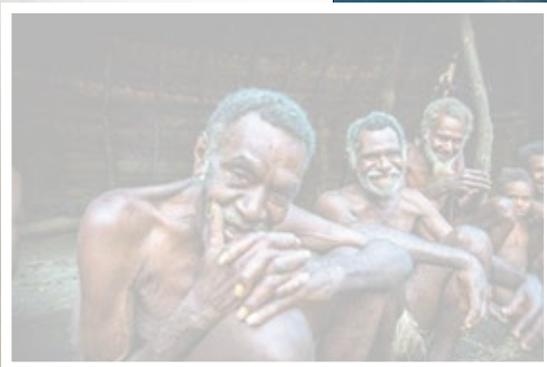




# REPUBLIC OF VANUATU

## Second National Communication to The United Nations Framework Convention on Climate Change (UNFCCC)

September - 2014



Empowered lives.  
Resilient nations.



## Foreword

Climate change is one of the key issues of our generation. Small Island Developing States (SIDS) has been recognised by the United Nations Framework Convention on Climate Change (UNFCCC) and Intergovernmental Panel on Climate Change (IPCC) as the most vulnerable countries to face the effects of climate change. Vanuatu being a part of SIDS share similar challenges.

Vanuatu is extremely vulnerable to natural disasters including the risks of climate change, climate variability and sea level rise. According to the Commonwealth Vulnerability Index, Vanuatu ranks as the world's most vulnerable country for natural calamities. Climate change is likely to impact all sectors that are pertinent to the sustainable development of Vanuatu.

Vanuatu anticipates many impacts from climate change on its society, economy, environment and human health and this Ministry is actively cooperating with United Nations agencies and international partners to assess these effects and develop appropriate plans through climate change adaptation and mitigation.

Vanuatu is classified as a non-Annex I country under the UNFCCC. The country has ratified the Climate Change Convention in 1993 and the Kyoto Protocol in 2001. Vanuatu has also appointed a Designated National Authority (DNA) to fulfil its obligations under the Kyoto Protocol, thereby supporting the implementation of sustainable development projects in Vanuatu under the Clean Development Mechanism (CDM) that will lead to the reduction of greenhouse gases regulated by the Kyoto Protocol.

It gives me great pleasure to state that Vanuatu has created a new ministry (Ministry for Climate Change Adaptation, Meteorology, Geo-Hazards, Environment, Energy and Disaster Management) to mainstream the country's efforts to address climate change and disaster risk management.

Vanuatu's National Adaptation Programmes of Action (NAPA) states that all economic and social sectors are likely to be adversely affected by climate change. The cost of adaptation is expected to be disproportionately high relative to the nation's Gross Domestic Product (GDP). The Ministry is working together with various agencies and stakeholders to make practical and locally appropriate climate change adaptation technologies available to people in Vanuatu who are already experiencing the effects of climate change.



Hon. Thomas LAKEN

Minister of Climate Change, Meteorology & Geo-Hazards,  
Environment, Energy and Disaster Management

# Executive Summary

## National Circumstances

The Republic of Vanuatu is an island nation located in the Western Pacific Ocean. The country is an archipelago of over 80 islands stretching 1,300 kilometres from North to South. Vanuatu's terrain is mostly mountainous, with narrow coastal plains larger islands are characterised by rugged volcanic peaks and tropical rainforests. Vanuatu is located in a seismically and volcanically active region and has high exposure to geologic hazards, including volcanic eruptions, earthquakes, tsunamis and landslides.

Vanuatu's climate is characterised by variable rainfall and high humidity, near-uniform temperatures throughout the year, winds dominated by the south-easterly trade winds and the occurrence of tropical cyclones during the southern-hemisphere summer. Vanuatu has two main seasons, hot and wet from November to April, and cool and dry from May to October. Vanuatu's latitude places it in the path of tropical cyclones, and it is subject to cycles of El Niño and La Niña, which, respectively, increase the risks of droughts and floods. Vanuatu is also vulnerable to anomalously long dry spells that coincide with the El Niño Southern Oscillation (ENSO).

Vanuatu's total land area is about 12,336km<sup>2</sup> with more than 36.1% (440,000 hectares) covered by tropical forest. By 2006, about 4,800 hectares were covered with planted forests; about 3% of the mid-to high forest (about 6,000 hectares) and 0.7% of the low forest (about 1,400 hectares) are in protected areas. Vanuatu has some 108 known species of amphibians, birds, mammals and reptiles and also home to at least 870 species of vascular plants. The region is also rich in sea life, with more than 4,000 species of marine molluscs. Coral reef systems fringe most islands in Vanuatu; the Reef Islands are a cluster of coral cays between Mota Lave and Ureparapara, in northern Vanuatu. Mangroves are also an important part of the ecosystem of Vanuatu, including sea grass beds and other near-shore marine ecosystems.

In 2009, the population of Vanuatu was 234,023 (51% Male and 49% Female); which represents an average annual growth rate of 2.3% per year since the last Census in 1999 (186,678). The urban and rural population is increasing with an average rate of 3.5% and 1.9% per year since 1999.

Vanuatu has a high adult literacy rate of 82% (ages 15 and older, 2011), which includes 81.5% females (ages 15 and above) and 84.5% males (age 15 and above). The literacy rate of females and males between the ages 15-24 is 94.7% and 94.4% respectively. The ratio of girls to boys in primary and secondary was 88% in 1991 rising to 97.32% in 2010 with much better progress in secondary education. In 2011, total enrolment in primary schools was 42,352 and total enrolment in secondary schools was about 18,064. The Vanuatu government and education system faces various challenges of responding to a fast growing population, growing demands and expectations from parents and students and communities, and from the formal economy.

Vanuatu has moderate health services; however it has very good estimated life expectancy at birth: 69.6 years for males and 72.7 years for females (as per 2009 Census). Communicable and non-communicable diseases are main priority diseases for Vanuatu. Vanuatu's health sector strategy has four broad objectives i.e. improve the health status of the population, ensure equitable access to health services at all levels of services, improve the quality of services delivered at all levels and promote good management and the effective and efficient use of resources.

Vanuatu has a small and developing economy, with a GDP of Vatu 72,278 million (current prices). Real GDP growth averaged 6.5% for 2004–2008, and then slowed to 3.3% in 2009, 1.6% in 2010, 1.2% in 2011 and about 1.8% in 2012. Vanuatu has a classic dual economy; the subsistence and the cash economy and it is heavily dependent on natural resources. Approximately 80% of the population engages in subsistence agriculture, contributing about 10% to Vanuatu's gross domestic product (GDP). Vanuatu's exports comprise mainly agricultural commodities and tourism related services; however the imports are significantly higher than exports of goods. Vanuatu's fisheries resources are under-exploited even though the fisheries sector has good potential. Vanuatu has a small light-industry sector mainly catering to the local market. The industry sector (Mining and Quarrying, Manufacturing, Electricity and Water Supply, Construction) contributed about 8% of current price GDP in year 2012. Vanuatu's economy largely depends on service sector, which contributes about 61% to GDP (2012). The Services Sector is dominant in terms of value added but its growth has been very unstable and in terms of labour it involves only the 30% of the population.

Vanuatu's national vision is "An Educated, Healthy and Wealthy Vanuatu". The goal of the Government of Vanuatu (GoV) is to raise the welfare of its people, and main agendas for action include growing the productive sector, especially agriculture and tourism, maintaining macroeconomic balance, raising public service performance, cutting costs associated with transport and utilities, and improving access to basic services such as health and education. Government of Vanuatu is committed to achieving MDG goals and targets and significant progress has been made towards achieving the MDG Goals.

## National Circumstances

The Vanuatu's Inventory for Greenhouse Gases has been calculated for the base year 2000 using the revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. The UNFCCC software "Non Annex1 National Greenhouse Gas Inventory Software, Version 1.3.3" has been used for the estimation of GHG. Sectoral data for GHG estimation was compiled from various sources primarily using national data collected from annual reports, statistical reports, studies and brochures of related department/institutions. In year 2000, the total GHG emissions by sources and removals by sink for Vanuatu was 585.39Gg CO<sub>2</sub>eq (excluding removals); which comprises of 70.34Gg CO<sub>2</sub>e from Energy; 502.83Gg CO<sub>2</sub>e from Agriculture and 12.21Gg CO<sub>2</sub>e from Waste Sector. Emissions from per fluorocarbons (PFCs), hydro fluorocarbons (HFCs) and sulphur hexafluoride (SF<sub>6</sub>) in Vanuatu are negligible, as the products containing these gases are not produced in the country. CO<sub>2</sub> sequestration by the forestry and land use sector in year 2000 amounted to 7,913.16Gg CO<sub>2</sub>e. Total GHG emissions, including FOLU, are estimated to be (-) 7327.77Gg CO<sub>2</sub>e, indicating that Vanuatu is a net sinks for GHG emissions.

Nearly 99% of GHG emissions in Vanuatu come from five activities: energy, transport, livestock, N<sub>2</sub>O from agriculture soils and waste. The largest contributor to GHG emissions in year 2000 was livestock

sector amounting to 56.5% of total GHG emissions. The next biggest contributor was N<sub>2</sub>O from agriculture soils with 29.4% of GHG emissions followed by transport sector which contributed to 5.9% of total emissions. Greenhouse gases covered in this analysis include CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O are estimated to be 12% CO<sub>2</sub>, 31% N<sub>2</sub>O and 57% CH<sub>4</sub> of the total GHG emissions.

In 2000, Vanuatu emitted 69.16Gg CO<sub>2</sub>e which is a 26% increase since the first inventory, which was published in 1999 and covered emissions for base year 1994. The energy sector is the main source of CO<sub>2</sub> emissions and mainly due to combustion of fossil fuel. Net CH<sub>4</sub> emissions in Vanuatu are estimated to be 15.85Gg and have increased by 43.1% from the year 1994 mainly due to increased livestock farming and improper waste management. Net N<sub>2</sub>O emissions in Vanuatu are estimated to be 0.58Gg which translates to 31% of total GHG emissions in 2000 mainly from agriculture sector. Emissions from the AFOLU sector, per-fluorocarbons (PFCs), hydro-fluorocarbons (HFCs) and Sulphur hexafluoride (SF<sub>6</sub>) were not considered in the 2000 GHG inventory.

The GHG emission for Vanuatu for the year 2005 and 2010 has also been calculated based on the similar data source and methodology used for estimation of GHG emissions for year 2000. The quantity of CO<sub>2</sub> emissions increased from 585.39Gg CO<sub>2</sub>e in 2000 to 720.66Gg CO<sub>2</sub>e in 2010.

## Vulnerability and Adaptation (V&A)

In Vanuatu, life and culture are interdependent and are strongly related to land, ocean and environment. The changes in climate parameters and adverse impacts related to climate variability and change are a significant threat to the biodiversity and ecosystems, the lives of its people and the economic viability of the islands.

Vanuatu faces a full range of geologic and climatic hazards and is also subjected to climatic variability and extremes. Future climate change and sea-level rise threaten to exacerbate the risks posed by tropical cyclones, coastal and river flooding, coastal erosion, land-slides, hailstorms, heavy rainfall events, and droughts. Climate-related disasters have had huge impacts on the economic growth and national development.

Impacts of climate variability and change are evident on most of Vanuatu's islands. The sea surface temperature changes around Vanuatu are consistent with the region. Water temperatures remained relatively constant from the 1950s to the late 1980s. This was followed by a period of more rapid warming (approximately 0.09°C per decade from 1970 to present). Ocean acidification indicator i.e. aragonite saturation state in Vanuatu has declined from about 4.5 in the late 18th century to an observed value of about  $3.9 \pm 0.1$  by 2000. The sea-level rise near Vanuatu measured by satellite altimeters since 1993 is about 6 mm per year, larger than the global average of  $3.2 \pm 0.4$  mm per year.

Over the course of the 21st century, surface air temperature and sea surface temperature are projected to continue increasing. Warming is physically consistent with rising greenhouse gas concentrations. Projections of annual mean rainfall tend to be equally divided between an increase (>5%) and little change (-5% to 5%) by 2090, with only a few models simulating a decrease (<-5%). Further, the intensity and frequency of days of extreme rainfall are projected to increase; extreme rainfall is consistent with larger-scale projections, based on the physical argument that the atmosphere is able to hold more water vapour in a warmer climate. The frequency of mild drought will remain approximately

stable from 2030 throughout the 21st century at seven to eight times every 20 years. Tropical cyclone numbers are projected to decline in the southwest Pacific Ocean basin (0–40°S, 130°E– 170°E) over the course of the 21st century. Sea level rise is projected between approximately 5cm –15cm by 2030, with increases of 20cm – 60cm indicated by 2090 under the higher emissions scenarios.

The Vanuatu's future climate projections show growing climate and disaster risks. Climate change is likely to impact on all economic sectors that are pertinent to the sustainable development of Vanuatu.

The GoV recognises that effective institutions and the inter-relationships between them are at the heart of its ability to respond to growing climate and disaster risks. For this reason, the Government has undertaken a major reform of national climate and disaster risk governance by establishing the Ministry of Climate Change and the National Advisory Board on Climate Change & Disaster Risk Reduction (NAB). The NAB is tasked to provide the strategic direction required for the country to navigate the complex current and future climate and disaster risks.

The “Profile of Risks from Climate Change and Geo-hazards in Vanuatu” outlines the major climate change impacts and geo-hazards for Vanuatu, which corroborate and build on Vanuatu's 2007 National Adaptation Programme of Action (NAPA). The Risks report describes the activities and results of the risk profiling activity. The sectors considered in this assessment to be most vulnerable for climate change are: Agriculture (crops, cattle and sustenance), Fisheries (freshwater, coastal, deep sea, aquaculture), Forestry (including mangroves and production forest), Tourism (cruise-ships, hotels), Transport (road, ferries, and air), Infrastructure (utilities [energy, water, and sanitation], houses, offices, and industry) and Health.

Vanuatu has an agriculture-based economy with at least 80% of the population residing in the rural areas and depending on subsistence agriculture for their livelihood. Any changes in rainfall distribution, both in terms of the amounts of rain and its spatial as well as temporal distribution could have severe impacts on agricultural production. Drought combined with higher temperatures would lead to greater evaporation, reduced availability of water for agriculture and added thermal stress on plants.

Variability of rainfall will increase the demand for drought-resistant crops in drier areas and for water tolerant crops in wetter areas. Farmers may modify their crop calendars, shift their cropping patterns, diversify the crops grown, or completely shift out of crop agriculture. Overall, it is expected that agriculture loss in Vanuatu from climate change outweigh any projected benefits. The risks include crop losses from excess heat and drought on the one hand, and oversaturation of soil and physical damage from increased rainfall on the other.

Water resources are already extremely sensitive to changes in precipitation in small islands and are therefore highly vulnerable to climatic changes. Most of Vanuatu's urban centres and outer islands are dependent on ground water for drinking, given the limited availability of surface water. Increased temperatures are likely to increase the demand for potable water. Increased radiative load, greater run-off from high intensity rainfall events, decreased rainfall and associated increase in evaporation could reduce the rate of ground water recharge.

Soil degradation is an important issue affecting agriculture. The traditional practice of shifting cultivation that allowed the soil to go through a process of regeneration by being left idle for extended periods ranging from 5-10 years is no longer possible. The numerous effects of climate change and variability:

cyclones, flash floods, high rainfall, high temperature and long dry periods will make agricultural production very challenging in Vanuatu.

The production of beef, pork, poultry, sheep and goat for local consumption forms an essential part of the rural economy. Climate change is likely to have a far greater effect on the small farmers compared to the larger commercial operations.

The Fisheries sector is vulnerable to the impacts of climate change due to enhanced coastal erosion, sedimentation and inundation. The projected impacts from climate change (increase in surface water temperature, ocean acidification) under different emission scenarios will directly affect the oceanic fish habitat (coral reefs, mangroves, sea grasses and intertidal flats) and food webs. Climate change is likely to have a direct impact on marine resources through its effect on marine ecosystems, while enhanced sedimentation due to soil erosion from agricultural and forestry practices would have a profound effect on the availability of marine resources.

The forests are a vital part of the country's cultural heritage and contribute to the welfare and economic development of the people. The detailed assessment on the effects of climate change on this important sector is currently not available. However, the effects of rainfall distribution, temperature and other climate stresses are likely to impact negatively on many tree species and the rich forest biodiversity. It has been observed that there is a change in the flowering and fruiting patterns of certain forestry crops and there appears to be an increase in the incidence of pest and diseases in species. Given the envisaged impact of extreme climatic events on the forestry sector, sustainable forest management is crucial for Vanuatu.

Tourism is increasing in importance as one of the key foreign exchange earners for Vanuatu. Much of the infrastructure, support services and the attractive features for the tourists are situated in the coastal areas. Increased sea level rise and coastal degradation is likely to have significant impact on this sector. The infrastructure and other fixed assets are extremely vulnerable to cyclone and storm surges.

The health sector in Vanuatu is likely to be severely impacted due to the projected climatic changes. Malaria is already endemic to certain areas of Vanuatu and there is some evidence to suggest that these areas are extending southwards. Other tropical and vector borne diseases such as dengue and water related diseases such as dysentery and diarrhoea are also likely to increase. Other problems associated with the increased temperature, such as contamination of food and heat stress are likely to exacerbate..

Adaptation to climate change and risk management of natural hazards is one of the core development issues for Vanuatu. In 2007, Vanuatu completed its National Adaptation Programme of Action (NAPA), which outlined the most urgent and immediate needs with respect to climate change and identified several priority sectors (Agriculture/Food Security, Coastal Zones and Marine Ecosystems, Water Resources and Public Health) for action.

Since 2007 the NAPA has been implemented in a de-facto way via a surge in government and non-government action on adaptation in all sectors.

Adapting to climate change and variability is a serious and urgent need for Vanuatu, which is

progressing rapidly with the collaboration of many government and non-government partners. The main problem with assessing the impact of climate change and in identifying a cost-effective response is the uncertainty surrounding estimates of the time and magnitude of the changes to be expected.

Despite the great success of literally thousands of adaptation actions taken by a myriad of partners in Vanuatu, much still needs to be done to ensure that Vanuatu is able to reduce the impact of climate change on areas that are already vulnerable and at the same time effectively protect others that are at risk from future changes.

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Adapting to climate change and variability is a serious and urgent need for Vanuatu, which is progressing rapidly with the collaboration of many government and non-government partners. The main problem with assessing the impact of climate change and in identifying a cost-effective response is the uncertainty surrounding estimates of the time and magnitude of the changes to be expected.

Despite the great success of literally thousands of adaptation actions taken by a myriad of partners in Vanuatu, much still needs to be done to ensure that Vanuatu is able to reduce the impact of climate change on areas that are already vulnerable and at the same time effectively protect others that are at risk from future changes.

## Mitigation

Vanuatu is committed to formulating strategies, national policies and best practices for addressing GHG emissions and making a practical contribution to the global mitigation efforts. While at the same time the country is also pursuing its national and regional development priorities and sustainable development objectives. This is planned to be achieved by integrating GHG abatement efforts with other social, environmental and economic priorities.

Energy is one of the crucial development indicators in any country and like the other Pacific Island Countries; Vanuatu's primary energy needs are mainly met by imported petroleum fuel. The majority

of electricity is produced from Diesel (67%) followed by Copra oil (14.3%), Hydro Power (10.3%), Wind Power (8.1%) and Solar Power (0.2%). Vanuatu is exploring opportunities to further utilize the renewable energy sources such as hydro, solar, biomass, wind, and coconut bio-fuel and geothermal.

Transportation infrastructure development is one of the priority sectors for Vanuatu and with this view the Government has initiated a long term Vanuatu Transport Sector Support Program (VTSSP). GoV is also focusing on mitigation options for emissions from land, sea and air transport sectors. Measures include public transportation awareness programmes, vehicle emission standards, promoting fuel-efficient and alternative fuel vehicles, improving public transport services, introducing financial incentives to encourage energy efficiency and promoting non-motorized transport.

The GHG emissions from the agriculture and waste sectors make a significant contribution to GHG emissions from Vanuatu. However the limited resources (financial and technical) poses a larger challenge in planning and implementation of GHG mitigation measures.

The GoV has also revised the 1997 National Forest Policy and developed the “Vanuatu Forest Policy 2011 – 2020” for the sustainable development and management of the forestry sector. The new forestry policy presents clear directives (short-term, urgent, medium-term, and long-term) supported by implementation strategies including timelines and responsibilities.

Vanuatu is an active participant in Pacific island regional affairs and has signed on to a number of regional policies and initiatives that have implications for climate change mitigation.

## Other Information

**National Energy Road Map 2013-2020:** The Government has developed a National Energy Roadmap 2013-2020 with an overall vision to “energize Vanuatu’s growth and development through the provision of secure, affordable, widely accessible, high quality, clean energy services for an educated, healthy and wealthy nation”. The Road Map directly responds to objectives in the energy sector from a national development perspective, key constraints and projects financing requirements for the energy sector implementation program timeframe 2013-2018.

The GoV has identified targets for the petroleum sector to achieve the vision of more reliable, secure, and affordable petroleum supply to be achieved by 2015 and 2020. The Government has also set targets to ensure Vanuatu achieves universal electricity access by 2030 to households (estimated 53,000 HH), social service institutions (health and education), as well as commercial establishments. It also aims to ensure that energy efficiency improvements can be achieved in the future and a comprehensive data collection is established and in effect by 2015.

The Government is committed to deliver vital social services and basic infrastructure including electricity to enable the well-being of all citizens – households, communities and institutions - and in a timely manner, irrespective of where they live. The least cost electrification strategic approach has been tailored considering the varied topography and varying degree of nucleation of the individual communities and households.

**Renewable Energy Opportunities:** Renewable energy is envisaged to contribute to improving energy security. In the off grid and remote areas of Vanuatu, on-going studies indicate that renewable energy can make a significant contribution to improve livelihoods of ni-Vanuatu. Renewable technologies (wind and hydro) have already been used to bring down the cost of generating electricity in Vanuatu and other potential renewable energy sources like Geothermal and Bio-energy are under assessment.

