalize this system would also be required.

A needs assessment has to be undertaken to build capacities of the key institutions to be involved, considering the key elements of data and information generation, user-based information system, interpretation of the information and application, demonstration at pilot sites. The establishment and institutionalization of a user-relevant climate information system involves:

a) *Assessment of users' information requirements*. Different users have different climate information requirements. Within the same group of users, information requirements are guided by the planning horizon, which could vary from 20-25 years at the organizational/ ministerial level to five years and below at the Directorate level;

b) *Tailoring of climate information to users' needs*. Forecast resolution and lead time vary with user type. For example, climate projections of a 20-25-year-lead time at a spatial scale are required for adaptation;

c) *Characterizing and packaging uncertainties associated with climate information of different timescales*. Uncertainties inherent in longer-lead climate information need to be characterized and communicated to facilitate application in a risk management framework. This would also prevent untrained and non-technical users from immediately perceiving and attributing climate variability-related phenomena to global warming;

d) *Interpretation and translation of climate information*. Climate information should be interpreted in terms of sector-specific thresholds that are jointly determined by institutional users and communities;

e) *Application in a risk management framework*. Climate information is applied in planning and decision-making, cognizant of the risks due to uncertainties in the information;

f) *Demonstration of the economic benefits in using climate information and adopting the CRM framework*. Appreciation of the economic and social benefits derived from investment in an end-to-end climate risk management system, in terms of time, human resources, and finances shall lead to a heightened acceptance of the CRM framework and institutionalization of the CRM system. Remains to be clarified if this also means the Finance Readiness Framework (CFR).

Information on market behaviour of input costs and their availability (e.g. seeds for alternate crops, fertilizer, etc.) as well as incidence of pest and diseases, should accompany climate information and response menus for farmers. Linking weather/ climate information with production input- and output-related information (e.g. market) is essential for meeting challenges of seasonal and inter-annual climate fluctuations.

AGRICULTURE RISK MANAGEMENT

Delineation of risk zones for food production.

Food production risk zones could be delineated, using climate risk assessment results and water management and agronomic practices, and building on the existing agro-climatic zones as shown in Table 6.1.

TABLE 6.1: RECOMMENDATIONS FOR CLIMATE RISK MANAGEMENT

GOVERNMENT PRIORITY ON CCA	CLIMATE RISK MANAGEMENT OPTIONS	ROLE OF CRM	CURRENT POLICY AND INSTITUTIONAL CONSTRAINTS	RECOMMENDATIONS	REMARKS
Agriculture risk management	Delineation of risk zones for food production	Use climate risk assessment results	Current agro-climatic zones need to be further refined	Update existing agro-climatic zoning	Low-risk zones could focus on production surplus; high-risk zones on minimizing crop losses
	Application of seasonal forecasts for enhancing food production	ENSO index-based climate forecast to institutionalize CRM	Differing stakeholder institutional objectives Lack of decision support tools	Harmonize sectoral policy objectives Develop user-focused decision support tools Institutional reform	Potential return on one-time investment of US$ one million in terms of crop losses avoided in a season, is US$ 350 million
	Integrate CRM decision-support tools for food logistics management	Integrate seasonal forecasts into decision-making processes	Current forecast calendar does not permit seasonal forecast	Policy change to accommodate decision-support tools based on seasonal forecasts	Minimizing decision errors in forecast operation
	Reform the Climate Field School (CFS) program	Seamless integration of weather/ climate forecasts for risk management	Current institutional arrangement, under NDMG, needs reform	Refine CFS program based on evaluation studies	Flexible crop calendars and anticipatory risk management options extended to agricultural cooperatives

TABLE 6.1 CONTINUED

GOVERNMENT PRIORITY ON CCA	CLIMATE RISK MANAGEMENT OPTIONS	ROLE OF CRM	CURRENT POLICY AND INSTITUTIONAL CONSTRAINTS	RECOMMENDATIONS	REMARKS
Local level management	Identification of potential farm sites, based on agro-climatic parameters, and considering new crop and agriculture practices	Integrate climate data into land use planning	Lack of capacity to deliver climate data Weak institutional coordination mechanism	Build institutional coordination capacity	Wean away communities from current low-yielding subsistence farming to high-potential and sustainable farming, with reduced climate risk
	Integrate climate data for siting watersheds	Incorporate climate risk information for managing water resources	Weak coordination and lack of capacity	Use local institutions, with participatory system, and build technical capacity	Minimize drought and flood risks
	Crop diversification: improve traditional methods, integration of agro-forestry	Assess risk considering patterns of rainfall behaviour and trade-off options for different cropping systems	Less linkage between applied research through pilot demonstrations and policy support	Build institutional mechanisms to link research to policy	Climate resilience with less dependence on relief
	Livestock management: Group cattle farming with supply chain risk management Shift from extensive to intensive, with integration of agro-forestry	CRM-based decision-support tools to guide a comprehensive information for decision-making	No policy or institutional support to integrate CRM	Pilot demonstration project, awareness raising and capacity building	
	Supply chain management: provide an integrated risk management to address production, as well as market risks	Assessment of cascading risk from agriculture production to processing to delivery to purchasing power potentials	No systematic study on cascading impact of climate risk on supply-chain process	Applied research, advocacy and capacity building	

TABLE 6.1 CONTINUED

GOVERNMENT PRIORITY ON CCA	CLIMATE RISK MANAGEMENT OPTIONS	ROLE OF CRM	CURRENT POLICY AND INSTITUTIONAL CONSTRAINTS	RECOMMENDATIONS	REMARKS
Local level management	Food logistics management: CRM decision support tool	Forecast information for production and distribution linked with global market information	No policy and institutional capacities at agriculture to incorporate anticipatory risk management decision-making	Decision- support tools need to be developed	Rational climate-informed decision-making for export-import of food grains
	Non-farm income enterprise that is less sensitive to climate stress	Cascading impact of climate risk considering climate sensitivity of non-farm enterprises	No research and policy advocacy mechanism exists	Applied research and demonstration projects	Ensuring minimum climate risk to non-farm enterprise
CRM institutional mechanism	End-to-end CRM	User-relevant climate information generation, communica-tion, and application system, including user feedback	Existing system at national level includes NDMG and Ministry of Agriculture only Existing system at provincial level is response-focused	At national level, National Food Security Council, and Ministries of Trade and Power At provincial level, include NDMG and expand functions to include forecast-based impact analysis and identification of management options	Would require capacity building in forecast interpretation and translation
Capacity building	Robust, capacitated farmers, and local, provincial, and national institutions	Decision-relevant CRM tools could enable various institutions to undertake CRM depending on mandates and responsibi-lities	No decision-map based policy advocacy and capacity building mechanisms exist	Applied research, curriculum development and training to meet different needs and demands of the stakeholders	Well-informed, capacitated institutional system

Crop relocation and/or de-concentration of food crop production.

At present, paddy rice production is concentrated in coastal plains, with other crops that are grown throughout the country. Decentralization could be extended to areas that are productive and conducive for crop growth, taking into consideration current and future climate trends. Such approach could help limit the country's vulnerability to climate shocks.

Climate information as decision-support tool.

The Timor-Leste climate has very high climate predictability by using ENSO parameters and with advances in climate prediction, it is possible to generate climate information at different timescales and lending itself to application in food production. An El Niño forecast, with a lead time of nine to twelve months, can inform the exploitation of normally water-logged marginal lands, before drying up. The forecast could also inform water resource management planning for the longer dry season. A La Niña forecast can inform crop planning. For example, with early onset and late withdrawal of the wet season due to La Niña, planting and, hence, harvest could be advanced, freeing land for one additional crop. Seasonal forecasts can inform rice production projections. Absence of robust decision support tools has led to under-estimation of domestic food production and over-estimation of import requirements, causing depression of domestic food prices and subsequent losses to farmers. In some years, domestic food production was over-estimated and import requirements under-estimated, which led to food price increases that harmed net food consumers in both urban and rural areas. For high climate risk zones, design of risk management options could consider reduction of climate risk to agriculture (a high climate-sensitive sector) and promotion of agroforestry-based livestock system (a moderately climate-sensitive sector), with gradual shift to non-farm occupations (least climate-sensitive sector), in addition to being socially acceptable, environmentally sustainable, and economically viable.

Climate risk reduction in agriculture.

Climatic data could be used to anticipate inter-annual and intra-seasonal variability. For example, in a situation where corn is the only crop, if a normal monsoon is expected, planting could be advanced to July-September, thus taking advantage of the water that is still available from springs and water storage structures at that time of the seasonal cycle. Low-cost pumps could be used for this purpose.