Government of Vanuatu is taking up climate change as one of the core development issues and has established specific teams and department to address the issue. The Government has a newly established Ministry for Climate Change Adaptation and a National Advisory Board (NAB) on Climate Change and Disaster Risk Reduction designed to improve coordination and governance surrounding the threats climate change and disasters pose to its people, environment and assets. One of the key functions of the NAB is to improve access to and the management of human, financial and technical resources to effectively respond to the priority adaptation needs of the people of Vanuatu.

The GoV's priorities and action agenda (2006 – 2015) has seven strategic priorities to achieve the national Vision, which include: (1) Private Sector Development and Employment Creation; (2) Macroeconomic Stability and Equitable Growth; (3) Good Governance and Public Sector Reform; (4) Primary sector development, environment, climate change, and disaster risk management; (5) Provision of Better Health Services, especially in rural areas; (6) Education and human resource development and (7) Economic Infrastructure and Support Services and there are policy objectives with associated strategies to achieve the objectives.

Technology transfer is a priority action under the UNFCCC. Decision 4CP/7 (Development and transfer of technologies) provides the framework for increasing and improving the transfer of and access to environmentally sound technologies (ESTs) and know-how. Technology Needs Assessment (TNA) is the first step in understanding the needs for technology transfer in the host country. However, TNA has not been initiated in Vanuatu due to various constraints including lack of institutional and financial capacity. Carrying out the TNA could provide an opportunity to realize the need for new techniques, equipment, knowledge and skills for mitigating greenhouse gas (GHGs) emissions and reducing vulnerability to climate change.

Vanuatu continues to face several barriers as it strives to meet its UNFCCC and the Kyoto Protocol obligations. The various obstacles include insufficient institutional and financial resources; lack of research data; information management; inadequate human resources and infrastructure. More needs to be done to build awareness both within the Government and amongst the stakeholders about Vanuatu's vulnerability to climate change and efforts to reduce GHG.

**Institutional Framework:** NAB a committee made up of government and non-government members. The primary purpose of NAB is to act as a focal point for climate change and DRR. NAB is also Vanuatu's supreme policy making and advisory body for all disaster risk reduction and climate change programs, projects, initiatives and activities.

The other key Climate Change and Disaster Risk Reduction institutions include:

Designated National Authority (DNA) to fulfil obligations under the Kyoto Protocol, thereby



supporting the implementation of sustainable development projects in Vanuatu under the Clean Development Mechanism (CDM)

Utilities Regulatory Authority (URA), an independent regulator, to provide prices and regulatory oversight of the electricity and water sectors.

Department of Energy charged with the responsibility of rural electrification and is responsible for access to energy in rural areas.

**Capacity Building, Education & Training:**

The majority of the population including many policy and decision makers within government, private and non-government organisations in Vanuatu have minimal understanding of the various aspects of global climate change, its implications and ramifications at local and national level.

To address the capacity building issues, GoV in association various development partners has been conducting many short-term capacity development training programs and workshops for the policy makers, government and non-government staff, students and local population. Both government and non-government institutions in Vanuatu have effectively stimulated interest and understanding of environmental issues through workshops, quiz contests, role-plays, theatre, radio, TV and video shows.

**Technology Transfer:** Technology Needs Assessment (TNA) is the first step in understanding the needs for technology transfer in the host country. TNA is a country driven activity to assist in identifying and analysing the priority technology needs for mitigating and adapting to climate change. However, TNA has not been initiated in Vanuatu due to various constraints including lack of institutional and financial capacity. Carrying out the TNA could provide an opportunity to realize the need for new techniques, equipment, knowledge and skills for mitigating greenhouse gas (GHGs) emissions and reducing vulnerability to climate change.

Vanuatu continues to face several barriers as it strives to meet its UNFCCC and the Kyoto Protocol obligations. The various obstacles include insufficient institutional and financial resources; lack of research data; information management problems and; inadequate human resources and infrastructure. More must be done to build awareness both within the Government and the community about Vanuatu's vulnerability to climate change. There is also an apparent need to feed information, knowledge and technologies to enable improved decision-making and environmental management.

## Abbreviations and Acronyms

ADB	Asian Development Bank
AusAID	Australian Agency for International Development
BCF	Biodiversity Conservation Fund
CBDAMPIC	Capacity Building for the Development of Adaptation Measures in Pacific Island Countries Project
CCCPIR	Coping with Climate Change in the Pacific Island Region Program (SPC-GIZ)
CC/DRR	Climate Change and Disaster Risk Reduction
CH <sub>4</sub>	Methane
CHARM	Comprehensive Hazard and Risk Management
CMIP3	Coupled Model Inter-comparison Project-Phase 3
CO <sub>2e</sub>	Carbon Dioxide equivalent
CO	Carbon Monoxide
CRP	Comprehensive Reform Program
DEMM	Department of Energy, Mines and Minerals
DNA	Designated National Authority
DoE	Department of Energy
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EIA	Environmental Impact Assessment
ENSO	El Nino-Southern Oscillation
ER	Emission Reduction
FAO	Food and Agriculture Organization
FOLU	Forestry and Other Land Use
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEF	Global Environment Facility
Gg	Giga Gram

GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation)
GHG	Greenhouse Gas
GoV	Government of Vanuatu
GPOBA	Global Partnership of Output-Based Aid
GWP	Global Warming Potential
HFCs	Hydro Fluorocarbons
HH	Households
HVAC	Heating, Ventilation, and Air Conditioning
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
IPPU	Industrial Processes and Product use
IUCN	International Union for Conservation of Nature
IWP	International Waters Project
JICA	Japan International Cooperation Agency
J-PRISM	Project for Promotion of Regional Initiative Solid Waste Management
LCDF	Least Developed Countries Fund
LPG	Liquefied Petroleum Gas
MCC	Millennium Challenge Corporation
MDGs	Millennium Development Goals
MEPS	Minimum Energy Performance Standards
MIPU	Ministry of Infrastructure and Public Utilities
MW	Megawatt
MWh	Megawatt hour
M&E	Monitoring and Evaluation
NAB	National Advisory Board
NAPA	National Adaptation Program for Action
NBSAP	National Biodiversity Strategy Action Plan

NDMO	National Disaster Management Office
NERM	National Energy Road Map
NGOs	Non-Governmental Organizations
NIP	National Implementation Plan
NMVOC	Non-methane volatile organic compounds
NO <sub>x</sub>	Oxides of Nitrogen
N <sub>2</sub> O	Nitrous Oxide
NPH	Northern Provincial Hospital, Luganville
OBA	Output-Based Aid
OTEC	Ocean Thermal Energy
PAA	Priorities and Action Agenda
PACC	Pacific Adaptation to Climate Change Project
PALS	Pacific Appliance Labeling and Standards
PCCSP	Pacific Climate Change Science Program
PDMCs	Pacific Developing Member Countries
PEEP2	Promoting Energy Efficiency in the Pacific - Phase 2
PFCs	Per Fluorocarbons
PFE	Permanent Forest Estate
PIC	Pacific Island Countries
PIGGAREP	Pacific Island Greenhouse Gas Abatement and Renewable Energy Project
PICCAP	Pacific Islands Climate Change Program
PIFACC	Pacific Island Framework for Action on Climate Change
PI-GCOS	Pacific Islands Global Climate Observation System
PLAS	Planning Long, Acting Short (2009–12)
PMO	Prime Minister's Office
POPs	Persistent Organic Pollutants
PPPs	Public Private Partnership
PPSRCI	Pacific Plan for Strengthening Regional Cooperation and Integration

POPs	Persistent Organic Pollutants
REDD	Reducing Emissions from Deforestation and Forest Degradation
SIDS	Small Island Developing State
SO	Sulphur dioxide
SPC	Secretariat of the Pacific Community
SPCZ	South Pacific Convergence Zone
SPEC	South Pacific Bureau for Economic Co-operation
SPREP	Secretariat of the Pacific Regional Environment Programme
TVET	Technical Vocational Education and Training
UN	United Nations
UNELCO	Union Electrique du Vanuatu Limited
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Program
URA	Utilities Regulation Authority
VANREPA	Vanuatu Renewable Energy and Power Association
VANWODS	Vanuatu Women's Development Scheme
V&A	Vulnerability and Adaptation
VCAN	Vanuatu Climate Action Network
VCCP	Vanuatu Carbon Credits Project
VCH	Vila Central Hospital
VCMB	Vanuatu Commodities Marketing Board
VERD	Vanuatu Energy for Rural Development
VHT	Vanuatu Humanitarian Team
VNSO	Vanuatu National Statistics Office
VT	Vatu (Vanuatu Currency)
VTSSP	Vanuatu Transport Sector Support Program
VUI	Vanuatu Utility Infrastructure
WSSD	World Summit on Sustainable Development

# Contents

Foreword	3
Executive Summary	4
Abbreviations and Acronyms	15
1. Vanuatu's National Circumstances	22
1.1 Geography & Climate	23
1.1.1 Geography	23
1.1.2 Climate	24
1.2 Environment and Ecosystem	26
1.3 Population	27
1.3.1 Education	28
1.3.2 Health	29
1.4 Economy	30
1.4.1 Agriculture, Fishing & Forestry	32
1.4.2 Industry	33
1.4.3 Services sector	33
1.5 National Priorities and Action Agenda & Millennium Development Goals	34
2. National Greenhouse Gas Inventory	36
2.1 Background	36
2.1.1 Methodology	36
2.1.2 Sectors and Gases Assessed	37
2.1.3 Uncertainty Assessment	38
2.2 Summary of Vanuatu's Greenhouse Gas Emissions	38
2.2.1 GHG Emissions in Vanuatu	39
2.2.2 Gas by Gas Emission Inventory	41
2.3 GHG Emission Trends: 2000-2010	44

2.4	GHG Emissions by Sector	45
2.4.1	Energy Sector	45
2.4.2	Carbon Dioxide Emissions from the Energy Sector Using the Reference Approach	48
2.4.3	Memo Items	49
2.5	Industrial Processes	49
2.6	Solvents and Other Products Use	49
2.7	Agriculture	50
2.8	Land Use Change and Forestry Sector	52
2.9	Waste	53
2.10	Conclusion	55
3.	Vulnerability and Adaptation (V&A)	56
3.1	Background	56
3.2	Vanuatu's Current Climatic Scenario	58
3.3	Vanuatu's Future Climate Projections	61
3.4	Vulnerable Sector Assessments	64
3.4.1	Agriculture	65
3.4.2	Fisheries	66
3.4.3	Forestry	68
3.4.4	Tourism	69
3.4.5	Transport Transport & Infrastructure	69
3.4.6	Health	70
3.5	Adaptation and Sustainable development	71
3.6	National and Sectoral Adaptation Programs	72
3.7	National Adaptation Priorities	86
3.7	Barriers and Opportunities	86
3.8	Conclusion	88
4.	Mitigation	89
4.1	Background	89

4.2	Potential Climate Change Mitigation Sectors	89
4.3	Vanuatu's GHG Emissions Scenario	93
4.4	Mitigation Related National/Regional Policies and Programs	95
4.5	Existing and Identified Mitigation Options	103
4.6	Barriers and Opportunities	105
4.5	Conclusion	107
5.	Other Information	108
5.1	Background	108
5.2	National Energy Road Map 2013-2020	108
5.2	Renewable Energy Opportunities	114
5.3	Climate Change and Energy Sector Institutional Framework	116
5.4	Capacity Building, Education & Training	118
5.5	Need for Technology Transfer	119
5.6	Gaps in Climate Change Policy and Information	120
5.6.1	Institutional and Policy Gaps	120
5.6.2	Research, Data and Information Gaps	121
	References	122

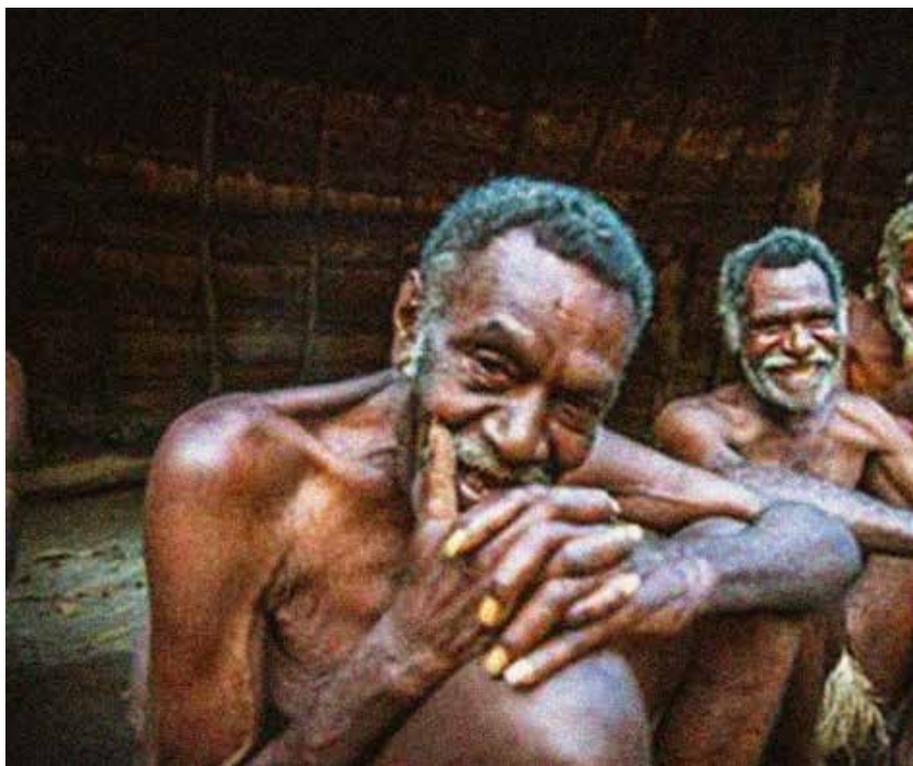
## Appendix

APPENDIX A	2000 EMISSIONS UNFCCC REPORTING TABLES
APPENDIX B	SECTOR WISE DIRECT CLIMATE CHANGE IMPACTS
APPENDIX C	KEY FINDINGS & RECOMMENDATIONS
APPENDIX D	NATIONAL ENERGY ROAD MAP (NERM) IMPLEMENTATION RECOMMENDATIONS

# 1. Vanuatu's National Circumstances

The Republic of Vanuatu is an island nation located in the Western Pacific Ocean. Vanuatu is an archipelago of over 80 islands stretching 1,300 kilometres from North to South in the Western Pacific Ocean. The archipelago, which is of volcanic origin, is some 1,750 km East of Northern Australia, 500 kilometres Northeast of New Caledonia, West of Fiji, and Southeast of the Solomon Islands, near New Guinea.

Vanuatu has been inhabited for several thousand years. The ancestors of indigenous ni-Vanuatu arrived in a series of migrations from the North-West. They settled throughout the archipelago practicing subsistence agriculture, hunting and gathering and limited trade. Due to the difficult terrain and open seas between islands there was limited contact between settlements. They developed complex cultures and languages. After some 74 years of joint "Condominium" rule between Britain and France, Vanuatu or "New Hebrides" as it was known in the condominium days, received its political independence in 1980. In December 1994, the 11 Local Government Councils were changed into 6 Provincial Councils, giving them more



autonomy, though they still remained under the rule of the national Government. Now the Republic of Vanuatu is an independent parliamentary democracy, where the Constitution provides for executive and legislative arms of Government as well as judiciary. The President is Vanuatu's Head of State. The judiciary consists of the Supreme Court with a Chief Justice and a Magistrates Court. Vanuatu is a full member of the British Commonwealth, the French League of Nations, the United Nations, Agence de Co-operation Culturelle et Technique, the South Pacific Bureau for Economic Co-operation (SPEC), the Secretariat of the Pacific Community (SPC), the World Bank and the Asian Development Bank (ADB).

## 1.1 Geography & Climate

### 1.1.1 Geography

Vanuatu is an archipelago of volcanic islands and submarine volcanoes located between latitude 12° to 23° South and longitude 166° to 173° East; covering some 1,300 km from North to South in the Western Pacific Ocean (Figure 1.1). Vanuatu's terrain is mostly mountainous, with narrow coastal plains. It comprises 83 islands, of which 65 are inhabited, with a total land area of 12,336 km<sup>2</sup> and a maritime exclusive economic zone of 680,000 km<sup>2</sup>.

The largest island is Espiritu Santo, while the island of Efate is home to the capital, Port Vila and the Vanuatu Government. From largest to smallest, the islands are Espiritu Santo, Malekula, Efate, Erromango, Ambrym, Tanna, Pentecost, Epi, Ambae or Aoba, Vanua Lava, Gaua, Maewo, Malo, and Anatom or Aneityum. The two largest islands; Espiritu Santo and Malekula comprise nearly 50% of the total land mass. Larger islands are characterised by rugged volcanic peaks and tropical rainforests. The highest peak, Mount Tabwemasana on Espiritu Santo, is 1877m above mean sea level and the total coastline is about 2,528 km long.



Figure 1.1 Map of Vanuatu

Vanuatu is geographically located in the “ring of fire” and the “cyclone belt” of the Pacific. The island nation is located in a seismically and volcanically active region and has high exposure to geologic hazards, including volcanic eruptions, earthquakes, tsunamis and landslides. Almost 81% of its landmass and 76% of its population is exposed to two or more potential hazards including volcanic eruptions, cyclones, earthquakes, droughts, tsunamis, storm surge, coastal and river flooding and landslides. In 2012, the United Nations World Risk Report<sup>1</sup> ranked Vanuatu as the most vulnerable country in the world to natural hazards and climate change.

### 1.1.2 Climate

Vanuatu is situated in a tropical maritime climate with characteristic uniform temperature, high humidity and variable rainfall. The tropical climate is moderated by southeast trade winds that occur from May to October. There are two main seasons, hot and wet from November to April, and cool and dry from May to October. Being an equatorial country, Vanuatu has relatively uniform temperature throughout the year with daily temperature ranging from 20°C to 30°C. Temperatures in the warmest months in Vanuatu (January-February) are about 4°C higher than those in the coolest months (July-August). In the coastal areas, the daily temperature average is 26°C in the hot season with an average maximum of 30°C and an average minimum of 24°C. Extreme night-time minimum temperature in some coastal areas may reach 13°C. Port Vila, the capital on the west coast of Efate has an average temperature of 25°C with August averaging 23°C and February averaging 27°C. The water temperature ranges from 22°C in the cooler season to 28°C in the hot season. It is cool between April and September and the days become hotter and more humid beginning from October onwards.



<sup>1</sup><http://www.ehs.unu.edu/article/read/worldriskreport-2012>

Vanuatu has a long rainy season, with significant rainfall occurring nearly every month. The country's rainfall is strongly influenced by the position and strength of the South Pacific Convergence Zone. During summer, the South Pacific Convergence Zone intensifies and moves further south, bringing the higher rainfall of the wet season. Rainfall in Vanuatu varies greatly from year-to-year mainly due to the influence of the El Niño-Southern Oscillation.



The predominant wind flows in most seasons are the trade winds from the east to southeast at about 5 knots. The wind flows during the hot season (November to April) are generally light and variable. In the cool season, from May to October, the southeast trade wind flows become persistent averaging 10 knots. Strong marine wind warnings over open waters are common in the cool season with speeds up to 25 knots. However, tropical cyclone and depression are also common, which can be responsible for high and destructive winds in the hot season.

Vanuatu's latitude places it in the path of tropical cyclones, and it is subject to cycles of El Nino and La Nina, which, respectively, increase the risks of droughts and floods. The hot or wet season in Vanuatu is also known as the cyclone season. The total area of Vanuatu (land and sea) receives about 2-3 cyclones in a cyclone season, and the greatest frequency is in January and February. On average, Vanuatu and its marginal seas are common routes for some 20 to 30 cyclones per decade; with 3 to 5 causing severe damage. Natural hazards affecting Vanuatu include tropical cyclones, volcanism (which causes earthquakes) and occasional tsunamis. Future climate change and sea-level rise threaten to exacerbate the risks posed from tropical cyclones, coastal and river flooding, coastal erosion, heavy rainfall events, and droughts.

## 1.2 Environment and Ecosystem

Almost 74% of the land area in Vanuatu is covered by natural vegetation, with around one third covered by forest. Vanuatu's total land area is about 12,336 km<sup>2</sup> with more than 36.1% (440,000 hectares) covered by tropical forest. In Vanuatu, land has not been classified according to functions or land capability classes; neither does it have a legally defined permanent forest estate (PFE). All lands, including forestlands, are customarily owned, i.e. by individuals or communities (clans or families). Government-owned land with forest does not exist. However, the forests are important to rural communities; it is one of their main sources of cash income. The quality of natural forests in terms of commercial forestry is low. In addition to the commercial forestry operations; the forests provide a wide range of products for the subsistence lifestyle of most ni-Vanuatu.

According to the National Forest Inventory (1990-1993)<sup>2</sup> around 74% of Vanuatu was covered by woody vegetation, half of which is closed forests and the remainder is discontinuous scrub and thicket. Of this, only 10% is primary forest. The estimated commercially exploitable forest was set at about 35% of forest cover. However, this situation is changing fast. Vanuatu is utilizing more forests than is being planted and some of the customary landowners are developing their logged forest areas for other activities, like rearing of cattle, or in coastland lowland areas of Efate and east Santo for real estate development. By 2006, about 4,800 hectares were covered with planted forests; about 3 % of the high to mid forest (about 6,000ha) and 0.7 % of the low forest (about 1,400ha) are in protected areas.

Vanuatu has some 108 known species of amphibians, birds, mammals and reptiles; of these, 21.3% are endemic, meaning they exist in no other country, and 13% are threatened. Vanuatu is also home to at least 870 species of vascular plants, of which 17.2% are endemic. There are around 1000 vascular plants of which 150 are endemic and 700 species of bryophytes including many Invertebrates species (butterfly, bees, flies, ants and termites etc.) One of the best-known invertebrate in Vanuatu is the coconut crab. There is a repertoire of 121 bird species, some of which are rare or vulnerable and around 30 species of Reptiles and Amphibians.