Farmers could also consider crop diversification. Already, efforts are ongoing to grow hybrid maize and vegetables, like tomatoes and greens, particularly around water impounding structures. Heavy rain and strong winds during February constrain the scaling up of these initiatives into commercially viable enterprises. Through contract farming, supported by insurance instruments, this could shift farming from subsistence to market-oriented farming, in a risk management framework. Another risk management strategy is to build food and/or fodder reserves during the normal or above-normal seasons, for use during below normal years.

TABLE 6.2: DIFFERENTIAL IMPACTS OF 'INSUFFICIENT RAINFALL' AFFECTING MAIZE

SUPPLY CHAIN PARTICIPANT	WHAT IS EXPOSED TO RISK?	RISK /THREAT	CONSEQUENCE	HOW IMPACT IS MANIFESTED	EXPECTED MAGNITUDE OF LOSS
Small-scale farmer	Rain-fed maize production	No rains in key month	30% decreased yield, lower water table	Lower income, limits planting for next year	Medium income loss
Large-scale farmer	Irrigated maize production	No rains in key month	Need to increase irrigation	Increased irrigation costs (electricity and labor)	Minimal income loss
Food processor	Maize purchases for milling	No rains in key month	10% less maize available for purchase	Higher costs for maize	Minimal income if cost increases can be passed on
Urban retail and consumption	Processed maize	Changing maize prices	15% higher maize cost, potential compromise of nutrition/health	Less real income	Depends upon availability of affordable substitutes

Risk management measures could be incorporated into supply chain management. The first step would be an assessment of climate impact pathways (Table 6.2) and non-climate risks, such as credit, fertilizer, and seeds availability, and the role of market price in affecting a farmer's decision, through feedback pathways. Managing climate risk within the supply chain framework could pave the way for addressing production and market risks holistically.

Integration of agriculture and animal husbandry.

The Australian Centre for International Agricultural Research (ACIAR) has shown in Timor and Flores that forage legumes integrated into maize cropping systems increases maize yield by as much as 700 kg/ha due to improvement in soil nitrogen. The resulting high quality forage supply contributes to an increase in livestock production.

Agroforestry-based animal husbandry system.

There is a possibility to make use of research results from Nusa Tengara Timor or NTT (Indonesia) in Timor-Leste. Sobang's (1997)[1] research in Kupang District has shown that cattle husbandry in dry areas could contribute about 30 percent-70 percent to a farmer's income, depending on the number of stocks owned and forage type and availability. The Bali cattle, found in about 90 percent of Nusa Tenggara, is able to thrive and reproduce, with high conception rates, even under adverse climatic and nutritional conditions. Management systems to enhance calf survival and productivity are in place, such as early weaning of calves born in the dry season, use of communal pens, and mixed grass-legumes feeding. Bamaulin and Wirdahayati (2003)[22] reported that this system reduces the fattening period from 1.5 – 2 years to about 6 months. Other sources of forage could include tarramba (*Leucaena leucocephala*, high protein source), and palm pith and cassava (energy sources). Tarramba thrives even during the peak of the dry season, hence is a year-round source for high quality fresh forage. Harvest of tarramba seeds also provides additional income.

INFRASTRUCTURE

The adaptation assessment matrix for infrastructure is presented in Table 6.3, which identifies some options to manage the potential impacts.

TABLE 6.3 ADAPTATION ASSESSMENT MATRIX FOR INFRASTRUCTURE

CLIMATE	IMPACT	OPTIONS
Submergence	-Some roads may be submerged -Embankments may become dikes -Construction in deltas and rivers poses problems	Engineering Options: - While seawalls or realignment - works offer the lowest cost long term solution where sea level inundates an existing road the acquisition of land problems may arise. - Re-planting of mangroves, where - physically possible, provide a cost effective means to protect against wind and wave erosion.
Rising level of water tables in coastal zones	Reduction in the effectiveness of drainage which will lead to a reduction in the bearing capacity of the soils which will in turn become saturated	- Water table levels are expected to change in coastal areas, i.e. along with sea level changes. - Drainage system capacity should be checked where sea level changes result in roads being located near a sea shore.

TABLE 6.3 CONTINUED

CLIMATE	IMPACT	OPTIONS
Insufficient moisture to sustain the vegetative cover	Erosion	- The feasibility of replanting - with drought tolerant species is dependent on the availability of land being made available over a wide enough area to have an impact. - Bio-Engineering (e.g. Matting / erosion control blankets) may become expensive when applied - at larger scales, but also provide wider benefits (see below for further details)
Forest and bush fires	Increased erosion due to reduced ground cover.	- Re-planting with fire tolerant species in suitable habitat areas may be constrained by the availability of land. This hazard is not expected to be a significant risk in the immediate future.
Drying of materials in fill	Shrinkage problem: No uniform deformation in the case of fills on slopes. Problem of connections with engineering structures. Surface drying (skin effect) making the soil erodible	- This hazard is not expected to be a significant risk in the immediate future.
More runoff water	-Gully erosion, -More severe floods, -Water build-up, -Overflow and mud /debris -Landslides and slips of the slopes of fill or cut slopes	Engineering Options: - Additional culverts and higher bridges are effective but expensive. The effectiveness of bio remediation systems to reduce runoff will be limited by the soil profile and steep terrain which are common in Timor-Leste. - For engineering solutions to be effective, adequate routine maintenance must be performed continuously. - It is unlikely that land and cost constraints will restrict using only bio-retention systems. - Re-vegetation can be a community-based activity that provides income to villages along the roads, if coupled with maintenance contracts. A discussion on land ownership issues could be anticipated.
Raising of water tables and of penetration of greater volumes of water infiltration affecting the subsurface moisture content	-Reduced pavement failure and increased risk of pavement failure due to water saturation. -Subsidence and collapse caused by natural or manmade underground cavities -Collapse of fill	Engineering Options: - The effectiveness of bioremediation systems to reduce runoff will be limited by the soil profile and steep terrain commonly found in Timor-Leste. Poor maintenance will render higher number of culverts ineffective. Bio-retention systems may have to be built in areas outside the ROW, which could be problematic due to land ownership issues. Re-vegetation can be a community-based activity - that provides income to villages along the roads, if coupled with maintenance contracts. Potential land ownership issues.

TABLE 6.3 CONTINUED

CLIMATE	IMPACT	OPTIONS
Increased wind (particularly for coast) Fallen trees Dune advance Wind erosion	Inadequate strength of vertical signing, particularly poles and gantries	- Re-planting of mangroves and coastal forests in suitable habitat areas provides wider benefits and is relatively inexpensive. However, it does not provide complete - protection, as some risk areas may not be suitable for mangrove re-planting.

Adapted from World Bank Document on Timor-Leste Road climate resilient road project 2009-2011

The previous section on infrastructure-related recommendations can thus be summed up as efforts to support the development of the existing capacities of the respective authorities and institutions. The recommended support will for example enable the Ministry of Infrastructure to better prepare for specific threats and to take remedial measures.

KEY MESSAGES: RECOMMENDATIONS FOR CLIMATE RISK MANAGEMENT

- To reduce climate risks for agriculture and infrastructure sector, efforts are needed to develop institutional and capacity mechanisms that will support integration of Climate Risk Management into all climate sensitive sectors.

- Establishing long-term coordination function can be achieved by enhancing information sharing between exisiting institutions and concerned Government ministries responsible disaster riks reduction and climate change adaptation policies and interventions.

- To develop capacities of key institutions on climate risk management, a needs assessment has to be undertaken taking into account relevant climate information and elements such as (i) users' information requirements, (ii) tailoring of climate information to users' needs (iii) characterizing and packaging uncertainties associated with climate information of different timescales, (iv) interpretation and translation of climate information, (v) application in a risk management framework and (vi) demonstration of the economic benefits in using climate information and adopting the CRM framework.

- Climate risk management actions identified to minimize climate risks on agricultural sector are (i) utilizing climatic data and tools such as ENSO to anticipate inter-annual and intra-seasonal variability, (ii) crop diversification, (iii) building food and /or fodder reserves during the normal or above-normal seasons, (iv) incorporating risk management measures into supply chain management by assessing climate impact pathways and (v) adopting agroforestry-based animal husbandry system.

- Key structural engineering and non-structural climate risk management actions to reduce potential impacts on infrastructures are (i) mangrove rehabilitation, (ii) inspection of drainage system capacity, (iii) adopt bio-engineering and bio-remediation systems and (iv) planting of fire tolerant species.