The region is rich in sea life, with more than 4,000 species of marine molluscs. The giant East African land snail arrived only in the 1970s but has already spread from the Port-Vila region to much of the rest of the country. There are three or possibly four adult saltwater crocodiles living in Vanuatu's mangroves with no current breeding population.

Coral reef systems fringe most islands in Vanuatu. The Reef Islands, also called Rowa ('ro-wa'), are a cluster of coral cays between Mota Lave and Ureparapara, in northern Vanuatu. They are important sources of economic and subsistence resources, and a draw-card for the important tourism sector, while protecting adjacent coastlines from extreme sea events.

Mangroves are also an important part of the ecosystem of Vanuatu consisting of sea grass beds and other near-shore marine ecosystems. The mangrove ecosystem services includes subsistence/commercial and recreational fishing, wood, tourism, bioremediation, sediment trap, protection against waves and carbon sequestration<sup>3</sup>.

<sup>2</sup>Forest Data and Resource Assessment of Forestry in Vanuatu <http://www.fao.org/forestry/18248-0b2552633ff6923bf49424c42a79c8740.pdf>

<sup>3</sup><http://thecommonwealth.org/sites/default/files/project/documents/The%20Management%20of%20Coastal%20Carbon%20Sinks%20in%20Vanuatu%20-%20Realising%20the%20Potential.pdf>

## 1.3 Population

**Table 1.1: Population of Vanuatu (National Census 2009)<sup>4</sup>**

Place of residence	Number of people	Male	Female	Number of households
Vanuatu	234,023	119,091	114,932	47,582
Urban	57,195	29,618	27,577	11,679
Rural	176,828	89,473	87,355	35,903

According to the Vanuatu National Statistics Office (VNSO), the urban population comprised of 24.4% of the total population in 2009, an increase from 21.5% in 1999. The urban population increased from 40,000 people in 1999 to 57,000 in 2009 or an average of 3.5% per year since 1999 (about 1,400 people a year). The population in rural areas is increasing as well; the rural population has increased by 21% or 1.9% on average each year since 1999 (about 2,750 people a year). The population of Vanuatu from 1967 to 2009 has shown an increasing trend as follows:

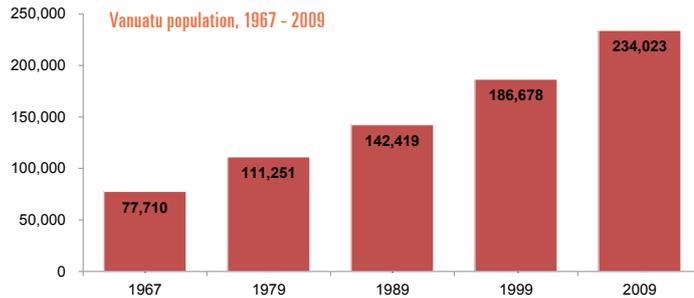
**Table 1.2: Total population by province and Census year, population density, Vanuatu: 1967-2009 (National Census 2009)**

Province	Population in census year					Land area (Km <sup>2</sup> )
	1967	1979	1989	1999	2009	
<b>VANUATU</b>	<b>77,710</b>	<b>111,251</b>	<b>142,419</b>	<b>186,678</b>	<b>234,023</b>	<b>12,281.25</b>
Torba	3,481	4,958	5,985	7,757	9,359	867.33
Sanma	12,785	19,423	25,542	36,084	45,855	4,262.06
Penama	13,968	18,937	22,281	26,646	30,819	1,203.92
Malampa	17,407	23,567	28,174	32,705	36,727	2,808.41
Shefa	17,633	26,860	38,023	54,439	78,723	1,507.36
Tafea	12,436	17,506	22,414	29,047	32,540	1,632.17

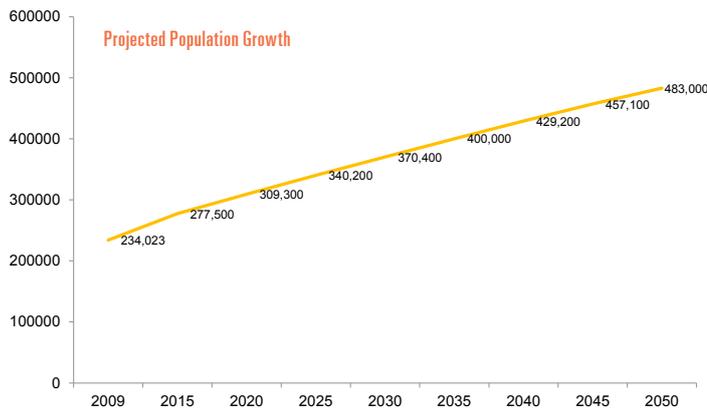
Further, the population density (number of persons per km<sup>2</sup>) in Vanuatu has increased significantly from 9.1 - 19.1 between 1979 and 2009. From the 2009 Census it is interesting to note that Torba, the Northern most provinces has one of the highest average annual growth rates outside of Shefa and Sanma. Every year since 1999, the population of Torba has increased by 1.9% on average. The province with the fastest annual growth rate since the 1999 Census is Shefa, which has increased on average by 3.7% each year, and this includes Port Vila. As per the 2009 Census, Vanuatu has a moderately sized economically active population i.e. 62,968 persons, which is about 47% of population in the range of 15-64 years. The total labour force is about 42,295 and unemployment rate is about 4.6%.

<sup>4</sup><http://www.spc.int/prism/nada/index.php/catalog/57>

**Figure 1.2 Vanuatu Population 1967-2009 (National Census 2009)**



**Figure 1.3 Vanuatu's Projected Population Growth (2009-2050) (SPC Statistics)<sup>5</sup>**



### 1.3.1 Education

The GoV has a vision that education is the pre-eminent tool for achieving increased economic prosperity and social welfare and stability. The Ministry of Education is mandated to provide one of the fundamental human rights – education for all. The Ministry aims to create an education system, which provides good conditions for knowledge, skills and values development, with the view of enhancing a harmonious and peaceful society, conducive to the promotion of a sustainable way of life in Vanuatu. Vanuatu has a high adult literacy rate of 82% (ages 15 and older, 2011), which includes 81.5% females (ages 15 and above) and 84.5% males (age 15 and above). The literacy rate of female and male between the ages 15-24 is 94.7% and 94.4% respectively. The ratio of girls to boys in primary and secondary was 88% in 1991 rising to 97.32% in 2010 with much better progress in secondary education. In 2011, total enrolment in primary schools was 42,352 and total enrolment in secondary schools was about 18,064<sup>6</sup>.

<sup>5</sup>www.spc.int/sdp

<sup>6</sup>Vanuatu Education Sector Strategy (VESS), 2007 – 2016; World Bank- World Development Indicators and the UNESCO Institute for Statistics (UIS)

The education sector of Vanuatu comprises of Pre-Schools (797), Primary Schools (443), Vanuatu Institute of Technology (3), Provincial Education Offices (6) and several national institutions (Vanuatu Institute of Teacher Education, Curriculum Development Centre, Examinations and Assessment Unit, Training and Scholarship Coordination Unit, Teaching Service Commission, Department of Education, Provincial Education Offices, National UNESCO Centre and National UNEVOC) which deliver education services to over 65,000 students. The number of pre-schools and schools varies from year to year as they are opened and closed by their owners. 44.2% of schools are on customary land, 27% are GoV-owned, and 12% are owned by other agencies.

The Vanuatu government and education system faces various challenges of responding to a fast growing population, growing demands and expectations from parents and students and communities, and from the formal economy. In the Pacific, Vanuatu has the highest proportion of children who have never attended school. Data suggests that only 74% of primary-aged children are enrolled in school, and not all complete Grade 5. There is also a low transition rate from primary to secondary education, with gross secondary enrolments at only 32%, and much lower at higher education level. Further, there are differences in enrolments across the provinces and between urban-rural areas and between boys and girls. People with disabilities face severe restrictions. There are several areas with more than 65% non-attendance (South-West Tanna, middle Santo, urban settlements) and high rate of student dropouts, repeats, withdrawals, and absenteeism.

The major challenges lie in lack of appropriate policy for primary education; poor education infrastructure in rural and remote areas, high costs of supporting and monitoring services and insufficient harmonization or coordination of donor activities.

GoV is committed to remove the barriers and inefficiency in the education sector and has prepared a long-term development plan (Vanuatu Education Sector Strategy – VESS) to address the issues in the sector. In addition the National Curriculum Statement mandates a full review of the curriculum (nearly complete), which fully mainstreams climate change and disaster risk reduction. The Emergency in Education Policy outlines how schools are to mitigate disaster and natural hazards risks. The MDGs of GoV includes the universal primary education completion and literacy goals, strengthening education quality and relevance, greater focus in the secondary and TVET education levels and increased efficiencies and partnerships in the education system. Vanuatu will potentially achieve universal primary education by 2015.

### 1.3.2 Health

GoV has the vision to have an integrated and decentralized health system that promotes effective, efficient and equitable health services for the good health and general well-being of all people in Vanuatu. As of 2009, the Ministry of health delivers its services through two regional referral hospitals (VCH & NPH), 3 provincial hospitals, 30 health centres, 97 dispensaries and 231 Aid posts; making health facility in Vanuatu per capita as one of the most highest and accessible amongst the least developed countries in the world. Vanuatu has very good estimated life expectancy at birth; 69.6 years for males and 72.7 years for females as per the census of 2009. Communicable and non-communicable

diseases are main priority diseases for Vanuatu. Malaria and Tuberculosis are major public health concerns along with Sexually Transmitted Infections, Acute Respiratory Tract Infections, Diarrhoea and Viral Hepatitis. Dengue Fever and Measles

Vanuatu's health facilities infrastructure (Hospitals, Health Centres and Dispensaries) and programs are mostly promoted by donors and partner organizations. More than half of the health programs in the Ministry of Health are donor funded, particularly the public health programs.

Vanuatu's health sector strategy has four broad objectives i.e. improve the health status of the population, ensure equitable access to health services at all levels of services, improve the quality of services delivered at all levels and promote good management and the effective and efficient use of resources.

## 1.4 Economy

Vanuatu has a classic dual economy; a subsistence and a cash economy. There is also a small, high-cost modern sector but most ni-Vanuatu earn their living from subsistence or small-scale agriculture and fishing, largely outside the cash economy. Approximately 80% of the population engages in subsistence agriculture, contributing about 10% to Vanuatu's gross domestic product (GDP). Vanuatu's exports comprise mainly agricultural commodities and tourism related services; however the imports are significantly higher than exports of goods. Tax revenues come mainly from import duties. Agricultural exports (copra, beef, timber, kava and coconut oil), offshore financial services, and tourism are other mainstays of the economy. Mineral deposits are negligible, and the country has no known petroleum deposits. A small light-industry sector caters to the local market.

Vanuatu has a small and developing economy, with a GDP of Vatu 72,278 million (current prices). Real GDP growth averaged 6.5% for 2004 - 2008, and then slowed to 3.3% in 2009, 1.6% in 2010, 1.2% in 2011 and about 1.8% in 2012. According to the preliminary estimates of Vanuatu National Statistics Office, Vanuatu's economy continued to show some weakening trends in the last five years with a slight expansion in 2012. The lower growth in 2012 was attributable to a considerable contraction in the industry sector with poor performances in construction and manufacturing industries, followed by other weak performances in agriculture and service industries.

Vanuatu's economy heavily depends on natural resources, both for the sustenance of its people and future economic expansion like many other less-developed Pacific Island Countries. Vanuatu's main primary industries are agriculture, fishing and forestry; secondary sector includes manufacturing (Mining and Quarrying, Electricity & Water, Construction) while the tertiary sector includes services (Retail, Hospitality-hotels and restaurants, Transport, Communication, Finance and Business services).

Figure 1.4 Vanuatu's GDP Growth Rate by Industry

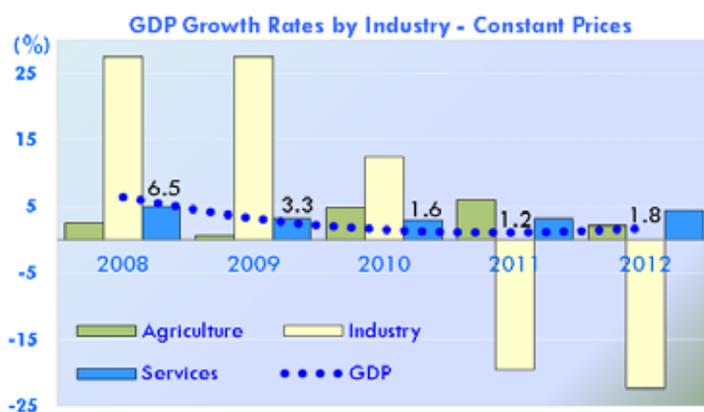
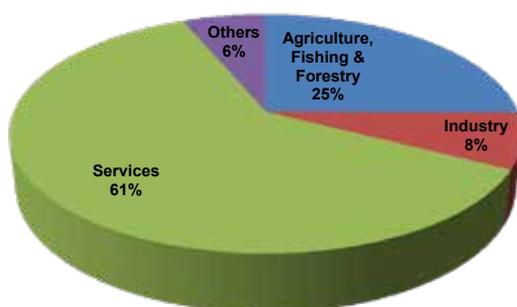


Table 1.3: Current Prices GDP (in Vatu)

Current Prices GDP (in Vatu) by Industry Sector (2012)	
Industry Sector	2012
Agriculture, Fishing & Forestry	18,115
Industry	5,455
Services	44,153
Others	4,555
<b>Gross Domestic Product</b>	<b>72,278</b>

Figure 1.5 GDP of Vanuatu by Sector (2012)



## 1.4.1 Agriculture, Fishing & Forestry

Vanuatu's economy is primarily agricultural; 80% of the population is engaged in agricultural activities that range from subsistence farming to smallholder farming of coconuts and other cash crops. The main agricultural products are copra, kava (*Piper methysticum*), cocoa, coffee, taro, yams, fruits and vegetables, beef and fish. Copra is by far the most important cash crop (making up more than 35% of the country's exports), followed by timber, beef, and cocoa. Kava root extract exports have also become important.

Since 2003, the agriculture sector has grown at an annual rate of 3.3% compared to a 2.8% growth for the economy and an average population growth rate of 2.6% per annum. In the year 2012, agriculture, fishing and forestry sectors have shown significant collective current prices GDP growth of 11.7% including an increase in crop production by 9.2%, animal production by 36.5% and fishing by 1.2%. However, there was a decline of 0.5% in forestry sector. The increase in the agricultural sector in 2012 was mainly driven by increased animal production, particularly cattle and other livestock. Copra production decreased by 34% due to a fall in average price. Vanuatu has a very limited domestic market for agricultural products and the challenge in agriculture is to increase production and productivity, improve marketing systems to allow market access for both traditional food crops and high value specialty commodities.

Vanuatu's pelagic fisheries resources (e.g. tuna) are potentially under-exploited, although the scientific evidence is lacking. The coastal fisheries sector however is trending towards overexploitation, with several fisheries near collapse (e.g. green snail, trochus etc.). The reef fisheries are particularly over-fished in some areas, notably in the vicinity of Efate and Santo. The fisheries sector requires huge social and commercial makeover including improvements in catching, handling and marketing systems and commercialization of the domestic fishing industry.

Vanuatu possesses soils and climate that is conducive to timber production and the best environment in the world for raising beef cattle<sup>7</sup>, although both of these industries require regulation to ensure sustainable expansion. The production of beef, pork, poultry, sheep and goat for local consumption forms an essential part of the rural economy.

According to the National Forest Inventory from 1993, approx. 900,000ha of the land area is covered with different types of forest, or are considered as other wooded land. Although about 890,000ha of this is still natural forests, production forests occupy only 36 % of Vanuatu's land area, and only about 20% of these forests are of commercial use - mainly due to the poor quality of timber and difficulty in assessing the sites.

By 2006, about 4,800ha were covered with planted forests; about 3% of the mid-to high forest (about 6,000 hectares) and 0.7% of the low forest (about 1,400 hectares) are in protected areas. Vanuatu's land has not yet been classified according to functions or land capability classes; neither does Vanuatu have a legally defined Permanent Forest Estate (PFE). All lands, including forestlands, are customarily owned, i.e. by individuals or communities (clans or families). Government-owned land with forest does not exist.

The development of Vanuatu's forest sector is highly influenced by outside forces includes conversion

<sup>7</sup><http://aid.dfat.gov.au/countries/pacific/vanuatu/Documents/government-of-vanuatu-priorities-action-agenda-2006-15.pdf>

of forest land to agricultural land due to the need for small-scale subsistence farming, use of forest land for cattle grazing in response to increasing international demand for Vanuatu's high-quality beef and for tourism development. The challenges for this sector include ensuring replanting of trees at a rate at least equal to the volume being harvested; fostering the utilization of additional species; and developing additional value-added processing. Forest growth in Vanuatu is also influenced by high population growth rate, international economic development and the impact of climate change (mainly due to frequent cyclones).

### 1.4.2 Industry

Vanuatu has a small light-industry sector mainly catering to the local market. The industry sector (Mining and Quarrying, Manufacturing, Electricity and Water Supply, Construction) contributed about 8% of current price GDP in 2012. This sector has continued to decline since the completion of the Millennium Challenge Corporation (MCC) project in 2010. The main driver for this industry is construction; construction activity is being driven by private-sector retail, residential and a number of donor-funded government construction projects mostly on the island of Efate, particularly in Port Vila.

The manufacturing sector has a very low contribution in Vanuatu's GDP (around 0.03% in 2012), and its contribution has been slowly growing. The manufacturing sector is primarily related to fish processing, copra and various coconut products as well as growing beef industry. Organic beef from Vanuatu is well-known throughout the Pacific and exported as far as Japan and Norway. Vanuatu Abattoirs in Port Vila is the principal exporter and is jointly owned by the government and private investors. Wood processing and an under-exploited coffee industry account for the remainder of Vanuatu's manufacturing sector. There was a manganese mine operating on the island of Efate in the 1960s and 1970s, but currently there is no significant mineral production.

### 1.4.3 Services sector

Vanuatu's economy largely depends on the service sector, which contributes about 61% to GDP (2012). The economic growth of Vanuatu is mainly driven by the service sector that includes tourism (accommodation and food services); transport; wholesale and retail trade; repair of motor vehicles; information and telecommunication as well as professional, scientific, financial and administrative services. The services sector is dominant in terms of value added but its growth has been very unstable and in terms of labour it involves only 30% of the population.

Tourism accounts for almost 80% of Vanuatu's services export but faces some serious constraints mainly due to infrastructure and other support services. However, Tourism is one of the most promising economic sectors for Vanuatu's future development and has been mentioned as a priority sector in the "Priority and Action Agenda 2006-2015". The sector offers great potential as a source of foreign exchange as well as for creating employment and fostering development of the outer islands.

Economic development is hindered by Vanuatu's poor transportation infrastructure, dependence on relatively few commodity exports, vulnerability to natural disasters and by the long distances between main markets and constituent islands. Vanuatu depends upon imported petroleum products for much

of its energy needs; hence the fluctuation in global fuel prices significantly affects the performance of all economy sectors. Further, a precipitous decline in world copra prices has reduced the real income of much of the population and has put increased pressure on other resources (i.e., timber, fisheries, and traditional agriculture).

However, Vanuatu's favourable tax regime, relative political stability, sound macro-economic management and recent institutional reforms have begun to attract foreign investment in tourism and land development. The GoV's "Priorities and Action Agenda 2006-2015" aims to achieve better macro-economic stability by creating a stable investment climate, increasing economic growth and improving the welfare of Vanuatu's people through better health, education and transport services in rural areas. Access to modern, secure and affordable energy services has a key role to play in achieving these priority actions.

## 1.5 National Priorities and Action Agenda & Millennium Development Goals

Vanuatu's national vision is "An Educated, Healthy and Wealthy Vanuatu". The goal of Government of Vanuatu is to improve the welfare of its people, and the main agendas for action include fostering the growth of productive sector, especially agriculture and tourism, maintaining macroeconomic balance, raising public service performance, cutting costs associated with transport and utilities, along with improving access to basic services such as health and education. In 2012 the Priority Action Agenda document was reviewed and revised to include climate change adaptation and mitigation priorities.

The GoV believes that the goal will be achieved firstly through achieving higher and sustainable economic growth to create jobs and raise incomes while conserving resources for future generations; secondly, by ensuring macroeconomic stability to create a stable investment climate and thirdly, by raising standards of service delivery particularly to the rural and outer regions to improve access to basic health and primary education services while lowering costs of internal trade.

The Government embarked on the Comprehensive Reform Program (CRP) in 1997 as a long-term framework to achieve the goal of raising welfare and Priorities and Action Agenda (PAA) was developed in 2003 to complement the CRP. The overall objective is to link policy and planning with the limited resources the Government controls.

### Box 1.1: Vanuatu's National Strategic Priorities (2006-2015)

- Private Sector Development and Employment Creation;
- Macroeconomic Stability and Equitable Growth;
- Good Governance and Public Sector Reform;
- Primary Sector Development (natural resources and the environment);
- Provision of Better Basic Services, especially in rural areas;
- Education and Human Resource Development;
- Economic Infrastructure and Support Services

The primary priority for the Government is to create an environment for private sector led economic growth, including activities in the primary sectors of agriculture, forestry and fisheries, as well as in tourism. This includes public sector reform and good governance, improving the investment, operating and regulatory environment for the private sector, and providing the necessary infrastructure and support services, particularly in rural areas, for the primary sectors and tourism as well as in the urban centres. At the next level of priority is human resource development. As the economy begins to grow, an increasing number of economic and employment opportunities will be created for both men and women. This will require a skilled, educated and motivated gender-balanced labour force. Adequate resources need to be provided to ensure that education and training is provided for all people across all levels of ability to enable everyone to achieve their own highest levels of potential. Health is at the same level of overall priority as the educational side of human resource development. A healthy community - physically, mentally, socially and environmentally - is a happy and productive community. Good health is therefore essential for the realization of educational potential and the ability to take advantage of opportunities.