REFERENCES

1. NSDP, 2010. Republica Democtarica de Timor Leste, 2010. "Timor Leste National Strategic Development Plan 2011-2030", p.11

2. NSD, 2011. National Statistics Directorate and United Nations Population Fund, 2011. "Population and Housing Census of Timor Leste, 2010. Volume 2: Population distribution by administrative areas" page xxi

3. National Statistics Directorate, Ministry of Finance, 2010. Demographic and Health Survey, 2009-10.

4. Barnett, J., et al., 2007. "Vulnerability to climate variability and change in East Timor"

5. FAO, 2010. Forest Department, Food and Agriculture Organization of the United Nations (FAO). Global Forest Resources Assessment 2010 Country Report, Timor-Leste. Estimated change in forested area is based on partial study, hence annual loss of forest may be underestimated.

6. Keefer, G. 2000. Report on the Restoration of Meteorological Network – Timor Loro Sae. Report II, United Nations Transitional Administration in East Timor

7. NDMG, 2011. Pacific Climate Change Science Program partners, 2011. "Current and future climate of Timor Leste"

8. Silva & Moniz, undated: Climate, climate variability and change of Timor-Leste, Pacific Climate Change Science Program.

9. Monk K., de Fretes Y., Lilley GR. (1997), 'The ecology of Nusa Tenggara and Maluku. The ecology of Indonesia series, Volume V.' Periplus Editions.

10. AK-2010: Acil C, KWK Consulting (2010), "Final Report, Preparing the Road Network Development Project – TA 7100, Volume III, Climate Change Assessment", Ministry of Infrastructure: Timor-Leste.

11. CSIRO & BoM. (2007), 'Climate Change in Australia.' CSIRO and Australian Bureau of Meteorology technical report, 150 pp available at www.climatechangeinaustralia.gov.au.

12. Katzfey J, McGregor J, Nguyen K, Thatcher M. (2010), 'Regional climate change projection development and interpretation for Indonesia.' Final Report to AusAID. CSIRO Climate Adaptation Flagship, Australia.

13. O'Farrell S. (2008), 'Regional sea level rise around the Australian coastline.' Extended Abstract, 2nd CAWCR Modelling Workshop 2008. High Resolution Modelling. Melbourne, Australia.

14. CSIRO. (2010), Sea level projections at http://www.cmar.csiro.au/sealevel/sl_proj_21st.html

15. Hunter JR. (2010), 'Estimating Sea-Level Extremes Under Conditions of Uncertain Sea-Level Rise'. Climatic Change, 99, 331-350. doi:10.1007/s10584-009-9671-6.

16. Steffen, W. (2009), 'Climate Change 2009: Faster Change & More Serious Risks'. Australian Department of Climate Change, Australia.

17. MED, 2010: National Adaptation Programme of Action (NAPA) on Climate Change, December 2010. Ministry of Economy and Development, Democratic Republic of Timor-Leste.

18. In economics, the Dutch disease is the apparent relationship between the increase in exploitation of natural resources and a decline in the manufacturing sector. The mechanism is that an increase in revenues from natural resources (or inflows of foreign aid) will make a given nation's currency stronger compared to that of other nations (manifest in an exchange rate), resulting in the nation's other exports becoming more expensive for other countries to buy, making the manufacturing sector less competitive. While it most often refers to natural resource discovery, it can also refer to "any development that results in a large inflow of foreign currency, including a sharp surge in natural resource prices, foreign assistance, and foreign direct investment

19. https://www.google.com/search?q=napa+timor+leste&oq=napa+timor+leste&aqs=chrome.0.57.4859j0&sourceid=chrome&ie=UTF-8

20. Benevides, 2003: Cropping systems in East Timor. Agriculture: New Directions for a New Nation East Timor (Timor-Leste) Workshop proceeding.

21. Sobang, 1997. Sobang, U.L. 1997. Karakteristik Sistem Penggemukan Sapi Pola Tradisional Menurut Zona Agroklimat dan Dampaknya Terhadap Pendapatan Petani di Kabupaten Kupang NTT. Thesis PPS. IPB Bogor.

22. Bamaulin and Wirdahayati, 2003

- 1995-2012 ITA, 2012. "Roving food security in Timor Leste to end 'hungry season'"

- ACIAR, 2003. "Agriculture: new directions for a new nation. East Timor (Timor Leste)

- ACIAR. "Rebuilding Agriculture in East Timor"

- ADB, 2002. "Promoting effective water management policies and practices." Report of Water Resources and Environmental Specialist, Phase I

- Barnett, J., 2003. "Climate Change in Timor Leste"

- Barnett, J., 2003. "Vulnerability and adaptation to climate change in Timor Leste"

- Barnett, J., et al., 2003. "Climate change in Timor Leste: science, impacts, policy and planning. Briefing to government, civil society, and donors, Republica Democratica de Timor Leste"

- CARE International. "Livelihood Security in a changing climate"

- CDERA, 2003. "Adaptation to climate change and managing disaster risk in the Caribbean and South East Asia. Report of a seminar"

- Chamber of Commerce and Industry of Timor Leste, 2011. "Agribusiness Investment in Timor Leste: Guidelines supporting Win-Win Outcomes"

- Commonwealth Bureau of Meteorology, 2002. Parliamentary inquiry on building Australia's relations with Indonesia.

- Costin, G. and Powell, B., 2006. "Situation Analysis Report – Timor Leste"

- CSIRO, 2010. "Climate change in Timor Leste – a brief overview on future climate projections"

- CSIRO Australia, 2006. "Infrastructure and climate change risk assessment for Victoria. Report to the Victorian Government 2007"

- Da Costa, H., 2003. "The evolution of agriculture policies in East Timor"
- Dolcemascolo, G., 2003. Presentation on "Climate risk and agriculture in Timor Loro Sae"
- EHA in the WHO South-East Asia Region. "Emergency and Humanitarian Action Country Report"
- European Commission, 2007. "Disaster Preparedness in Timor Leste"
- FAO and WFP, 2003. "Special Report. FAO/WFP crop and food supply assessment mission to Timor Leste"
- FAO and WFP, 2007. "FAO/WFP crop and food supply assessment mission to Timer Leste"
- FAOSTAT. Yield of maize in Timor Leste – 1961-2009.
- Fox, J., 2003. Drawing from the past to prepare for the future: responding to the challenges of food security in Timor Leste"
- IMF, 2005. "Democratic republic of Timoe Leste: poverty reduction strategy paper – national development plan, road map for implementation of national development plan, overview of sector investment programs – strategis and priorities for the medium term
- IMF, 2011. "Democratic Republic of Timor Leste: 2010 Article IV Consultation – Staff Report; Joint World Bank/IMF Debt Sustainability Analysis; Staff Statement; Public Information Notice on the Executive Board Discussion; and Statement by the Executive Director for Timor Leste"
- International Federation of Red Cross and Red Crescent Societies, 2007. "East Timor: Floods"
- International Federation of Red Cross and Red Crescent Societies, 2008. "Recovery and risk reduction through livelihood support in Timor Leste"
- International Federation of Red Cross and Red Crescent Societies, 2011. "Mid-Year Report-Timor Leste"
- International Federation of Red Cross and Red Crescent Societies Information Bulletin No.1, 2004. "Timor Leste – Floods"
- International Federation of Red Cross and Red Crescent Societies Information Bulletin, 2006. Timor Leste: strong winds and flash floods
- International Labor Office, 2007. "Evaluation Summaries. Evaluation: Rural Development Programme for Timor Leste (RDP) – Skills Training for Gainful Employment (STAGE)
- Jarvis, P., 2008. "A proposal to establish a rice development corporation in Timor Leste to coordinate and fast-track the development of the rice industry"
- JICA, 2009. "JICA Timor Leste Information Sheet"
- JIRCAS, 2010. "Guideline on how to support the revitalizing of rural communities"
- Leeming, D., 2003. "Challenges for sustainable rural networking in Solomon Islands: the people first network"
- Lopes, M. and Nesbitt, H., 2012. "Improving food security in Timor Leste with higher yield crop varieties"
- MAFF, 2007. Map on "Agro-climatic zones"
- Ministry of Agriculture and Fisheries, Agribusiness Division, 2008. "Agribusiness Timor Leste". Volume 3, Issue 1.