Beginning in 2013, the GoV has embarked on revising its development policy to be more focused on sustainability and emphasizing environmental and social/cultural priorities. The new National Sustainable Development Plan will replace the existing Priority Action Agenda in 2015. This new policy is grounded soundly in the need for integrated adaptation to climate change and disaster risk reduction. Being a responsible member of United Nations, GoV is adhering to the UN Millennium Declaration that was adopted by the UN General Assembly in 2000. The Declaration establishes eight goals to which the international community will commit its resources. GoV is pursuing these commitments in the interest of Vanuatu and its citizens because the MDGs represent basic developmental benchmarks and a better life for the people of Vanuatu. The Government of Vanuatu is currently undertaking consultations to roll out the new UN Sustainable Development Goals commencing in 2015.

#### **Box 1.2: The Millennium Development Goals (MDGs)**

1. Eradicate extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV/AIDS, malaria and other diseases
7. Ensure environmental sustainability
8. Develop a Global Partnership for Development

Progress has been made towards achieving the MDG goals including continual and sustained economic growth, increasing employment, achieving universal basic education, reducing child and maternal mortality, combating malaria and tuberculosis as well as providing access to safe drinking water and basic sanitation. While much progress has already been made, some challenges still remain, including social and cultural barriers that prevent women from participating in parliament and corporate level positions, restructuring of health care service delivery, human resource shortfalls and focus on community health. The increasing vulnerability of Vanuatu to natural disasters combined with the effects of climate change has increased the importance of climate proofing and disaster risk reduction in Vanuatu.

## 2. National Greenhouse Gas Inventory

### 2.1 Background

As per Article 4 (paragraph 1) and Article 12 (paragraph 1) of the United Nations Framework Convention on Climate Change (UNFCCC), each party is required to report to the Conference of Parties (COP) information on its emissions by sources and removals by sinks of all Greenhouse Gas Emissions (GHGs) not controlled by Montreal Protocol. Vanuatu prepared and submitted its Initial National Communication in 1999.

As required by decision 17/CP.8 of COP, “For the second national communication, non-Annex I Parties shall estimate national GHG inventories for the year 2000. The least developed country Parties could estimate their national GHG inventories for years at their discretion”. As a non-Annex I country and a least developed country, Vanuatu has chosen year 2000 as the base year for estimating GHG inventory as part of its Second National Communication. The current inventory also contains results from Vanuatu’s first inventory to reflect changes in the country’s national GHG emissions since 1994.

#### 2.1.1 Methodology

This GHG inventory is prepared using methodology developed in the revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. The UNFCCC software “Non Annex 1 National Greenhouse Gas Inventory Software, Version 1.3.3” has been used for the estimation of GHG. The preparation of GHG inventory in Vanuatu was coordinated by the Department of Energy, GoV and was prepared with support from relevant departments namely Bureau of Statistics, Customs Department, Utility Regulatory Authority (URA), Department of Environment, Department of Forestry, Department of Agriculture, Department of Livestock and electricity utility companies UNELCO and Vanuatu Utility Infrastructure (VUI) through data compilation and reporting. The key steps carried out in inventory preparation include:

- Team Formation to work on Inventory
- Team Capacity Building/Training
- Data Collection for sectors covered under the Inventory
- Identification of Gaps
- Documents / Data Review for quality assurance
- Report (inventory) writing

Sectoral data for GHG estimation was compiled from various sources primarily using national data collected from annual reports, statistical reports, studies and brochures of related department/institutions. Where actual data was not available judgment of sector experts was relied on. A number of assumptions were used to represent the local conditions of the country. These assumptions have been verified with the local sector experts and crosschecked with other resources for correctness. Sparsely populated cities/regions wherein no formal data is available are not considered in the study.

## 2.1.2 Sectors and Gases Assessed

This section presents information on Vanuatu's emissions by sources and removals by sinks of all anthropogenic GHGs. As per the revised 1996 IPCC guidelines, the inventory estimates the GHG emissions from the following sectors which are relevant for Vanuatu:

- Energy
- Industrial Processes and Product Use (IPPU)
- Agriculture, Forestry and Other Land Use (AFOLU)
- Waste

In addition to the sectoral approach, the reference approach is also used to estimate CO<sub>2</sub> emissions from the energy sector. Emissions from bunker and biomass fuel are also estimated and reported as memo items in the inventory but are not included in the national totals. The direct GHGs whose emissions are estimated in this national GHG inventory are:

- Carbon dioxide (CO<sub>2</sub>)
- Methane (CH<sub>4</sub>)
- Nitrous oxide (N<sub>2</sub>O)

Emissions from the following indirect GHGs are also estimated and reported in this inventory:

- Oxides of nitrogen (NO<sub>x</sub>)
- Carbon monoxide (CO)
- Non-methane volatile organic compounds (NMVOC) and
- Sulphur dioxide (SO<sub>2</sub>)

The indirect GHG emissions and GHG emissions resulting from non-anthropogenic activities (like volcanoes etc.) are not included in Vanuatu's aggregate national emissions.

In this report, Vanuatu has reported emissions mainly in Giga grams (Gg). The aggregated GHG emissions and removals are expressed in CO<sub>2</sub> equivalents (Gg CO<sub>2</sub>e) using the Global Warming Potential (GWP) provided by the IPCC. The concept of GWP has been developed to allow the comparison of the ability of each greenhouse gas to trap heat in the atmosphere relative to carbon dioxide (CO<sub>2</sub>) over a specified time horizon. The greenhouse gas emissions are calculated in terms of how much CO<sub>2</sub> would be required to produce a similar warming effect over the chosen time horizon. This is called the carbon dioxide equivalent (CO<sub>2</sub>e) value and is calculated by multiplying the amount of gas by its associated GWP. Table 2.1 provides the GWP of GHGs assessed in the inventory report.

**Table 2.1: Global Warming Potential (GWP)**

Global Warming Potential (IPCC 1996)					
Species	Chemical Formula	GWP	Species	Chemical Formula	GWP
<b>CO<sub>2</sub></b>	CO <sub>2</sub>	1	<b>HFC-23</b>	CHF <sub>3</sub>	11,700
<b>Methane</b>	CH <sub>4</sub>	21	<b>HFC-236fa</b>	C <sub>3</sub> H <sub>2</sub> F <sub>6</sub>	6,300
<b>Nitrous Oxide</b>	N <sub>2</sub> O	310	<b>HFC-143a</b>	C <sub>2</sub> H <sub>3</sub> F <sub>3</sub>	3,800
<b>Perfluoroethane</b>	C <sub>2</sub> F <sub>6</sub>	9,200	<b>HFC-134a</b>	CH <sub>2</sub> FCF <sub>3</sub>	1,300
<b>Perfluoropentane</b>	C <sub>5</sub> H <sub>12</sub>	7,500	<b>HFC-134</b>	C <sub>2</sub> H <sub>2</sub> F <sub>4</sub>	1,000
<b>Perfluorohexane</b>	C <sub>6</sub> H <sub>14</sub>	7,400	<b>HFC-32</b>	CH <sub>2</sub> F <sub>2</sub>	650
<b>Sulphur hexafluoride</b>	SF <sub>6</sub>	23,900	<b>HFC-41</b>	CH <sub>3</sub> F	150

### 2.1.3 Uncertainty Assessment

Although the 2006 IPCC Guidelines provides a comprehensive overview and categorization of all potential sources of GHG emissions, not all of them are relevant to Vanuatu. Furthermore, there is insufficient data on certain sources for them to be included in this inventory exercise and has been described in the sections below. A detailed assessment of each IPCC category was carried out as part of Vanuatu's second GHG inventory, including each category's relevance to Vanuatu and the availability of data required to estimate emissions from these categories. The 2006 IPCC guidelines provide guidance for an advance and technical uncertainty analysis. Such a detailed analysis is beyond the scope of Vanuatu's second GHG inventory.

In Vanuatu, key uncertainties are associated with data availability, lack of comprehensive information, data archiving and lack of country specific emission factors. It is recognized that having country specific emission factors and more detailed activity data will help reduce uncertainty in future inventory. For example, in the energy sector there is good data available on fuel imports into the country but there is lack of information on end usage. Similarly, for Land Use Change currently there is no national data available. The extent of the national forest resources is estimated based on reports and studies undertaken in the past and also crosschecked with FAO data. The waste sector also lacks information on waste characterization and composition. It can be concluded that with adequate training and capacity building on GHG inventory requirements, Vanuatu can provide more detailed and accurate information in subsequent GHG inventories.

## 2.2 Summary of Vanuatu's Greenhouse Gas Emissions

### 2.1.3 Ghg emissions in Vanuatu

Table 2.2 presents total GHG emissions by sources and removals by sinks for Vanuatu for the year 2000. Total national GHG emissions excluding removals in year 2000 were 585.39Gg CO<sub>2</sub>e, which is composed of 70.34Gg CO<sub>2</sub>e from energy; 502.83Gg CO<sub>2</sub>e from agriculture and 12.21Gg CO<sub>2</sub>e from waste. Emissions from perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur

hexafluoride (SF6) in Vanuatu are negligible, as the products containing these gases are not produced in the country. CO2 sequestration by the forestry and land use sector in year 2000 amounted to 7,913.16Gg CO2e. Total GHG emissions, including FOLU, are estimated to be (-) 7327.77Gg CO2e, indicating that Vanuatu is a net sink for GHG emissions.

**Table 2.2: GHG Emissions in Vanuatu in year, 2000**

("-" represents, not estimated due to non-availability of data or negligible value).

GHG Sources & Sinks	Total (CO <sub>2</sub> , CH <sub>4</sub> and N <sub>2</sub> O), CO <sub>2</sub> -equiv	GHG Gg						
		CO <sub>2</sub> Emissions	CH <sub>4</sub>	N <sub>2</sub> O	NOx	CO	NM VOC	SO <sub>2</sub>
Energy	70.34	69.61	0.02	0.00	0.45	1.41	0.25	0.001
Industrial Processes	-	-	-	-	-	-	-	-
Solvent and Other Product Use	-							
Agriculture	502.83	-	15.59	0.57	-	-	-	-
Land-Use Change & Forestry	-7,913.16	-7,913.16						
Waste	12.21	-	0.42	0.01	-	-	-	-
<b>Total GHG Emissions, excl. Removals</b>	<b>585.39</b>	<b>69.61</b>	<b>16.03</b>	<b>0.58</b>	<b>0.45</b>	<b>1.41</b>	<b>0.25</b>	<b>0.00</b>
<b>Total GHG Emissions, incl. Removals</b>	<b>-7,327.77</b>	<b>-7,843.55</b>	<b>16.03</b>	<b>0.58</b>	<b>0.45</b>	<b>1.41</b>	<b>0.25</b>	<b>0.00</b>

Figure 2.1 on page 40 presents a sectoral breakdown of Vanuatu's GHG emissions for year 2000. Contribution of each of the sectors is as follows:

- Energy (70.34Gg CO2 e.), 12.0%
- Industrial Process (0Gg CO2 e.), 0%;
- Solvent & other product use (0Gg CO2 e.), 0%;
- Agriculture<sup>8</sup> (502.83Gg CO2 e.), 85.9 %;
- Waste (12.21Gg CO2 e.), 2.1 %

The Agriculture sector is the biggest source of GHG emission in Vanuatu. Methane is the main GHG emitted as result of extensive agriculture activities in Vanuatu. Methane is a strong GHG with global warming potential 21 times that of CO2.

<sup>8</sup>Excluding Removals

Figure 2.1 Vanuatu's GHG Emission by Sectors (Year 2000)

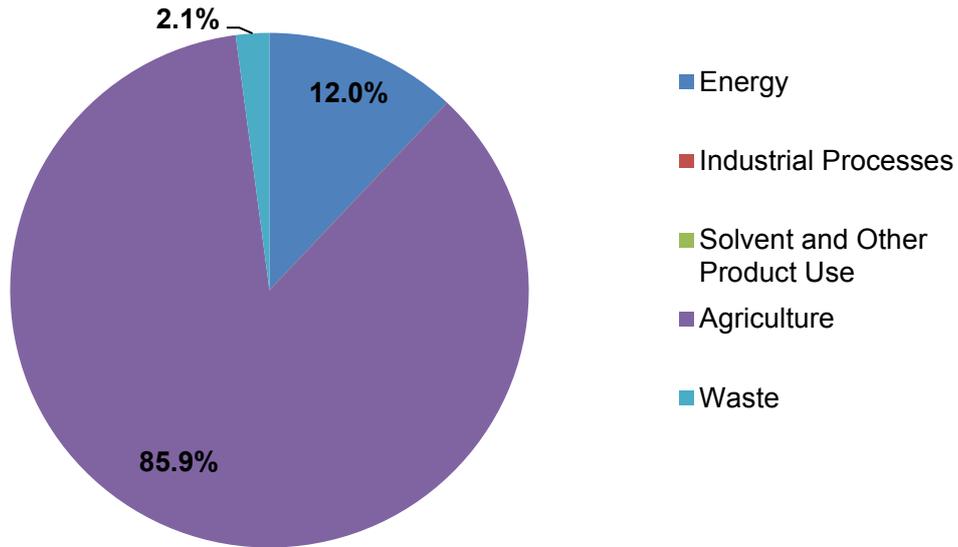


Figure 2.2 highlights the breakdown of various sub sectors in Vanuatu's GHG emissions for the year 2000. Each of these sub sectors are further discussed in Chapter 4. The largest contributor to GHG emissions in the year 2000 was the livestock sector amounting to 56.5% of total GHG emissions. The next biggest contributor was N2O from agriculture soils with 29.4% of total GHG emissions followed by the transport sector that contributed to 5.9% of total emissions.

Figure 2.2 Contribution of Various Sub Sectors in GHG Emission (Year 2000)

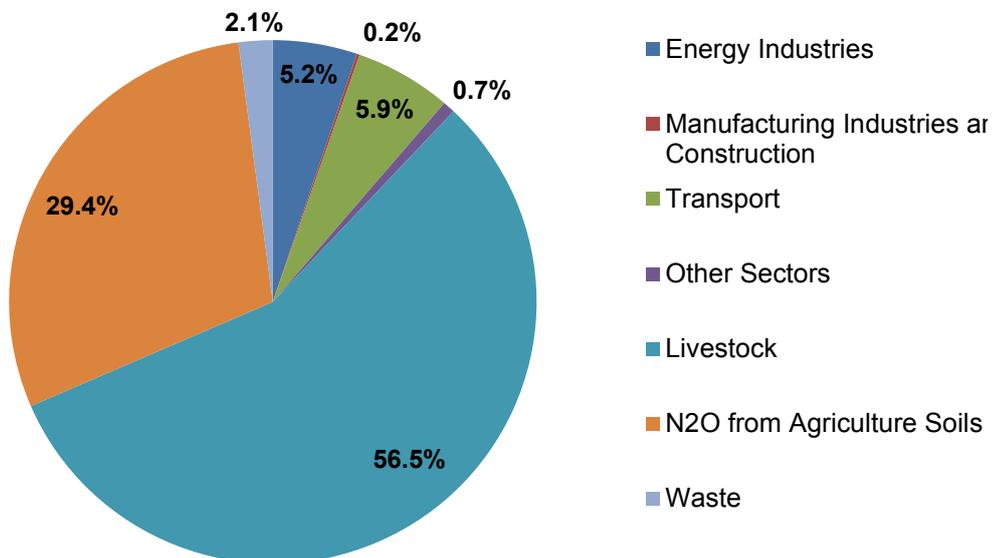


Table 2.3 presents the share of major GHG emitting activities in Vanuatu. It is observed that nearly 99% of GHG emissions in Vanuatu come from five activities: energy, transport, livestock, N<sub>2</sub>O from agriculture soils and waste. The biggest contributors are livestock and N<sub>2</sub>O emissions from agriculture soils. Vanuatu has a limited industrial sector and relatively poor energy infrastructure; which results in a high share of GHG emissions from agriculture sector. Department of Agriculture in Vanuatu needs both technical and financial support to come up with mitigation plans to reduce GHG emissions from the agriculture sector.

**Table 2.3: Sources of GHG Emissions in Vanuatu**

Emission by Activities	Emissions (Gg CO <sub>2</sub> e)	% Share
Livestock	331	56.5%
N <sub>2</sub> O from Agriculture Soils	172	29.4%
Transport	35	5.9%
Energy Industries	30	5.2%
Waste	12	2.1%
Other Sectors	4	0.7%
Manufacturing Industries and Construction	1	0.2%
<b>Total</b>	<b>585.39</b>	<b>100%</b>

## 2.2.2 Gas by Gas Emission Inventory

This section provides a brief description of emissions by GHG type in Vanuatu for the year 2000. These emissions arise from Energy, IPPU, AFOLU and Waste sectors. Greenhouse gases covered in this analysis include CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O and are estimated to be 12% CO<sub>2</sub>, 31% N<sub>2</sub>O and 57% CH<sub>4</sub> of the total GHG emissions. Figure 2.3 presents the breakdown of emissions by gases in Vanuatu.

**Figure 2.3 GHG Emissions by Gases (Year 2000)**

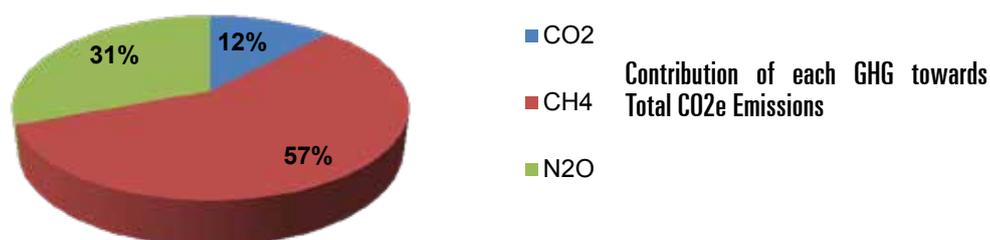


Table 2.4 presents emissions from different GHG in Vanuatu. It can be confirmed from the table that Methane is the most potent GHG in Vanuatu. This is primarily due to emissions from livestock farming, solid waste management and disposal, domestic and commercial wastewater handling. The next most prominent GHG in Vanuatu is N<sub>2</sub>O followed by CO<sub>2</sub>.

**Table 2.4: Share of GHG Emissions in Vanuatu (Year 2000)**

Type of Gas	Emissions (Gg CO <sub>2</sub> e)	% Share
CO <sub>2</sub>	69.61	12%
CH <sub>4</sub>	336.67	57%
N <sub>2</sub> O	179.11	31%

**Carbon dioxide (CO<sub>2</sub>):** Net CO<sub>2</sub> emissions in Vanuatu are estimated to be 69.16Gg i.e. 12% of total GHG emissions. The energy sector is the main source of CO<sub>2</sub> emissions, accounting for 98% of emissions. Combustion of fossil fuels is the main contributor of CO<sub>2</sub> emissions in Vanuatu. Overall, the CO<sub>2</sub> emissions in Vanuatu have increased by 26% since 1994. This is mainly due to increased use of petroleum fuels in transportation and increased electricity generation. Table 2.5 represents the contribution of CO<sub>2</sub> emissions from sectors covered under this inventory report.

**Table 2.5: CO<sub>2</sub> Emissions (Gg), Vanuatu (Year 2000)**

Sectors	1994	2000	% Change since 1994
Energy	55.13	69.61	26.3%
Industrial Processes	-	-	
Solvent and Other Product Use	-	-	
Agriculture	-	-	
Land-Use Change & Forestry	-	-	
Waste	-	-	
<b>Total</b>	<b>55.13</b>	<b>69.61</b>	<b>26.3%</b>

**Methane (CH<sub>4</sub>):** Net CH<sub>4</sub> emissions in Vanuatu are estimated to be 15.85Gg and constitute 57% of total GHG emissions. Livestock farming is the biggest source of methane emissions in Vanuatu and accounts for 98.3% of methane emissions in the country and is followed by the waste sector (1.4% shares) and energy sector (0.3% share). The overall methane emission in Vanuatu has increased by 43.1% from the year 1994. This increase is mainly due to increased livestock farming as the country has one of the most conducive environments in the world for raising cattle. Table 2.6 represents emission of methane in Vanuatu from different sectors.

**Table 2.6: CH4 Emissions (Gg), Vanuatu (Year 2000)**

Sectors	1994	2000	% Change since 1994
Energy	0.00	0.022	
Industrial Processes	-	-	
Solvent and Other Product Use			
Agriculture	11.20	15.59	39.2%
Land-Use Change & Forestry			
Waste	-	0.42	
<b>Total</b>	<b>11.20</b>	<b>15.85</b>	<b>43.1%</b>

**Nitrous Oxide (N2O):** Net N2O emissions in Vanuatu are estimated to be 0.58Gg, which translates to 31% of total GHG emissions. N2O emissions from managed soil is the biggest source of nitrous oxide emissions and accounts for 98% of N2O emissions in the country followed by the waste sector (1.9% share) and energy sector (0.2%) The overall nitrous oxide emissions show a substantial increase mainly because these emissions from the AFOLU sector were not considered in the 2000 GHG inventory. Table 2.7 represents N2O emission in Vanuatu from different sectors.

**Table 2.7: N2O Emissions (Gg), Vanuatu (Year 2000)**

Sectors	1994	2000
Energy	0.03	0.001
Industrial Processes	-	-
Solvent and Other Product Use	-	-
Agriculture	-	0.57
Land-Use Change & Forestry	-	-
Waste	-	0.01
<b>Total</b>	<b>0.03</b>	<b>0.58</b>

**Hydrofluorocarbons (HFCs):** Emissions from perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and Sulphur hexafluoride (SF6) in Vanuatu are negligible, as the products containing these gases are not produced in the country. Emissions from the consumption of Halocarbons and SF6 were not estimated due to lack of activity data.

**Indirect Greenhouse Gases:** Table 2.8 represents emissions from indirect gases in Vanuatu. NOx, CO, NMVOC are the main indirect gases emitted. The main sources of these gases are from energy sector wherein these gases are emitted due to burning of fossil fuel.