- Ministry of Agriculture and Fisheries, National Directorate of Fisheries and Aquaculture, 2012. "Timor Leste National Aquaculture Development Strategy (2012-2030)"
- Ministry of Infrastructure, Timor Leste. "Final Report. Preparing the Road Network Development Project – TA 7100". Volume III. Climate Change Assessment.
- Ministry of Infrastructure, Timor Leste. "Final Report. Preparing the Road Network Development Project – TA 7100". Volume II – Part D. Poverty and Social Assessment
- Molyneux, N., et al., 2012. "Climate change and population growth in Timor Leste: implications for food security"
- Montgomery, R., et al., 2010. "Farm Risk Reduction Assessment for Nusa Tenggara Islands, Indonesia"
- Naswa, P. and Garg, A., 2011. "Managing climate-induced risks on Indian infrastructure assets"
- National Statistics Directorate, 2010. "Timoe Leste demographic and health survey 2009-10"
- NSD, 2011. National Statistics Directorate and United Nations Population Fund, 2011. "Population and Housing Census of Timor Leste, 2010. Volume 2: Population distribution by administrative areas"
- Noltze, Martin et al., 2012. "Farm diversity and heterogeneous impacts of system technologies on yield, income and poverty: the system of rice intensification in Timor Leste"
- Oxfam, 2003. "Overview of the coffee sector in Timor Leste"
- Pacific Climate Change Science Program. "Climate, climate variability and change of Timor Leste"
- NDMG 2011. Pacific Climate Change Science Program partners, 2011. "Current and future climate of Timor Leste"
- Piggin, C. and Palmer, B., 2003. "An introduction to the ACIAR project "Seeds of Life-East Timor"
- Republica Democratica de Timor Leste, 2003. "First National Workshop on Climate Change Proceedings"
- Republica Democratica de Timor Leste, 2010. "National Adaptation Programme of Action (NAPA) on climate change"
- Republica Democratica de Timor Leste, 2005. "National Disaster Risk Management Plan"
- Republica Democtarica de Timor Leste and UNDP, 2009. "The Millennium Development Goals, Timor Leste"
- Republica Democratica de Timor Leste, 2010. "State Budget 2011 Budget Overview, Book 1"
- Republica Democratica de Timor Leste, 2011. "State Budget 2012 Budget Overview, Book 1"
- Republica Democratica de Timor Leste, 2011. "State Budget 2012 Development Partners, Book 5"
- Republica Democratica de Timor Leste, 2011. "A citizen's guide to the 2012 State Budget of the Democtaric Republic of Timor Leste"
- Republica Democratica de Timor Leste, Ministry of Social Solidarity, 2008. "National Disaster Risk Management Policy"
- Sandlund, O. "Assessing environmental needs and priorities in East Timor: issues and priorities"
- Seeds of Life, 2006. "Annual Research Report 2006"

- The World Bank. "Community-based development and infrastructure in Timor-Leste: Past experiences and future opportunities"

- The World Bank. "Country and Lending Groups". http://data.worldbank.org/about/country-classifications/country-and-lending-groups#Low_income

- The World Bank. "News and Broadcast. Timor Leste Road Climate Resilience Project". http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:22917104~pagePK:64257043~piPK:437376~theSitePK:4607,00.html

- The World Bank, 1999. "Report of the Joint Assessment Mission to East Timor"

- The World Bank, 2008. "Reducing the Risk of Disasters and Climate Variability in the Pacific Islands. Timor Leste Country Assessment"

- The World Bank, 2011. "Project appraisal document on a proposed grant in the amount of SDR12.7 Million (USD20 Milion equivalent) to the Democratic Republic of Timor Leste for the Road Climate Resilience Project"

- UNDP, 2009. "Initial National Communication under the UN Framework Convention on Climate Change for Timor Leste"

- UNDP, 2011. "Timor Leste Human Development Report 2011. Managing natural resources for human development. Developing the non-oil economy to achieve the MDGs"

- USAID, 2006. "Sustainable improvements in upland agriculture productivity and incomes in Timor Leste"

- USAID, 2011. "Mapping fisheries dependence and aquaculture development in Timor Leste: a scoping study"

- WFP, 2005. "Food insecurity and vulnerability analysis-Timor Leste"

- WFP, 2006. "Comprehensive Food Security and Vulnerability Analysis (CFSVA)

- WFP, 2006. "Timor Leste Pre-Crisis Market profile. Strengthening Emergency Needs and Assessment Capacity Project"

- WFP, 2009. "Final report. Evaluation of WFP Timor Leste PRRO 10388.1 assistance to vulnerable populations"

Empowered lives.
Resilient nations.

For more information: **www.undp.org**

United Nations Development Programme

One United Nations Plaza • New York, NY 10017 USA