**Table 2.8: Indirect Greenhouse Gas Emissions in Vanuatu (Year 2000)**

Type of Gas	Emissions (Gg CO <sub>2</sub> e)
NOx	0.45
CO	1.41
NMVOC	0.25

## 2.3 GHG Emission Trends: 2000-2010

The GHG emission for Vanuatu for the year 2005 and 2010 has been calculated based on the similar data source and methodology used for estimation of GHG emissions for the year 2000. Table 2.9 presents Vanuatu's experience in overall increase in GHG emissions during the period 2000-2010. The quantity of CO<sub>2</sub> emissions increased from 585.39Gg CO<sub>2</sub>e in 2000 to 720.66Gg CO<sub>2</sub>e in 2010. The agriculture sector is the highest emitter of GHG during this period. Emission from agriculture sector increased by 17%; during this period primarily due to increase in livestock during the period. The next biggest increase in emissions during this period is in the energy sector which increased by 73%, primarily due to increased use of fossil fuel in electricity generation and transportation.

**Table 2.9: Total Emissions in Vanuatu (CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O) CO<sub>2</sub>e (Gg)**

GHG Sources & Sinks	2000	2005	2010
Energy	70.34	94.30	122.44
Industrial Processes	-	-	-
Solvents and Other Products Use	-	-	-
Agriculture	502.83	513.25	587.48
Land Use Change and Forestry (removals)	-7,913.16	-7,910.69	-7,913.16
Waste	12.21	9.38	10.75
<b>Total GHG Emissions, excl. Removals</b>	<b>585.39</b>	<b>616.94</b>	<b>720.66</b>
<b>Total GHG Emissions, incl. Removals</b>	<b>-7,327.77</b>	<b>-7,293.75</b>	<b>-7,192.50</b>

## 2.4 GHG Emissions by Sector

### 2.4.1 Energy Sector

GHG emissions in the energy sector are primarily associated with fuel combustion and fugitive emissions from fuels. Since Vanuatu is 100% dependent on imported fossil fuels to meet its energy demand and has no mining and exploration activities, fugitive emissions from fuels are not considered in GHG estimation. Emissions from the energy sector from fuel combustion includes the following categories:

- Energy Industries
- Manufacturing Industries and Construction
- Domestic Aviation
- Road Transport
- National Navigation
- Commercial/Institutional Sector
- Residential
- Fishing

In the year 2000, the energy sector was the second dominant source of GHG emissions in Vanuatu accounting for 12% of total GHG emissions in country. GHG estimation from the energy sector is based on data from Vanuatu National Statistics Office (VNSO), Customs Department on fuel imports, Department of Energy and UNELCO. GHG emissions from fuel combustion in Vanuatu are associated with the use of petroleum products mainly for electricity generation and road transport. Kerosene and LPG are mainly used for cooking. The total GHG emissions from the energy sector are estimated to be 70.34Gg CO<sub>2</sub>e. Table 2.10 below presents CO<sub>2</sub>e emissions from different sub sectors under the energy sector.

**Table 2.10: Emissions from Energy Sector in Vanuatu (Gg CO<sub>2</sub>e)**

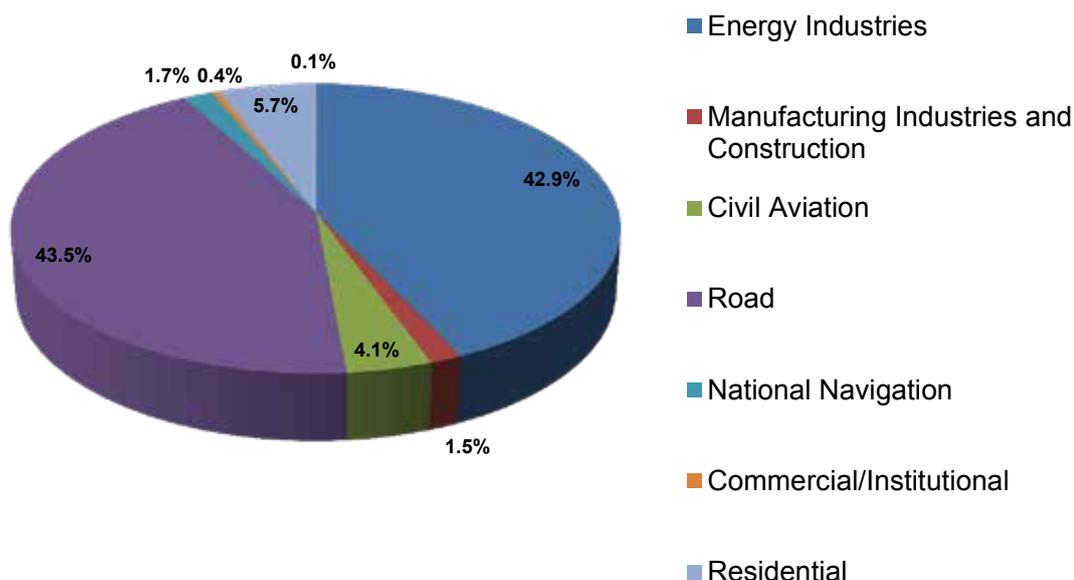
Source	2000
Energy Industries	30.21
Manufacturing & Construction	1.08
Transport	34.69
Other Sectors (commercial, residential, /fishing)	4.37
<b>Total CO<sub>2</sub>e Emissions</b>	<b>70.34</b>
<b>International Bunkers (not included in national total)</b>	<b>5.90</b>

Table 2.11 presents emission of different gases from energy sector in Vanuatu. From the table it can be inferred that the most prominent GHG emitted from the energy sector is CO<sub>2</sub> amounting to 69.61Gg followed by CH<sub>4</sub> emissions of 0.02Gg. Some minor NO<sub>x</sub> and CO emissions associated with the energy sector exist and are estimated to be 0.45 and 1.41Gg respectively.

**Table 2.11: GHG Emissions from Energy Sector in Vanuatu (Gg CO<sub>2</sub>e, 2000)**

Source	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	NO <sub>x</sub>	CO	NM VOC	SO <sub>2</sub>	Total CO <sub>2</sub> e
Energy Industries	30.10	0.00	0.00	0.08	0.01	0.00	0.001	<b>30.21</b>
Manufacturing Industries and Construction	1.07	0.00	0.00	0.00	0.00	0.00	0.00	<b>1.08</b>
Domestic Aviation	2.84	0.00	0.00	0.01	0.00	0.00	-	<b>2.87</b>
Road	30.44	0.00	0.00	0.31	1.09	0.21	-	<b>30.60</b>
National Navigation	1.22	0.00	0.00	0.03	0.02	0.00	-	<b>1.22</b>
Commercial/ Institutional	0.31	0.00	0.00	0.00	0.00	0.00	-	<b>0.31</b>
Residential	3.53	0.02	0.00	0.01	0.28	0.03	-	<b>3.98</b>
Fishing	0.09	0.00	0.00	0.00	0.00	0.00	-	<b>0.09</b>
<b>Total GHG Emissions</b>	<b>69.61</b>	<b>0.02</b>	<b>0.00</b>	<b>0.45</b>	<b>1.41</b>	<b>0.25</b>	<b>0.00</b>	<b>70.34</b>
<b>International Bunkers (not included in National total)</b>	<b>5.90</b>	-	-	-	-	-	-	<b>5.90</b>

**Figure 2.4 Sub – sectoral breakdown of GHG Emissions under Energy Sector**



### **Road Transport**

It is observed that the share of GHG emission from the transport sub-sector (under energy sector) is the largest accounting for 43.5% of emissions. The majority of emissions from this sector are CO<sub>2</sub> resulting from the combustion of gasoline used in internal combustion engines. Road transportation constitutes 85% of GHG emissions under transportation; which is dominated by cars and other light multiutility vehicles.

### **Electricity Generation**

Energy industries are the next big emitter under energy sector accounting for 42.9% of emissions. The emissions from energy industries have increased by 138% since 1994. Electricity generation is the single largest source of GHG emission from the energy industries in Vanuatu. The significant growth in emissions from energy industries reflects increased demand for electricity in the country. Emissions from all other sub - sectors constitute less than 15% of all the GHG emission under the energy sector.

### **Residential**

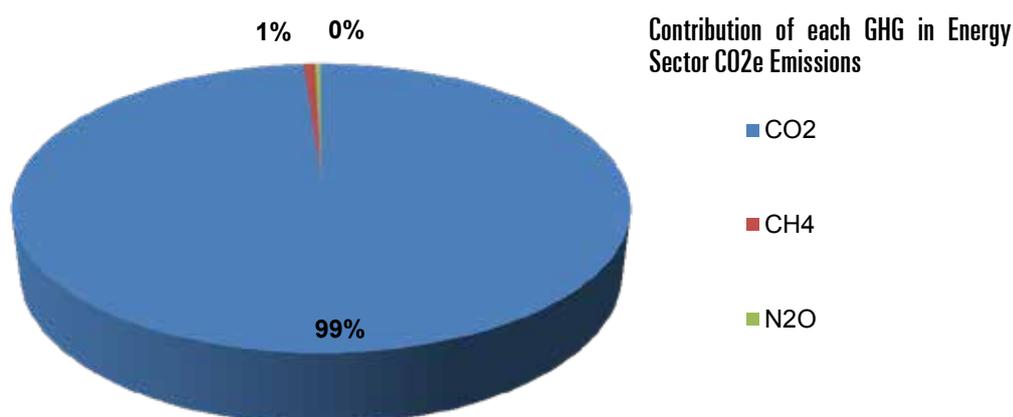
The residential sub-sector in Vanuatu is the third biggest source of GHG emissions and constitutes 5.7% of energy sector emissions. LPG is used for cooking and kerosene is primarily used for lighting. It is important to note that households in Vanuatu also consume large quantities of biomass as cooking fuel. Since CO<sub>2</sub> emission from biomass is not counted under net emissions, it is reported separately as a memo item.

### Other Sub - Sectors

The other sub-sectors consist of domestic aviation, manufacturing industries and construction, national navigation, commercial/institutional and fishing. Total emissions from these sub sectors account for 13.6% of GHG emissions under the energy sector. Domestic aviation is the biggest emitter in this category amounting to 4.1% of total emissions. However, this does not include emissions due to international flights; such emissions are estimated separately and are reported as memo items in this report.

During the year 2000, energy sector contributed 98% of the total CO<sub>2</sub> emissions, 1% of the CH<sub>4</sub> and N<sub>2</sub>O emissions for Vanuatu respectively. Figure 2.5 presents the contribution of various gases under the energy sector.

Figure 2.5 GHG Emissions by Gases under Energy Sector (Year 2000)



### 2.4.2 Carbon Dioxide Emissions from the Energy Sector Using the Reference Approach

The GHG Emissions from the energy sector were estimated using two approaches - reference approach and sectoral Approach using IPCC Tier 1 analytical framework. Under the reference approach GHG emissions were estimated using only the fuel consumption data for each type of fuel. The results of estimated CO<sub>2</sub> emissions for the year 2000 using reference approach was 72.02Gg which is close to the 69.61Gg of CO<sub>2</sub> emissions estimated using sectoral approach. The difference between the outputs from the two approaches is 0.03%, which could be considered as negligible. Table 2.12 represents the calculation results using reference approach and sectoral approach.

**Table 2.12: Energy Sector CO2 Emissions using Reference and Sectoral Approach**

Sector		CO <sub>2</sub> Emissions	CH <sub>4</sub>	N <sub>2</sub> O	NO <sub>x</sub>	CO	NM VOC	SO <sub>2</sub>	Total GHG CO <sub>2</sub> e
Energy	Reference Approach	72.016	-	-	-	-	-	-	72.016
	Sectoral Approach	69.607	0.022	0.001	0.448	1.407	0.251	0.001	70.34
Fuel Combustion		69.607	0.022	0.001	0.448	1.407	0.251	-	70.34
Fugitive Emissions		-	-	-	-	-	-	-	-

### 2.4.3 Memo Items

In accordance with 2006 IPCC guidelines, CO<sub>2</sub> emissions from International Bunkers and burning of biomass are not included under the national items, but are reported separately as memo items in the inventory.

**International Bunkers:** International bunkers include aviation and navigation. Emissions from marine transportation are not estimated due to lack of data. CO<sub>2</sub> emissions from international aviation for the year 2000 were estimated to be 5.9Gg CO<sub>2</sub>e, while emissions from other gases were insignificant. These emissions are not counted under national totals.

**Biomass:** In Vanuatu biomass comprises a substantial amount of fuel mix used in both rural and urban households for cooking. CO<sub>2</sub> emissions from biomass fuels are included in this inventory as memo item and are estimated to be 5.96Gg CO<sub>2</sub>e. Emissions from use of biomass fuels are not included or reported in the national emissions.

## 2.5 Industrial Processes

This sector covers GHG emissions from industrial processes as an output of non-energy related activities. In Vanuatu this sector is small and there is limited data available. Hence GHG emissions from this sector are not estimated.

## 2.6 Solvents and Other Products Use

This sector comprises emissions (primarily Non Methane Volatile Organic Compounds) from solvents and other products use containing volatile compounds. There are no calculations and emissions factors in the revised 1996 IPCC guidelines to estimate GHG emissions from this sector. However in Vanuatu there is limited data available on use of such solvents and products use, hence GHG emissions from this sector are not estimated.

## 2.7 Agriculture

The agriculture sector is the major contributor of methane emissions in Vanuatu and is also the top contributor of GHG emissions in Vanuatu. Emissions in this sector are estimated for following categories:

- Livestock Farming
- Enteric Fermentation
- Manure Management
- N<sub>2</sub>O Emissions from managed soils

Emissions due to rice cultivation and burning of Savannas do not occur in Vanuatu while emissions from field burning of agricultural residues have not been estimated due to lack of data. Data used for estimating GHG emissions from agriculture sector were from national livestock statistics and Department of Agriculture. These were also crosschecked and confirmed with FAO data. Since use of fertilizers in Vanuatu is very limited and records are not available for 2000, emissions from use of fertilizer are not estimated under the agriculture sector.

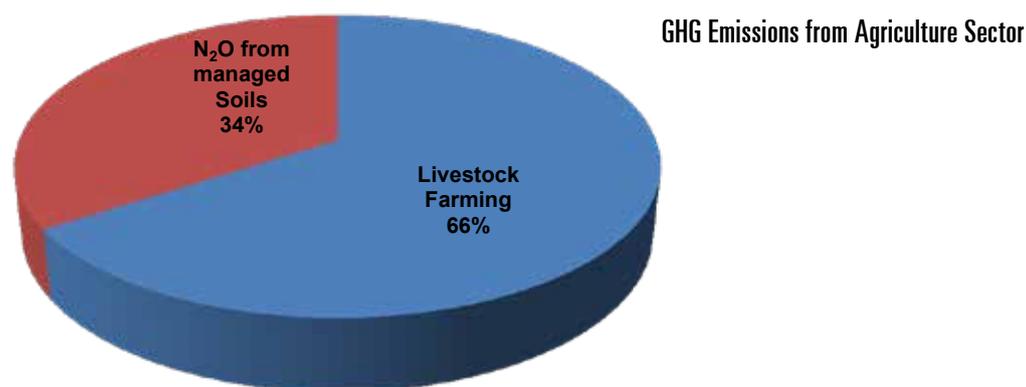
The emissions from agriculture sector in Vanuatu are the largest contributor and account for 86% (502.83Gg CO<sub>2</sub>e.) of Vanuatu's total GHG emissions for the year 2000. It can be observed from Table 2.13, that GHG emissions from agriculture sector have increased since 1994. This increase is primarily due to increase in livestock farming and N<sub>2</sub>O emissions from managed soils were not estimated under the Initial National Communication.

**Table 2.13: GHG Emissions from Agriculture Sector in Vanuatu (Gg CO<sub>2</sub>e)**

Source	1994	2000	% Change since 1994
Livestock Farming	235.16	330.56	41%
N <sub>2</sub> O from managed Soils	NE*	172.27	
<b>Total GHG Emissions</b>	235.16	502.83	
*NE – Not estimated			

Emissions from the agriculture sector are primarily composed of methane and nitrous oxide. However, emissions of indirect GHGs such as CO and NO<sub>x</sub> are considered negligible and are not estimated. Emissions from this sector are largely from livestock farming and account for 330.56Gg CO<sub>2</sub>e which is 66% of emissions from the sector. The remaining 34% of GHG emissions are due to N<sub>2</sub>O emissions from managed soils (Figure 2.6).

Figure 2.6 GHG Emissions from Agriculture Sector



### Livestock Farming

There are two sources of GHG emissions from Livestock farming:

**Enteric Fermentation:** Enteric Fermentation is the fermentation that takes place in the digestive system of animals. In particular in ruminant animals (cattle, buffalo, sheep, goats) methane is produced in the rumen by the bacteria as a by-product of fermentation process. This methane when released adds to GHG emission in the atmosphere. Enteric fermentation accounts for 62% of GHG emissions from Livestock farming in Vanuatu. Cattle account for the majority of methane emissions in this category. The subtropical environment of Vanuatu is well suited for cattle farming. This provides a conducive environment for cattle farming in Vanuatu, which has increased significantly since 1994 and hence is a significant source of GHG emissions in the country.

**Manure Management:** Systematic management of manure from livestock is not practiced in Vanuatu. There is limited data available on management of manure from cattle, swine, poultry, horses and goats excretion. Hence, GHG emission for manure management is estimated based on default values provided in Revised 1996 IPPC guidelines. In Vanuatu, GHG emissions from manure management amount to 38% of GHG emissions from livestock farming sector. This can be reduced by introducing animal waste management systems.

**N<sub>2</sub>O Emissions from managed soils:** Emissions of N<sub>2</sub>O from managed soils are primarily due to the microbial processes of nitrification and de-nitrification. Emissions from this category constitute 34% of total CO<sub>2</sub> emissions from livestock farming sector. Due to limited data available on usage of fertilizers in Vanuatu for the year 2000, only emissions due to animal waste are taken into account.

## 2.8 Land Use Change and Forestry Sector

Forest land (all types) covers about 75% of the total land area in Vanuatu, and include dense tropical rainforests and exotic plantation forests. Much of the natural forest is on steep inaccessible sites and contains few species for commercial use.



In the current inventory, under Land Use Change and Forestry sector, CO<sub>2</sub> emissions / removals are estimated for changes in forest and other woody biomass stock including commercial logging. Due to lack of data, emissions/removals from forest and grassland conversion, abandonment of managed lands and CO<sub>2</sub> emissions from soil have not been estimated. The data for estimation of CO<sub>2</sub> removals from forests is based on reports from Department of Forests which were also crosschecked and confirmed with FAO data.

The land-use change and forestry sector is a net sink of CO<sub>2</sub> in Vanuatu. The CO<sub>2</sub> removals from the forestry sector are estimated to be -7,913.14Gg of CO<sub>2</sub>e for the year 2000. The prominence of carbon sequestration in the national GHG inventory reflects national forest policy that regards forests as crucial for the wellbeing of the ni-Vanuatu population to furnish essential needs such as wood, food, fodder and traditional remedies. In the year 2000, the forestry sector contributed VT295 million i.e. approximately 0.9% of the GDP<sup>9</sup>.

<sup>9</sup>[http://cn.china.cn/2011images/vanuatu/NFP\\_Comprehensive\\_June\\_2011.pdf](http://cn.china.cn/2011images/vanuatu/NFP_Comprehensive_June_2011.pdf)

**Table 2.14: Carbon dioxide emissions and removals from Land Use Change and Forestry Sector, 2000 (Gg CO<sub>2</sub>e)**

Source	2000
Forest and other Woody Biomass	- 8,062.67
Commercial Harvest	149.53
<b>Net GHG Removals</b>	<b>-7,913.14</b>

During the first national communication (INC), emissions from Land Use Change and Forestry were estimated only for commercial forestry and commercial plantations. The current inventory also considers biomass growth for GHG estimation. Table 2.15 provides information on land area and forest cover in Vanuatu for the year 2000.

**Table 2.15: Land Area and Forest Cover, 2000**

Type of Land	Value	Unit
Total Land Area	1219	1000 Hectare
Total Forest Cover	447	1000 Hectare
Percentage of land area covered by forest	36.7%	
Other wooded land	39.3%	
Other Land Types	24.4%	
Source: FAO Stat		

## 2.9 Waste

GHG emissions from the waste sector in Vanuatu are estimated for following sub sectors:

- Solid Waste Management and Disposal
- Domestic and Commercial Wastewater Handling

Waste management sector emissions have been estimated using data for two major cities Port Vila and Luganville, which are the main population centres of the country. The remaining islands in Vanuatu

are sparsely populated and are not included in the estimation due to lack of reliable data on waste generation. Data for waste sector has been largely sourced from published literature on municipal solid waste management, study on Port Villa urban development project, studies conducted by Japan International Cooperation Agency (JICA) under its Project for Promotion of Regional Initiative Solid Waste Management (J-PRISM), Department of Environmental Protection and Conservation data, and results from the population census.

Table 2.16 presents GHG emissions from waste disposal in Vanuatu for the year 2000. The emissions from waste sector were not estimated in 1994 under the first national communication. Emissions from this sector are a total of 12.21Gg CO<sub>2</sub>e i.e. 2.1% of Vanuatu's total GHG emissions. Solid waste disposal on land accounted for 51% of total waste-related GHG emissions followed by domestic wastewater handling that accounts for the remaining 49%.

**Table 2.16: CO<sub>2</sub> Emissions from Waste Sector in Vanuatu (Gg CO<sub>2</sub>e)**

Source	1994	2000
Solid Waste Management and Disposal	NE	6.3
Domestic and Commercial Wastewater Handling	NE	5.92
<b>Total GHG Emissions</b>	-	<b>12.21</b>

Table 2.17 presents emissions of different gases in the waste sector in Vanuatu. Methane is the most prominent gas emitted from the waste sector. Unmanaged solid waste and wastewater sites, lead to methane emissions. The methane emitted is estimated using the quantity of waste generated by the management of the waste, the proportion of carbon that may be transformed into methane etc.

**Table 2.17: GHG Emissions from Waste Sector in Vanuatu (Gg)**

Source	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	Total CO <sub>2</sub> e
Solid Waste Management and Disposal	-	0.3	-	6.3
Domestic and Commercial Wastewater handling	-	0.12	0.11	5.92
<b>Total GHG Emissions</b>	-	<b>0.42</b>	<b>0.01</b>	<b>12.21</b>

**Solid Waste Management and Disposal:** The key source of methane emissions from solid waste management and disposal include emissions from anaerobic decomposition of waste disposed at Bouffa landfill site, Port Villa and Luganville solid waste disposal site. Solid waste disposal constitutes 41% of GHG emissions from waste sector in Vanuatu and is one of the major concerns for the country. The problem of solid waste disposal is particularly pronounced in the urban areas as the waste from rural areas is generally scattered and does not pose much hazard. GoV is currently working with JICA to improve the solid waste management situation in the country. The waste composition considered for the current inventory calculation is provided in Table 2.18.

**Table 2.18: Break-up of Waste Composition in Vanuatu**

Type	%
A. Paper and textiles	4.6%
B. Garden and park waste and other (non-food) organic putrescible	0.0%
C. Food waste	72.6%
D. Wood and straw waste	0.0%
E. Other	22.8%

**Domestic and Commercial Wastewater Handling:** The sanitation system in Vanuatu is largely decentralized, consisting of privately managed household and commercial septic tanks for the collection of human waste. These allow the decomposition of the waste but the process leaves sludge as a by-product. Periodically the residual sludge is removed by private service providers through tankers and disposed of at a designated site. Emissions from this sub-sector constitute 59% of GHG emissions from the waste sector and are quite significant. GoV, with support from ADB is currently considering developing a sludge treatment facility at Port Vila.

Emissions from incineration and open burning of waste have not been estimated in the current inventory.

## 2.10 Conclusion

This GHG inventory serves as a baseline for the country to measure its progress towards reduction of greenhouse gases. It also serves as an integral tool in designing the country's climate change policies and to measure the success of such policies. The current GHG inventory provides comprehensive information about GHG emissions and removals in Vanuatu for the base year 2000 and also reflects the GHG emission trend since 1994. The inventory for the base year 2000 and subsequent year 2005 and 2010 indicates that Vanuatu is a net sink for CO<sub>2</sub> emissions. The key findings and recommendations of this inventory development exercise have been included in Appendix C.

## 3. Vulnerability and Adaptation (V&A)

### 3.1 Background

The aim of the vulnerability and adaptation assessment is to generate and update information about how projected climate change, climate variability and extreme events may affect Vanuatu's economic and social sectors. This chapter outlines Vanuatu's current climatic, socio-economic and natural systems; current vulnerability and adaptation efforts; future risks and national/sectoral adaptation policies, strategies and measures including a summary of potential adaptation actions for priority sectors. In terms of adaptation projects, consideration has been given to those areas and/or sectors that are most critical and are of highest priority.

Vanuatu has positioned itself as a regional leader in the fields of Climate Change (CC) and Disaster Risk Reduction (DRR) and has been widely applauded for its initiative to establish a National Advisory Board for Climate Change and Disaster Risk Reduction (NAB) as a means of improving coordination and governance around the two issues. Vanuatu's implementation of the UNFCCC has progressed exponentially in recent years as government sector agencies become more organized and civil

society, academic, the private sector, development partners and regional agencies have stepped up their activities in Vanuatu. Vanuatu faces a full range of geologic and climatic hazards and is also subjected to climatic variability and extremes. The country is located in a seismically and volcanically active region and has high exposure to geologic hazards, including volcanic eruptions, earthquakes, tsunamis, and landslides. Earthquakes are frequent and often originate at considerable depth and are



therefore not too destructive (large magnitude but low density). Nevertheless, some earthquakes have caused extended damages in the past. Destructive tidal waves (tsunami) occur occasionally as a result of earthquakes.

Vanuatu's latitude places it in the path of tropical cyclones, also making it subject to cycles of El Niño and La Niña, which increase the risks of droughts and floods respectively. Future climate change and sea-level rise threaten to exacerbate the risks posed by tropical cyclones, coastal and river flooding, coastal erosion, land-slides, hailstorms, heavy rainfall events, and droughts. Vanuatu is also vulnerable to anomalously long dry spells and prolonged wet conditions associated with the El Niño (warm phase) and La Niña (cool phase) of the El Niño-Southern Oscillation (ENSO) phenomenon, ocean acidification and sea level rise.



Vanuatu is among the countries in the Pacific region that are most vulnerable to the risks of climate change, climate variability and sea level rise. In a report for the International Decade for Natural Disaster Reduction for the Pacific Island Countries<sup>10</sup> (1990-2000), Vanuatu was classified as highly vulnerable to all natural hazards. According to the Commonwealth Vulnerability Index-based on (a) the impact of external shocks over which an affected country has little or no control and (b) the resilience of a country to withstand and recover from such shocks - Vanuatu ranks as the world's most vulnerable country out of 111 developing countries assessed. Climate-related disasters have had huge impacts on the economic growth and national development. According to International Disaster Database, 37 disasters reported in Vanuatu during 1950-2004 resulted in significant economic (approximately US \$384.4 million) and social costs (Loss of life, livelihood, homes, roads, relocation, job losses etc.). Due to which, on an average 15.5% of population were affected during disaster years and 4.5% overall the years with average impact on GDP estimated at around 30% during disaster years and 4.4% over all the years<sup>11</sup>.

The vulnerability and adaptation assessment has followed IPCC, UNFCCC and Pacific-community-based vulnerability and adaptation methodologies adapted for Vanuatu. The assessments were built upon the considerable body of existing information (e.g. recent sector policies, plans and strategies, the Vanuatu Climate Risk Profile) and used a risk-based approach based on up-to-date, factual and often quantitative information, wherever possible.

<sup>10</sup>[http://www.pacificdisaster.net/pdnadmin/data/original/SOPAC\\_2003\\_Disaster\\_in\\_Pacific.pdf](http://www.pacificdisaster.net/pdnadmin/data/original/SOPAC_2003_Disaster_in_Pacific.pdf)

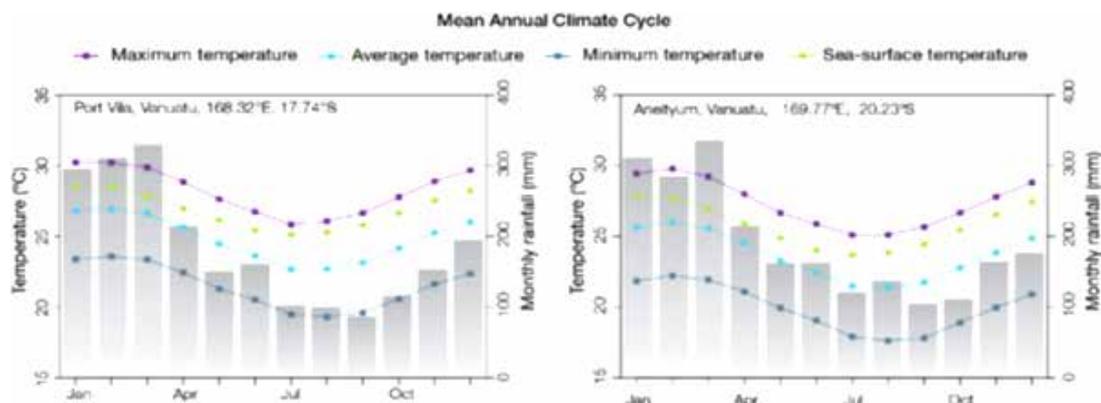
<sup>11</sup>Estimated economic and social impact of disasters in selected Pacific Island countries (1950-2004), World Bank

## 3.2 Vanuatu's Current Climatic Scenario

This section provides a brief description of climatic scenario for Vanuatu including its past (since 1950) and present climate as well as projections for the future, and is derived from the collective work of ni-Vanuatu and Australian climatologists under the Pacific Climate Change Science Joint Program<sup>12</sup> (PCCSP- a collaborative research partnership between Australian Government agencies, East Timor and 14 Pacific Island countries). Observed trends and analysis of air temperature, rainfall, extreme events (including tropical cyclones), sea-surface temperature, ocean acidification, mean and extreme sea levels are presented and projections for air and sea-surface temperature, rainfall, sea level, ocean acidification and extreme events for the 21st century are provided.

The climatic scenarios for Vanuatu studied under the PCCSP have identified a set of 18 models, which provide a reasonable representation of observed climate over the region and future climate for Vanuatu. The climatic data has been obtained from existing 47 operational meteorological stations in Vanuatu (Multiple observations within a 24 hour period are taken at Sola, Pekoia, Saratamata, Lamap, Bauerfield, White grass and Analguahat). At three climate stations, Lambubu, Lamap and Aneityum and at 39 rainfall stations across the country a single observation is taken daily at 9.00 am local time. The primary climate stations are located at Port Vila and Bauerfield Airport on the island of Efate.

**Figure 3.1 Mean annual cycle of rainfall (grey bars) and daily maximum, minimum and mean air temperatures at Port Vila (left) and Aneityum (right), and local sea-surface temperatures derived from the HadISST dataset (1870 to Present) (PCCS 2012)<sup>13</sup>**



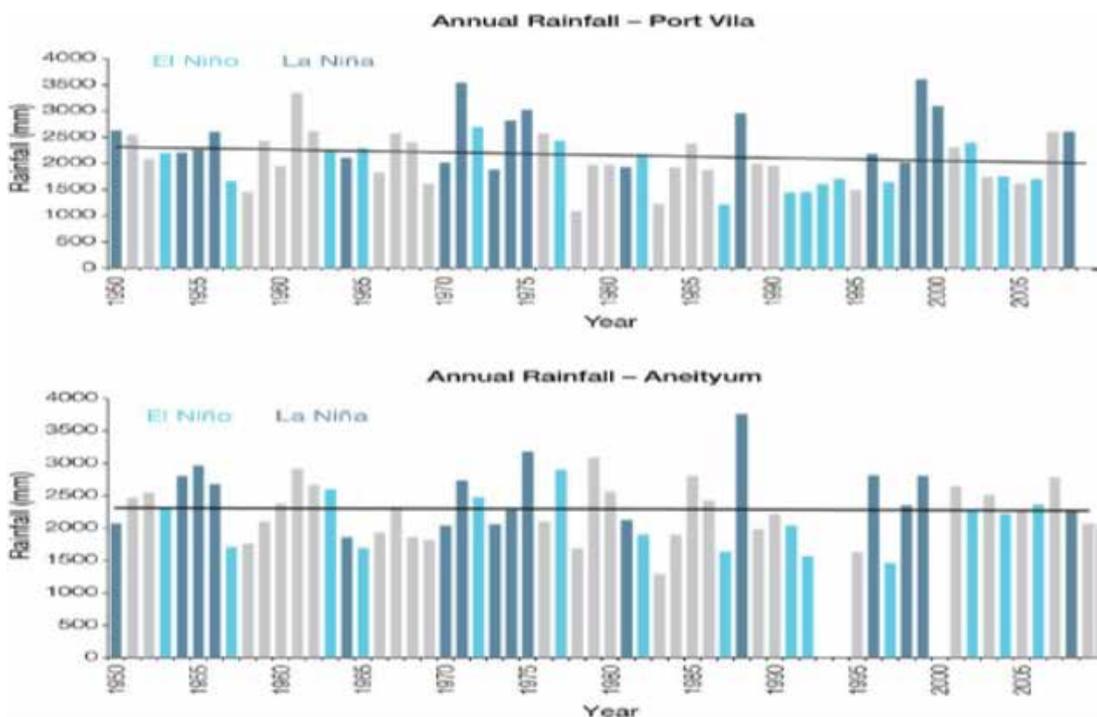
The seasonal cycles data (seasonal variations in rainfall and air temperature) of Vanuatu at Port Vila (central region) and Aneityum (in the south) station, shows that mean monthly Aneityum temperatures are about 2°C cooler than those in Port Vila; highest temperatures in January-February, with the coolest months (July-August) about 4°C cooler than the warmest months. The cooler winter air temperatures are due to weaker solar radiation and the influence of high-pressure cells bringing cold winds from higher latitudes. Seasonal variations in sea-surface temperatures closely match those of air temperatures and have a strong influence on the air temperatures on the islands of Vanuatu.

<sup>12</sup>[www.pacificclimatechangescience.org](http://www.pacificclimatechangescience.org)

<sup>13</sup>Pacific Climate Change Science, Government of Australia, 2012(<http://www.pacificclimatechangescience.org/publications/reports/>)

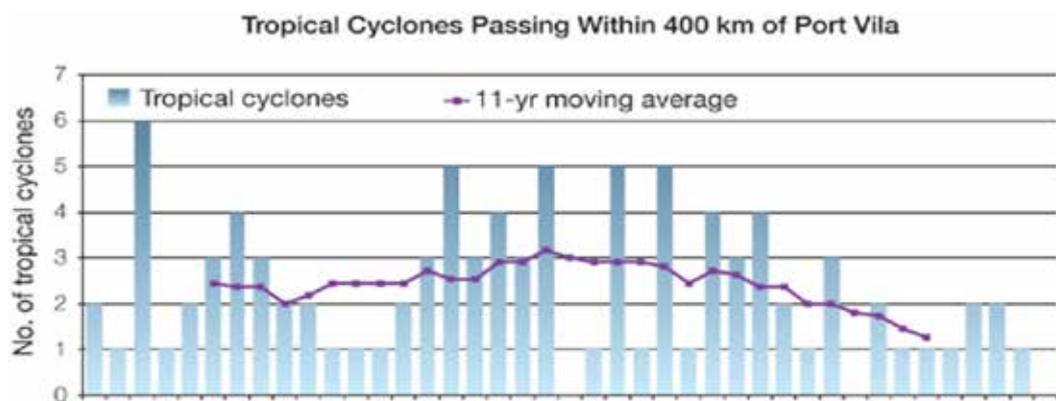
Vanuatu's rainfall is strongly influenced by the position and strength of the South Pacific Convergence Zone (SPCZ), which lies north of the country during the winter. Wet season is usually marked from November to April with highest rainfall from January to March and a dry season from May to October. Low-pressure systems embedded in the SPCZ often become tropical cyclones during the cyclone season. Large variations in rainfall are observed in Vanuatu from year to year. The wettest years receive up to three times more rainfall than the driest years mainly linked to the El Niño Southern Oscillation (ENSO). El Niño events tend to bring a late start to the wet season and lower rainfall in both the wet and dry seasons as well as cooler conditions in the dry season. Opposite impacts are usually observed during La Niña events.

**Figure 3.2 Annual rainfall at Port Vila and Aneityum (Light blue, dark blue and grey bars denote El Niño, La Niña and neutral years respectively)(PCCS 2012)**



The tropical cyclone season in the Vanuatu region is between November and April. Occurrences outside this period are rare. There has been a significant increase in the frequency of tropical cyclones in the country as a whole over the recorded period. The tropical cyclone archive for the Southern Hemisphere indicates that between the 1969/70 and 2009/10 seasons, the centre of 94 tropical cyclones passed within approximately 400 km of Port Vila making this site the most impacted capital city in the Pacific. A total of 124 tropical cyclones have affected Vanuatu since 1939. Forty-five (36%) of these were categorized as having hurricane force winds (>64 knots), twenty-six (21%) had storm force winds (48 - 63 knots) and twenty-five (20%) were of gale force winds (34 - 47 knots). An additional 28 tropical cyclones were not categorized.

Figure 3.3 Tropical cyclones passing within 400 km of Port Vila per season (PCCS 2012)

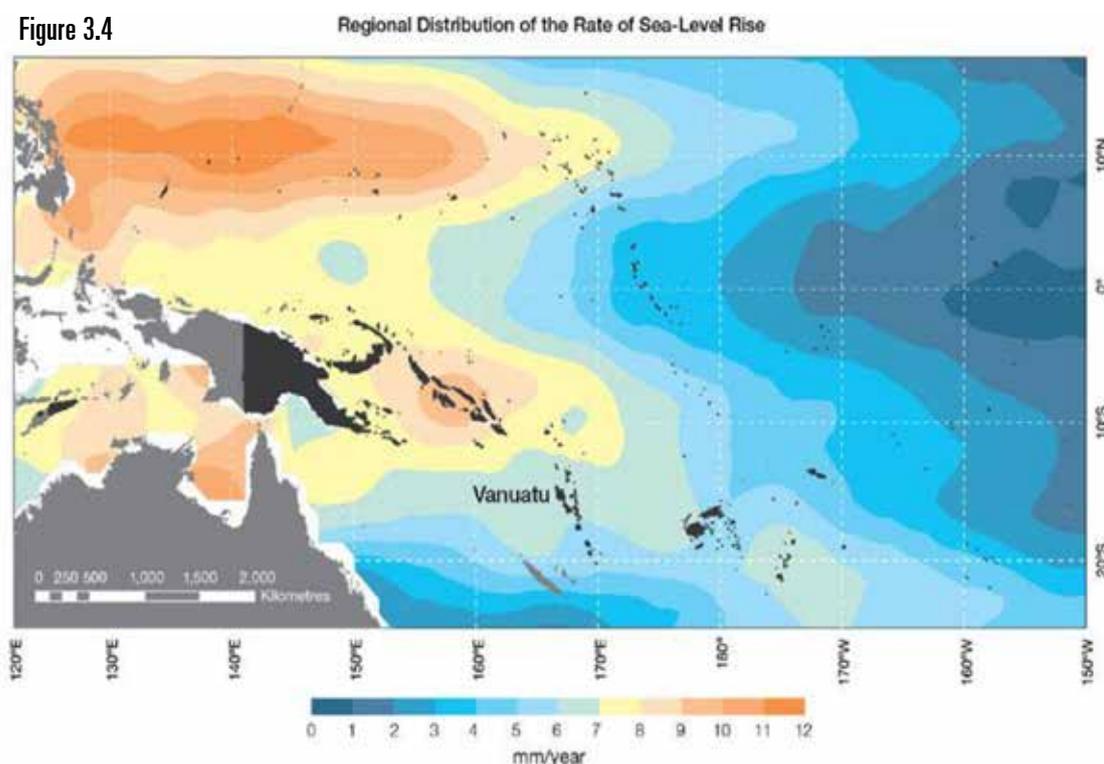


Impacts of climate variability and change are evident on most of Vanuatu's islands. ENSO-related drought and flooding are prevalent and continue to impact the socio-economic livelihood of the people of Vanuatu. The sea surface temperature changes around Vanuatu are consistent with the region. Water temperatures remained relatively constant from the 1950s to the late 1980s. This was followed by a period of more rapid warming (approximately 0.09°C per decade for 1970 to present). However, the natural variability may play a large role in the sea-surface temperature changes making it difficult to identify any long-term trends. Ocean acidification indicator i.e. aragonite saturation state in Vanuatu has declined from about 4.5 in the late 18th century to an observed value of about  $3.9 \pm 0.1$  by 2000.

The sea-level rise near Vanuatu measured by satellite altimeters since 1993 is about 6 mm per year, larger than the global average of  $3.2 \pm 0.4$  mm per year. This rise is partly linked to a pattern related to climate variability from year to year and decade to decade. Annual climatology of the highest daily sea levels has been evaluated from hourly measurements by the tide gauge at Port Vila. High tides peak in November to January and seasonal variations throughout the year are small. However, seasonal water levels tend to be higher during La Niña years and slightly lower during El Niño years. Short-term variations show evidence of a seasonal cycle, with a generally higher likelihood of high water levels in December to March, roughly corresponding to the cyclone season.

<sup>14</sup>Conformal Cubic Atmospheric Model

Figure 3.4



### 3.3 Vanuatu's Future Climate Projections

The Vanuatu's future climate projections have been derived from the outputs of the PCCSP, which analysed up to 18 global climate models from the CMIP3 database for up to three emissions scenarios (B1 (low), A1B (medium) and A2 (high)) and three 20-year periods (centred on 2030, 2055 and 2090, relative to 1990). These projections represent an average change over the broad geographic region encompassing the islands of Vanuatu and the surrounding ocean.

Over the course of the 21st century, surface air temperature and sea surface temperature are projected to continue increasing. Warming is physically consistent with rising greenhouse gas concentrations. The majority of CMIP3 models simulate a slight increase (<1°C) in annual and seasonal mean temperature by 2030. However by 2090, under the A2 (high) emissions scenario temperature increases of more than 2.5°C are simulated by almost all models.

Total annual rainfall is projected to increase over the course of the 21st century. Projections of annual mean rainfall tend to be equally divided between an increase (>5%) and little change (-5% to 5%) by 2090, with only a few models simulating a decrease (<-5%). Wet season (November-April) rainfall is projected to increase; majority of CMIP3 models simulate little change (-5% to 5%) in wet season rainfall by 2030. However, by 2090, under the A2 (high) emissions scenario, the majority simulate an increase (>5%) with the remainder simulating little change. Dry Season (May-October) rainfall is projected to decrease; majority of CMIP3 models simulate little change (-5% to 5%) in dry season rainfall by 2030, however, by 2090, they tend to be approximately equally divided between a decrease

(<-5%) and little change, with only a few models simulating an increase (>5%). Further the intensity and frequency of days of extreme rainfall are projected to increase; extreme rainfall is consistent with larger-scale projections, based on the physical argument that the atmosphere is able to hold more water vapour in a warmer climate.

The majority of CMIP3 models project that the frequency of mild drought will remain approximately stable from 2030 throughout the 21st century at seven to eight occurrences every 20 years. Tropical cyclone numbers are projected to decline in the south-west Pacific Ocean basin (0-40°S, 130°E-170°E) over the course of the 21st century. There is a moderate level of confidence on this type of change as many studies suggest a decline in tropical cyclone frequency globally. Despite this projected reduction in total cyclone numbers, five of the six CCAM<sup>14</sup> 60 km simulations show an increase in the proportion of the most severe cyclones. This increase in wind hazard coincides with a pole ward shift in the latitude at which tropical cyclones are most intense. However, most models also indicate a reduction in tropical cyclone wind hazard north of 20°S latitude.

The acidification of the ocean will continue to increase over the course of the 21st century as the rate of ocean acidification is driven primarily by the increasing oceanic uptake of carbon dioxide in response to rising atmospheric carbon dioxide concentrations. Projections from all analysed CMIP3 models indicate that the annual maximum aragonite saturation state will reach values below 3.5 by about 2035 and continue to decline thereafter.

Mean sea level is projected to continue to rise over the course of the 21st century. Sea-level rise is a physically consistent response to increasing ocean and atmospheric temperatures due to thermal expansion of the water and the melting of glaciers and ice caps. The CMIP3 models simulate a rise of between approximately 5cm - 15cm by 2030, with increases of 20cm - 60cm indicated by 2090 under the higher emissions scenarios. Further, Inter annual variability of sea level will lead to periods of lower and higher regional sea levels.

The future climate projection for Vanuatu and surrounding region has been presented in the table below. The projections are given for three 20-year periods centered on 2030 (2020–2039), 2055 (2046-2065) and 2090 (2080-2099) relative to 1990 (1980-1999). The values represent the multi-model mean change  $\pm$  twice the inter-model standard deviation. The confidence (low, Moderate, High) associated with the range and distribution of the projections is also given (indicated by the standard deviation and multi-model mean, respectively).

**Table 3.1: Projected change in the annual and seasonal-mean climate for Vanuatu (PCCS 2012)<sup>15</sup>**

Projected change in the annual and seasonal-mean climate for Vanuatu (under the B1 (low; blue), A1B (medium; green) and A2 (high; purple) emissions scenarios)						
Variable	Season	1980–1999 average	2030	2055	2090	Confidence
Surface air temperature (°C)	Annual	24.2 (Efate)	+0.6 ± 0.4 +0.7 ± 0.4 +0.7 ± 0.3	+1.0 ± 0.5 +1.4 ± 0.6 +1.4 ± 0.3	+1.4 ± 0.7 +2.2 ± 0.9 +2.6 ± 0.6	High
Maximum temperature (°C)	1-in-20-year event	N/A	N/A	+1.0 ± 0.6 +1.5 ± 0.7 +1.5 ± 0.5	+1.3 ± 0.5 +2.1 ± 0.9 +2.6 ± 1.2	Low
Minimum temperature (°C)	1-in-20-year event	N/A	N/A	+1.2 ± 1.8 +1.5 ± 1.9 +1.5 ± 1.7	+1.5 ± 1.8 +2.0 ± 1.9 +2.3 ± 1.8	Low
Total rainfall (%)*	Annual	2118mm (Efate)	+3 ± 9 +2 ± 11 +1 ± 17	+1 ± 12 +3 ± 15 +3 ± 16	+1 ± 16 +3 ± 19 +8 ± 20	Low
Wet season rainfall (%)*	November- April		+5 ± 8 +3 ± 11 +3 ± 17	+3 ± 12 +5 ± 15 +5 ± 15	+3 ± 15 +7 ± 19 +11 ± 18	Moderate
Dry season rainfall (%)*	May-October		0 ± 16 +1 ± 20 -2 ± 22	-4 ± 20 -1 ± 24 -1 ± 27	-2 ± 23 -4 ± 25 +2 ± 31	Low
Sea-surface temperature (°C)	Annual	27.1 (Average)	+0.6 ± 0.4 +0.6 ± 0.3 +0.6 ± 0.4	+0.9 ± 0.5 +1.2 ± 0.5 +1.3 ± 0.4	+1.3 ± 0.5 +2.0 ± 0.7 +2.5 ± 0.6	High
Aragonite saturation state (Qar)	Annual maximum	N/A	+3.5 ± 0.1 +3.4 ± 0.1 +3.4 ± 0.1	+3.2 ± 0.1 +3.0 ± 0.1 +3.0 ± 0.1	+3.1 ± 0.1 +2.6 ± 0.1 +2.5 ± 0.1	Moderate
Mean sea level (cm)	Annual	N/A	+10 (5–16) +10 (5–16) +10 (3–17)	+19 (10–27) +20 (8–31) +19 (7–31)	+32 (17–47) +40 (20–59) +42 (21–63)	Moderate

<sup>15</sup>Projected change in the annual and seasonal-mean climate for Vanuatu presented under the B1 (low; blue), A1B (medium; green) and A2 (high; purple) emissions scenarios. Projections are given for three 20-year periods centred on 2030 (2020–2039), 2055 (2046–2065) and 2090 (2080–2099), relative to 1990 (1980–1999). Values represent the multi-model mean change ± twice the inter-model standard deviation (representing approximately 95% of the range of model projections), except for sea level where the estimated mean change and the 5–95% range are given (as they are derived directly from the Intergovernmental Panel on Climate Change Fourth Assessment Report values).

## 3.4 Vulnerable Sector Assessments

TVanuatu's future climate projections show growing climate and disaster risks which augment the existing risk from natural climate vulnerability and geological hazards. In 2012 The World Risk Report<sup>16</sup> identified Vanuatu as one of the countries in the world that was most at risk to natural disasters. Thus climate change and variability is already impacting on all economic sectors that are pertinent to the sustainable development of Vanuatu. Ni-Vanuatu livelihoods and social structures are inextricably linked to the natural environment and its resource base. Any perturbations to this availability of natural resources will have a direct bearing on the poverty levels and the very survival of the people. Changes to the traditional social system, coupled with any decrease in food security and water availability, could lead to deterioration of social systems and law and order. The GoV recognises that effective institutions and the inter-relationships between them are at the heart of its ability to respond to growing climate and disaster risks. For this reason, the Government has undertaken a major reform of national climate and disaster risk governance by establishing the Ministry of Climate Change and the National Advisory Board on Climate Change & Disaster Risk Reduction (NAB). At the heart of the Vanuatu NAB is decentralized governance that prioritizes sectoral leadership and implementation in a way that is coordinated and focused on integrated and sustainable development. The NAB's members are the heads of all government agencies, including provincial government, the private sector and civil society representatives. The NAB is tasked to provide the strategic direction required for the country to navigate the complex current and future climate and disaster risks.

A recently compiled "Profile of Risks from Climate Change and Geo-hazards in Vanuatu (November 2013)" outlines the major climate change impacts and geo-hazards for Vanuatu, which corroborate and build on Vanuatu's 2007 National Adaptation Programme of Action (NAPA). The Risks report describes the activities and results of the risk profiling activity. The sectors considered in this assessment to be most vulnerable for climate change are: Agriculture (crops, cattle and sustenance), Fisheries (freshwater, coastal, deep sea, aquaculture), Forestry (including mangroves and production forest), Tourism (cruise-ships, hotels), Transport (road, ferries, and air), Infrastructure (utilities [energy, water, and sanitation], houses, offices, and industry) and Health. The impacts of climate change variability on these sectors are discussed below:



<sup>16</sup><http://www.ehs.unu.edu/article/read/worldriskreport-2012>

### 3.4.1 Agriculture

According to the 2013 Vanuatu Agricultural Position Paper on Climate Change & Disaster Risk Reduction, Vanuatu is already experiencing disruptive changes consistent with the expected effects of climate



change - more erosion from rains and storms; more frequent storm surges, floods, and droughts; saltwater intrusion on land due to storms; coral bleaching from increasing seawater temperatures; more widespread and frequent vector-borne diseases due to increasing areas of suitable habitat for the vectors with warmer temperatures; and periods of exceptionally high sea levels.

Increased temperatures, more frequent and prolonged dry conditions, increased variability of rainfall, salt water intrusion, droughts, soil erosion, and cyclones have increasingly put pressure on crop production. Projected temperature increases may reach the maximum heat tolerance thresholds of crops and induce heat stress, wilting, and crop failure, especially in traditional crops like taro, yam, and cassava. Coastal and low-lying farms are suffering from seawater inundation and intrusion of saltwater into underground freshwater lenses.

Because both commercial and subsistence agriculture in Vanuatu are based on rain-fed agricultural production systems. Any changes in rainfall distribution, both in terms of the amounts of rain and its spatial as well as temporal distribution could have severe impacts on agricultural production. Dry conditions during El Niño years are most devastating to farming activities in Vanuatu that depend on rainfall.

The prevalence of wetter conditions in the future would benefit water-sensitive crops such as coconut, breadfruit, and cassava. However, intense rainfall, especially during planting seasons, could damage seedlings and reduce growth for seasonal or annual

crops. Wetter conditions are also conducive to multiplication and spread of plant pests and diseases and more rapid postharvest deterioration of crops. In areas where waterlogging is a problem, increased rainfall could put equally severe pressure on plant growth that leads to lower production. Increased rainfall in good years may offset the effect of warmer temperatures, but a warmer and possibly drier climate would lead to more intense drought in El Niño years.

Vanuatu's future climate scenario projections as per the above section for the 21st century shows that, the average minimum, mean and maximum daily temperatures will increase and potential direct impact on agriculture sector includes the shifts in crop-seasons (all phases will happen earlier and faster). This will have a direct impact on the economy and livelihood.

Considering the uncertainty of future climates, assessments of climate change on Vanuatu's agriculture can only be broad. Variability of rainfall will increase the demand for drought-resistant crops in drier areas and for water tolerant crops in wetter areas. Farmers may modify their crop calendars, shift their cropping patterns, diversify the crops grown, or completely shift out of crop agriculture. Overall, it is expected that agriculture loss in Vanuatu from climate change outweigh any projected benefits. The risks include crop losses from excess heat and drought on the one hand, and oversaturation of soil and physical damage from increased rainfall on the other.

Vanuatu has one of the most conducive environments for raising livestock. The production of beef, pork, poultry and sheep and goat for local consumption forms an essential part of the rural economy. Climate change is likely to have a far greater effect on the small farmers compared to the larger commercial operations. Small and subsistence farms often rely on streams for their water supply and do not have the means to set up adequate water storage facilities. As the streams dry up the farmers find it hard to cope. Further, there has been increased incidence of intestinal problems in cattle often associated with pasture. Similar problems (worm and infections) have been encountered by the piggery farmers. The increased demand for land and its enhanced degradation due to climate extremes and other hazards have added to the challenges of this sector.

### 3.4.2 Fisheries

According to the 2013, Priority Adaptations to Climate Change for Fisheries and Aquaculture in Vanuatu<sup>17</sup>, the fisheries sector is implementing adaptation actions that capitalise on the opportunities expected to eventuate from climate change. The areas of highest impact to the sector are expected to occur in terms of (1) fish for food security, (2) the livelihoods that are based on fisheries and aquaculture, and (3) tuna harvests for economic development.

The sea, oceans and coastal areas play an important role in the lives of ni-Vanuatu people as a source of food, transport and livelihood. Most of the coastal people rely on fish as an important source of protein and income, however, these are likely to be affected through the destruction of marine ecosystems such as mangroves and reefs. According to the 2011 SPC study, Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change<sup>18</sup>, the Vanuatu fisheries sector is vulnerable to a range of impacts of climate change including enhanced storm intensity, temperature increase, coastal erosion, sedimentation and inundation.

The coastal fisheries of Vanuatu are made up of four components: demersal fish (bottom-dwelling fish associated with coral reef, mangrove and sea grass habitats), near shore pelagic fish (including tuna, rainbow runner, wahoo and mahi-mahi), invertebrates targeted for export, and invertebrates gleaned from intertidal and subtidal areas. The projected impacts from climate change (increase in surface water temperature, ocean acidification) under different emission scenarios will directly affect the oceanic fish habitat (coral reefs, mangroves, sea grasses and intertidal flats) and food webs.

<sup>17</sup>[http://www.spc.int/fame/doc/meetings/2013\\_Vanuatu\\_Climate\\_Workshop/Vanuatu\\_Climate\\_Workshop\\_2013\\_Report.pdf](http://www.spc.int/fame/doc/meetings/2013_Vanuatu_Climate_Workshop/Vanuatu_Climate_Workshop_2013_Report.pdf)

<sup>18</sup><http://www.spc.int/climate-change/fisheries/assessment/e-book/>

The Tuna fisheries are also likely to be affected by rising ocean temperatures and due to increased stratification between warmer surface waters and colder, deeper waters<sup>19</sup>. There is also some concern about the possible increase in ciguatera poisoning due to increased temperatures of the ocean and marine pollution from land-based activities and sedimentation.

Changes in ocean circulation patterns may affect fish populations and the aquatic food web as species seek conditions suitable for their lifecycle. Higher ocean acidity (resulting from carbon dioxide absorption from the atmosphere) could affect the marine environment through deficiency in calcium carbonate, affecting shelled organisms and coral reefs.

Climate change is likely to have a direct impact on marine resources through its effect on marine ecosystems and enhanced sedimentation due to soil erosion from agricultural and forestry practices would have a profound effect on the availability of marine resources. The table below presents the projected percentage change in coastal fisheries production under the different emission scenarios.

**Table 3.2: Projected change in coastal fisheries production (SPC 2011)<sup>20</sup>**

Projected change in coastal fisheries production (%) (under the B1 (low; blue), and A2 (high; purple) emissions scenarios)				
Coastal fisheries category	B1/A2 2035	B1 2100*	A2 2100	Main effects
Demersal fish	-2 to -5	-20	-20 to -50	Habitat loss and reduced recruitment (due to increasing Sea Surface Temperature and reduced currents)
Near shore pelagic Fish (tuna dominate)	0	-10	-15 to -20	Reduced production of zooplankton in food webs for non-tuna species and changes in distribution of tuna
Targeted invertebrates	-2 to -5	-10	-20	Habitat degradation, and declines in aragonite saturation due to ocean acidification
Inter/sub-tidal invertebrates	0	-5	-10	Declines in aragonite saturation due to ocean acidification
* Approximates A2 in 2050				

<sup>20</sup><http://www.spc.int/climate-change/fisheries/assessment/chapters/summary/22-vanuatu.pdf>

### 3.4.3 Forestry

According to the 2013 Vanuatu Forest Policy<sup>21</sup>, “The combined impacts of climate change, population growth and soil fertility declines will exert a growing and cumulative pressure on the remaining lowland forests of Vanuatu to be converted to agricultural land.”

Forests have always been an integral part of lives of the people of Vanuatu and have played an important role in the general welfare of local communities. Some 36% of Vanuatu’s total land area is forested, 27% of which is a merchantable forest. Rugged terrain prevents access to the rest of the forested areas.

The forests are a vital part of the country’s cultural heritage and contribute to the welfare and economic development of the people. The detailed assessment on the effects of climate change on the forestry sector is currently not available. However, the effects of rainfall distribution, temperature and other climate stresses are likely to impact negatively on many tree species and the rich forest biodiversity.

According to the FAO Report, an assessment of the impact of climate change on Agriculture & Food Security in Vanuatu<sup>22</sup>, loss of forests, whether from agriculture land clearing or from climate related activities can have devastating effects for the people and economy of Vanuatu.

The rapid increase in population growth, coupled with the effects of cyclones and agriculture on the remaining land would inevitably result in the rapid decrease in total forested areas. Most island forest species have small ranges, which in turn leaves them particularly vulnerable to land use changes because these changes can easily affect the species’ entire range. Open forest increases the potential for invasion by alien species that then dominate secondary forests.

Changes are reported in the flowering and fruiting patterns of certain forestry crops and there appears to be an increase in the incidence of pest and diseases in species such as sandalwood, white wood (caterpillar attack) and mahogany (shoot porous). Invasive species, including the creeping vine *Meremia Peltata* are said to be more wide spread and seed collection from major species has been particularly low compared to in the past.

Salt spray in certain islands of Vanuatu is causing forest dieback. While slash and burn is certainly contributing to forest impacts, very little is known about the likely impact of climate change on forest wildlife in Vanuatu.

The large forest cover (more than 36% of total land area) makes Vanuatu a net sink for CO<sub>2</sub> emissions. The Commonwealth’s Vanuatu Blue Carbon Report of 2012<sup>23</sup> suggests that per unit area, blue carbon coastal ecosystems are significantly better at trapping and storing carbon than their terrestrial counterparts (mangroves averaging 1500-2250t CO<sub>2</sub> eq/ha).

Given the envisaged impact of extreme climatic events on the forestry sector, sustainable forest management and integrated watershed management is crucial for Vanuatu. The concept of sustainable forest management in Vanuatu needs to be tempered by the fact that there’s no government-owned forest land, and that it is an inalienable right of landowners under the Constitution to manage their land in a way that “safeguards the national wealth, resources and environment in the interests of the present generation and of future generations”.

<sup>21</sup><http://vanuatuforestry.com.vu/wp-content/uploads/2014/01/Forest-Policy.pdf>

<sup>22</sup><ftp://ftp.fao.org/docrep/fao/011/i0530e/i0530e02.pdf>

<sup>23</sup><http://www.nab.vu/management-coastal-carbon-sinks-vanuatu-realising-potential>

### 3.4.4 Tourism

According to the 2014 Vanuatu Strategic Tourism Action Plan<sup>24</sup>, “Climate change issues are a focus of the Government in this sector”. Tourism is increasing in importance as one of the key foreign exchange earners for Vanuatu. Tourism contributes to 40% of Vanuatu’s GDP. The growth in Vanuatu’s economy over the last five years has been largely due to real estate and tourism activities. The diversity of cultures, geologic forms, biological life forms and the world’s most accessible wreck dive and proximity makes Vanuatu a preferred destination for Australian and New Zealand visitors. Vanuatu developed the National Tourism Development Mater Plan in 1994 which has resulted in Vanuatu’s tourism growth over the last decade, while the new Vanuatu Strategic Tourism Action Plan highlights climate change adaptation priorities.

The most promising export in years to come would continue to be Tourism. Recent academic studies<sup>25</sup> highlight Vanuatu’s tourism sector vulnerability to climate change, emphasizing the fact that the ecosystems on which most tourism activity is based will be impacted by climate change. Much of the infrastructure, infrastructure support services and the attractive features for the tourist are situated in the coastal sector, for example; even modest ocean warming causes coral bleaching. Sea level rise and resultant inundation from storm surge threatens coastal assets. Storms pose a real threat to tourism infrastructure and are projected with very high confidence to increase in intensity.

In addition to the above-mentioned impacts on tourism supply, tourism demand will also be affected by climate change. International action to mitigate Green House Gas (GHG) emissions will increase travel costs; especially for long haul travel and ethical concerns regarding air transport will affect consumer demand for different destinations, potentially impacting on Vanuatu’s tourism.

### 3.4.5 Transport & Infrastructure

Air and sea is the only route to connect Vanuatu from outer world and the group of islands. Vanuatu has very few roads and the limited road networks are confined to the larger islands mainly around the major population centres situated on the coasts. Many of the smaller islands do not even have airstrips. In terms of infrastructure, Vanuatu has 29 airports (5 paved and 24 unpaved) and approximately 1,894km of roadways (111km paved and 1,783km unpaved) and two main ports and terminals, Port Vila and Santo. Inter-island and intra-island travel and communications is difficult and expensive. Extreme climatic events are already leading to irregular air and shipping services to remote and outer islands.

Infrastructure plays a vital role in generating economic growth. Much of the infrastructure including the main commercial centres of Port Vila and Luganville, are located on the perimeter of the major islands. These centres are only a few meters above sea level. Moreover, much of the road network is also situated on the perimeter of the islands. The infrastructure and other fixed assets are extremely vulnerable to cyclones and storm surges. Enhanced human activities in the coastal areas, including sand extraction and mangrove and other coastal vegetation removal has increased the sensitivity of these important coastal buffers to climate and sea level variations.

<sup>24</sup>[http://www.nab.vu/sites/all/files/documents/13/02/2014%20-%2009%3A21/vanuatu\\_strategic\\_tourism\\_action\\_plan\\_dec\\_13\\_-\\_final\\_-\\_february\\_2014.pdf](http://www.nab.vu/sites/all/files/documents/13/02/2014%20-%2009%3A21/vanuatu_strategic_tourism_action_plan_dec_13_-_final_-_february_2014.pdf)

<sup>25</sup>[http://epubs.surrey.ac.uk/534351/3/Wong\\_Climate\\_Change.pdf](http://epubs.surrey.ac.uk/534351/3/Wong_Climate_Change.pdf)

According to a 2013 ADB Report<sup>26</sup>, the Vanuatu transport sector is vulnerable to changes in climate variables. Increased frequency and intensity of extreme weather events, changes in temperature, as well as projected sea-level rise will affect transport infrastructure in various ways. Both gradual and extreme changes in temperatures are likely to impact pavements. Sea-level rise and storm surges damage highways, roads, tunnels, and bridges due to flooding, inundation in coastal areas, and coastal erosion; damage infrastructure from land subsidence and landslides; and erode road bases and bridge supports. Increases in intense precipitation events damage roads and drainage systems due to flooding and/or landslides; increase scouring of roads, bridges, and support structures; and overload drainage systems. Increased storm intensity damages road infrastructure; threatens stability of bridge decks; and increases damage to signs, lighting fixtures, and supports.

### 3.4.6 Health

The health sector in Vanuatu is likely to be severely impacted due to the projected climate change. According to recent academic studies<sup>27</sup>, “The highest level of risk from climate change in Vanuatu includes the health impacts from water-borne and food-borne diseases.” The main potential health impacts from climate change in Vanuatu tended to emphasise the public health risks that are dominant in a society experiencing the so-called “epidemiological transition”, with relatively high burdens of both infectious and non-communicable diseases. In the case of Vanuatu, climate change will not necessarily bring new health threats, but rather act as an “amplifier” or “multiplier” of existing health problems (that is, in the absence of effective adaptation strategies).

UNICEF reported in 2011<sup>28</sup> that Vanuatu’s children are at a health risk from direct physical impacts such as cyclones, storm surges and extreme temperature, but also to more subtle impacts on education, psychological wellbeing and nutrition.”

Making judgements about risks to human health is challenging in Vanuatu because of the uncertainty from interacting climatic variations and consequential environmental changes. The levels of uncertainty surrounding consequences and/or likelihood of the potential health impacts are higher for indirect and social health impacts, often because of the complexity of the relationship between the climate variable and the health impact, and knowledge gaps about this relationship.



<sup>26</sup><http://www.adb.org/sites/default/files/pub/2013/climate-change-transport.pdf>

<sup>27</sup><http://www.eldis.org/go/home&id=64386&type=Document#.U6tngpSSzZg>

<sup>28</sup>[http://www.unicef.org/pacificislands/Children\\_and\\_Climate\\_Change\\_.pdf](http://www.unicef.org/pacificislands/Children_and_Climate_Change_.pdf)

Malaria is already endemic to certain areas of Vanuatu and there is some evidence to suggest that these areas are extending southwards. Other tropical and vector borne disease such as dengue and water related diseases such as dysentery and diarrhoea are also likely to increase. Other problems associated with the increased temperature, such as contamination of food and heat stress are likely to be exacerbated.



Extreme climatic events (flooding, heavy rain, cyclone) also have strong implications on the health infrastructure and their accessibility as it erodes roads, damages commutation facility and compromises utilities like water and electricity. Limited information is available on the extent and frequency of any climate change related health issues, however, addressing the impacts of climate variability and change on the health sector requires addressing issues of poverty, sanitation, nutrition and environmental degradation.

Changing weather patterns from climate variability and change are already having a negative impact on all the sectors in Vanuatu and most evidence points to the fact that they will be exacerbated by climate change related events in future. The effects of climate change on agriculture production, human health and well-being will have the consequences of decreasing national income while increasing key social, environmental, cultural and infrastructure costs. ENSO-related drought and flooding are already very prevalent and continue to impact the socio-economic livelihood of the people of Vanuatu. The increasing incidence of extreme events and climate change could add further stress to these sectors. The specific sector related direct climate change impacts are presented in Appendix B. These negative development impacts will affect all levels including individual, household, community, private and government sector.

### 3.5 Adaptation and Sustainable development

Adaptation to climate change and risk management of natural hazards is one of the core development issues for Vanuatu. According to the highest level Government policy, the Priority Action Agenda<sup>29</sup>, “social and economic development in Vanuatu will continue to be affected by climate change, underlining the need to mainstream disaster risk reduction and disaster management (DRR&DM) and climate change adaptation into national planning and budgetary processes.” The PAA Policy Objective

<sup>29</sup>[http://www.nab.vu/sites/all/files/documents/14/11/2013%20-%2009%3A53/paa\\_2012\\_update.pdf](http://www.nab.vu/sites/all/files/documents/14/11/2013%20-%2009%3A53/paa_2012_update.pdf)

4.5 is most relevant to Climate Change and states, “ to ensure the protection and conservation of Vanuatu’s natural resources and biodiversity, taking climate change issues inconsideration.” Strategy 4.1.3 is to Improve and strengthen access to high yield and pest and climate change resistant crops, vegetables and fruit varieties and seedlings.” Strategy 4.5.5 is to finalize and implement the Vanuatu climate change policy including its integration in the PAA, sector plans and ministry corporate plans. Strategy 4.5.6 is to review the Vanuatu Meteorological Act to reflect climate change issues. As the Government prepares its new National Sustainable Development Plan 2016-2030, climate change and disaster risk reduction both constitute cross cutting and high priority issues.

Vanuatu is among countries in the Pacific region, and the world, that are most vulnerable to the risks of climate change, climate variability and sea level rise making climate change adaptation a major priority for Vanuatu.

In 2007, Vanuatu completed its National Adaptation Programme of Action (NAPA), which outlined the most urgent and immediate needs with respect to climate change and identified several priority sectors (Agriculture/Food Security, Coastal Zones and Marine Ecosystems, Water Resources and Public Health) for action. Since 2007 the NAPA has been implemented in a de-facto way via a surge in government and nongovernment action on adaptation in all sectors.

Despite the resounding successes outlined below, several development challenges continue to limit the country’s ability to respond effectively to climate variability and change such as (i) political instability and weak institutions, (ii) unequal distribution of economic benefits gained from existing policies, (iii) disparities in income distribution and access to basic services, (iv) increased urban migration into temporary and makeshift settlements, and limited employment opportunities in urban centres, (v) limited and poor infrastructure, and (vi) increased environmental degradation including deforestation, loss of topsoil, and deterioration of the quantity and quality of water supplies.

This section provides an overview of Vanuatu’s adaptation efforts to date, including those implemented by Government and non-government actors that address the current and anticipated adverse effects of climate change and variability including extreme events.

## 3.6 National and Sectoral Adaptation Programs

A number of climate change related policies, projects and activities have been implemented in Vanuatu during the past few years. The Government of Vanuatu has instituted a web-based information portal and project database ([www.nab.vu](http://www.nab.vu)) where all climate change and disaster risk reduction projects that have been endorsed by Vanuatu’s National Advisory Board on Climate Change & Disaster Risk Reduction are summarized and geographically plotted.

In mid 2014, there were a total of 23 projects listed on the NAB portal, list of climate change projects registered with the National Advisory Board on Climate Change & Natural Disasters have been provided in Appendix E.

## Governance

In 2013, the Government of Vanuatu formalized its commitment to UNFCCC implementation by establishing the Ministry of Climate Change, which amalgamized the departments of Meteorology, Geohazards, Disaster Management, Environment, and Energy into a single administrative unit to better provide services to ni-Vanuatu people.

The establishment of the National Advisory Board on Climate Change & Disaster Risk Reduction in 2012 has vastly streamlined the implementation of the UNFCCC and ensured that duplication with the disaster risk sector is avoided. Members of the board are made up of director generals and directors of all government line agencies, and also include permanent representatives from the private sector and civil society. The NAB meets monthly and is tasked with setting the strategic agenda for climate change and disaster risk in the country, and endorsing new programs and projects. The NAB established a web-based portal which contains a shared calendar of events, a resource library, project and policy database and contact list of key organizations and individuals.

GoV has developed a draft Climate Change & Disaster Risk Reduction strategy which will drive the implementation of a revised, but not yet endorsed, Meteorology Act. Several partners are supporting the Government to finalize this overarching climate and disaster policy including SPC-GIZ and UNDP.

The Government of Vanuatu, through the NAB has also established a series of technical working groups that focus on specific issues. A UNFCCC Task Force, supported by Oxfam and SPC-GIZ successfully undertook a major COP preparation program in 2013, which led to the preparation of Vanuatu's first ever submissions to the UNFCCC Secretariat, and a fully gender balanced, 15 member delegation to COP19 in Warsaw, Poland including representatives from Vanuatu's youth and civil society. A Cost-Benefit Analysis Working Group, supported by the Australian Government, SPC, SPREP, Forum Secretariat and GIZ, successfully implemented a series of adaptation-focused CBA trainings in 2013 and 2014.

Around the same time the NAB was established in 2012, two non government agency networks were also launched which sought to improve coordination and collaboration in the climate change and disaster risk reduction sector. The Vanuatu Climate Action Network (VCAN), focusing on climate adaptation and the Vanuatu Humanitarian Team (VHT), which helps to coordinate disaster preparedness & response, are now well operational. These networks have played an important role in terms of ensuring government policy and action is grounded in the needs and strengths of communities, in disseminating information, in accessing expertise, and in building strong, stable and productive relationships between government, NGOs communities, VCAN and VHT have been cited as promising examples of enhanced coordination and collaboration between diverse stakeholders, with multiple studies looking at how similar networks and collaborative approaches can be incorporated into the national strategies of other Pacific countries. VCAN has also been instrumental in establishing the Pacific Climate Action Network.

Provincial Governments have a climate change and disaster risk reduction governance mandate

through the Decentralization Act. Several provinces are now working on their Disaster Plans, while MALAMPA Province completed its Climate Change Directive in 2014. The MALAMPA Climate change directive outlines provincial priorities and vulnerable areas and stipulates the process for implementing new climate and disaster risk programs in the provinces.

## Agriculture

The Department of Agriculture and Rural Development has taken the lead in coordinating the agricultural sector in regards to climate change and disaster risk reduction. In 2013, the department released a National Agriculture Position on Climate Change & Disaster Risk Reduction which outlined the key adaptation priorities for the country, and sets out a clear policy directive, to coordinate and guide all actors, regarding climate change and the development of its agriculture sector. The 2013 Position statement indicates that the adaptation priorities for new programs and projects on agriculture, climate change and disaster risk reduction should highlight and take into consideration the following priority solutions:

- introduction and improvement of climate resilient crops for cultivations by local farmers,
- preservation and improvement of local and endemic crops that hold climate resilience and environmental suitability
- introduction and improvement of farming systems that enable adaptation or climate resilience
- uptake, up scaling and dissemination of climate resilient crops and technologies
- overcoming barriers to increased production and food security
- economic analysis and cost benefits of climate resilient agriculture

In addition to the Agriculture Position, the Ministry of Agriculture completed its Overarching Productive Sector Policy 2012-2017, which directs that the “competing demands on the environment and differentiated impacts of climate change will be assessed and taken into consideration when formulating strategies to address the development challenges the sector faces.” Its Policy thrust on Environmental Services and Resilience, includes Direct Outcome 5 of Enhanced environmental services and sector resilience to natural disasters and climate change. This is accomplished by the relevant Strategy 5.1 to shift policy focus from “crisis management or response” to “risk reduction and resilience building”.

In 2012, the Department of Agriculture in cooperation with the VHT, under the NDMO, established an Agriculture Cluster with all government and non-government stakeholders to ensure an effective response from the sector before and after major disasters. The Agriculture Cluster also has an adaptation coordination function.

The Department of Agriculture & Rural Development (DARD) is currently co-implementing with the Vanuatu Agriculture Research and Training Centre (VARTC) a major Increasing Resilience to Climate Change & Natural Hazards program to expand and make accessible the genetic diversity of key planting materials that hold climate resilient traits. The program is also establishing climate nurseries and demonstration centres in each of Vanuatu's six provinces.

In cooperation with the National Agricultural Research Institute (NARI) of Papua New Guinea, Vanuatu DARD is trialling several climate adaptation approaches to soil moisture conservation including micro irrigation. NARI is also supporting DARD to disseminate climate tolerant species of root crops in several pilot sites.

In cooperation with the SPC-GIZ Coping with Climate Change in the Pacific Island Region Project (CCCPIR)<sup>30</sup>, Vanuatu DARD is trialling and demonstrating the climate resilient benefits of alley cropping with glyricidia, including soil fertility, windbreak protection, soil moisture retention, shading and staking support. In addition the SPC-GIZ/DARD collaboration is field-testing the productivity of climate resilient varieties of sweet potato and taro, while also trialling the application of locally produced organic plant derived pesticides. Traditional knowledge and practices for banana propagation have been tested and developed into guidebooks and manuals for farmers. With support of SPC-GIZ, DARD and VARTC have developed a series of crop brochures, which outline the impacts and adaptation solutions for key root and vegetable crops (e.g. manioc, banana, taro, tomato, cucumber, beans, etc.). Together, these stakeholders have released two Bislama-language DVDs on Agriculture & Climate Change as well as Food Security & Climate Change which demonstrate in simple steps how farmers can adapt to climate variability.

In cooperation with the SPC-GIZ Climate Change Program, the Department of Industry has developed a Bislama-language guidebook and DVD on how to build and operate a Solar Food Dryer. The dryers have been established and trainings run on over 10 islands in three provinces covering a total of over 2000 rural women participants.

The Vanuatu Department of Meteorology and Geohazards signed an MOU with DARD and SPC-GIZ in 2012 to work together on the topic of agrometeorology for climate change adaptation. These agencies organized major Agrometeorology Summits in 2011, 2013 and 2014 which brought together farmers, climate scientists, extension officers and civil society to learn best adaptation practice, integrate traditional knowledge into solutions and chart the way forward for the sector. Major outputs from these summits have included climate cropping calendars for each province, crop specific brochures and DVDs, comprehensive lists of adaptation options and funding proposals for further work.

An SPC-USAID Food Security project is working in remote Torba Province to establish climate resilient nurseries and train farmers on good farming practices.

The Vanuatu Agriculture College is teaching students on climate adaptation and has a series of demonstration plots.

The FAO Vegetable Project is training lead farmers on how to treat and properly care for soil nutrients and undertake effective composting for climate change adaptation.

ADRA is working with DARD extension officers on the island of Santo to expand backyard farming and permaculture practices.

<sup>30</sup><http://www.nab.vu/projects/coping-climate-change-pacific-island-region-spc-giz>

The Technical Vocational Education and Training (TVET) and the Vanuatu Rural Development Training Centres Association (VRDTCA) programs are running trainings on agricultural marketing and agribusiness.

Live and Learn Environmental Education has produced a Guidebook on Food Security and Climate Change which is based on their experience in a series of agricultural pilot sites on the island of Lelepa on North Efate

The Vanuatu Farm Support Association is working very closely with the DARD and the VARTC to field test climate resilient varieties of root crops for productivity and taste. FSA is also trialling and promoting climate tolerant farming systems.

Care Vanuatu is working with DARD extension officers on the island of Futuna to expand the diversity of crops grown, and ensure their climate tolerance. A Guidebook and manual for best practice adaptation is now being developed.

Save the Children Fund is working with DARD extension officers on the island of Ambae to improve backyard and hanging garden adaptation approaches.

The Vanuatu Red Cross Society is implementing food security community programs in Torba Province.

As part of the Australian funded Vanuatu NGO Climate Change Adaptation Program coordinated by Oxfam; Care International, Save the Children, the Vanuatu Red Cross Society, VRDTCA and SPC-GIZ are sharing their agriculture lessons and resources to support farmers' resilience.

## Forestry

The Vanuatu Forest Policy (2013-2023) highlights the following policy directives for climate change adaptation: "Integrate climate change adaptation issues into forestry sector planning and activities" This is accomplished by the following strategies:

- Develop forestry-related CC adaptation demonstration projects including concerns for food security, soil stabilization, water management, and coastal erosion.
- Raise awareness of stakeholders on forestry climate adaptation opportunities in Vanuatu, and develop related materials.
- Liaise, collaborate and share expertise with relevant government and non-government organizations (national, regional and international) to assist local efforts to adapt to climate change.
- Introduce and promote climate change resilient tree species and varieties.
- Maintain and enhance food security through agro-forestry systems.

- Undertake ground cover initiatives to prevent soil and coastal erosion.
- Identify and seek financing for novel and promising forestry adaptation projects and programs.
- Train all stakeholders on the opportunities for climate change adaptation and impact assessment.
- Rehabilitate watershed and water catchment areas to secure water supplies.
- Systematically assess and continuously monitor the impacts of climate change on forest systems.
- Zone development activities and undertake land use planning to minimize site-specific climate change impacts.
- Minimize wind damage to crops and infrastructure by trialling windbreak species and systems.
- Establish and manage buffer zones around climate sensitive ecosystems, and undertake enrichment planting within these areas.
- Develop and regularly update a database of climate change adaptation information in the Vanuatu forest sector.
- Update the herbarium database to document existing vegetative biodiversity that may yield resilience to climate impacts.
- Enable the storage of forestry seeds for germination of vulnerable species 'out of season'.
- Identify, prioritize and implement appropriate and effective strategies for the forestry sector to adapt to climate change.

The Vanuatu Forestry Department has recently been restructured to include a full-time climate change officer.

In addition, the department is hosting several climate change focused projects including the GEFPAS project<sup>31</sup> which is working to expand sustainable forest management and enhance protected area management for climate change adaptation. The program has undertaken climate related forest inventories in several islands (e.g. Santo, Erromango, Pentecost and Gaua).

The SPC-GIZ Regional REDD+ Project<sup>32</sup> has supported the Department of Forests to design and train its offices on a new forest inventory protocol, which includes climate adaptation assessments. The program has also supported the finalization of the Vanuatu REDD+ Readiness proposal, and worked to assess the climate adaptation and mitigation costs of several possible REDD+ sites on the island of Santo.

The Department of Forests co-implemented alongside IUCN the Mangrove Ecosystems for Climate Change Adaptation & Livelihoods (MESCAL)<sup>33</sup> Project which undertook mangrove species assessments, mapping, and coastal rehabilitation work on the islands of Efate and Malekula.

<sup>31</sup><http://vanuatuforestry.com.vu/projects/project-1-forestry-protected-area-management/>

<sup>32</sup><http://www.spc.int/lrd/spcgiz-qclimate-protection-through-forest-conservation-in-the-pacific-islandsq>

<sup>33</sup>[http://cmsdata.iucn.org/downloads/mescal\\_brochure\\_030810\\_compressed.pdf](http://cmsdata.iucn.org/downloads/mescal_brochure_030810_compressed.pdf)

The Department of Forests also worked alongside the SPC-GIZ CCCPIR Program to trial a new design of climate resilient tree nursery. A guidebook and manual on climate nursery construction and species husbandry. The program has also successfully rehabilitated an erosion-prone hillside on the island of Pele with drought and salt tolerant tamarind and glyricidia species. A Bislama-language erosion control manual and DVD was also produced to showcase the use of Vetiver grass for low cost coastal stabilization and management.

LLEE is working on the island of Santo with several forest communities on REDD+ readiness, including the adaptation benefits of forest conservation and management. They have released a very popular Bislama-language Claymation on the climate issues associated with forests in the Pacific region. The LLEE program is implementing a *Meremia peltata* eradication trial on the island of Tanna to protect natural forests and enable adaptation.

## Livestock

The Vanuatu Department of Livestock has recently finalized its business plan and medium term framework, both of which elevate climate change as a top priority.

Department staff are implementing a series of climate adaptation initiatives including a market access program at the Morobe Market in which farmers are encouraged and enabled to access smallholder markets for island-reared animals.

The department is currently undertaking a pasture grass climate tolerance trial with the support of the SPC-GIZ CCCPIR program, as well as a pig breeding and climate husbandry trial program at the SPC-GIZ site on Pele Island. With the support of SPC-GIZ, the Department has also implemented a backyard and medium size biogas program which is intended to provide alternative fuel sources, thereby reducing pressure on natural forests and maintain the adaptive capacity of the natural ecosystem.

In 2013, as a result of the series of Vanuatu Agrometeorology Summits, the Department of Livestock alongside the SPC-GIZ program launched a set of livestock and climate change adaptation brochures based on key animals (pigs, cattle, goats, chickens and honey bees).

## Environment

The Department of Environmental Protection and Conservation has been working on and nearly finalized its National Environment Policy which includes a heavy focus on climate change adaptation. There are three policy objectives directly related to adaptation including: PO1 - Climate change

adaptation initiatives are designed and implemented according to sound Ecosystem-Based Adaptation approaches, PO2 - Climate change policies programs, initiatives and projects do not negatively impact on environmental integrity and PO3 - The National Climate Change & Disaster Risk Reduction Policy and National CCA & DRR Action Plan is fully implemented.

The Department is primarily implementing climate change adaptation by strengthening its enforcement of the EIA laws codified in the revised Environmental Management and Conservation Act of 2003 and ensuring that development does not compromise adaptive capacity. In addition, the DEPC is supporting communities to register and develop management plans for Community Conservation Areas which are protecting valuable ecosystem buffers to climate and that yield adaptation co-benefits.

The Department of Environment is capturing lessons learned on conservation and climate change through the support of the SPC-GIZ at the Nguna-Pele Marine and Land Protected Area Network. These partners have released a series of Bislama-language Guidebooks and Manuals on how to establish protected areas in a way that meets adaptation priorities and is in line with legislation and traditional resource management practices.

LLEE is working on ecosystem-based climate change adaptation in its community pilot sites on Santo, as well as supporting the protection of climate vulnerable species like the coconut crab.

## Fisheries & Coastal Management

In 2013, the Vanuatu Department of Fisheries convened a major workshop on climate change adaptation where they produced recommendations on priority adaptation actions. The adaptations identified during the workshop were designed to address the 'drivers' and 'root causes' influencing the management of fisheries and aquaculture in the shorter term (e.g. population growth), and climate change in the longer term. Such measures are considered to be 'win-win' adaptations. In some cases, 'lose-win' adaptations were also recommended, i.e. adaptations involving costs in the shorter term to maintain any natural adaptive capacity of resources to cope with the changing climate.

The workshop also recognised that many of the adaptations to climate change are management actions that should already be in place to deliver sustainable benefits from the nation's fisheries and aquaculture resources. A prime example is integrated coastal zone management, commonly called the 'ridge to reef' approach. The need for 'ridge to reef' actions to maintain coastal fisheries production was widely recognized by ni-Vanuatu stakeholders and should help build resilience of coral reefs, mangroves and sea grasses to climate change.

Many of the specific management measures are recommended to become a part of Vanuatu's National Environment Policy and the National Policy on CC & DRR.

The Vanuatu Department of Fisheries is leading the sector towards climate change adaptation through the implementation of several programs and projects.

Working alongside technical advisors from Japan, the Fisheries Department's Grace of the Sea project seeks to relieve pressure on local coral reefs by training fishermen to utilize deep-sea resources and deploy fish aggregating devices. The program is also supporting the seeding of reefs with climate-impacted species like trochus, giant clam and green snail while also providing alternative livelihood activities in the form of prawn aquaculture.

The Fisheries Department, alongside the French IRD, private sector SCUBA operators, the Department of Tourism, SPC-GIZ and others have launched a major Crown of Thorns starfish eradication, reporting and research program. Crown of Thorns starfish are widely believed to undergo population outbreaks in response to a range of factors including climate.

SPC has recently launched a climate change adaptation program alongside the Vanuatu Fisheries Department in order to more heavily focus on and expand backyard and small-scale aquaculture which has been trialled by the private sector and by SPC-GIZ.

The Wan Smolbag Theatre NGO has expanded the role of its over 400 island based resource monitors to include climate change adaptation. These volunteer monitors now undertake regular climate adaptation assessments for their communities and are able to advise on the most appropriate adaptation approaches including coastal stabilization, MPA establishment or species/gear/size restrictions.

Several community-based organizations are currently working towards climate adaptation in the marine sector, primarily by establishing small-scale protected areas and monitoring for climate impacts. Groups like the Crab Bay Network on Malekula, the Tasi Vanuatu Network on Efate, the Mystery Island Reserve in Aneityim and the Nguna-Pele Marine and Land Protected Area Network<sup>34</sup> are all working closely with government agencies on adaptation action. For example, the Nguna-Pele Network has recently deployed a fish-aggregating device to relieve reef pressure, and have set up over 20 small-scale marine and land-protected areas. The Network undertakes regular monitoring of reefs, has developed a crown of thorns starfish composting technology, and they have initiated a coral mariculture based sponsorship program.

In 2014, the Department of Fisheries co-hosted Vanuatu's first Climate Services Dialogue which sought to bring together stakeholders to understand how climate information could be transformed into more useful tools and products for the marine sector. As a result of the dialogue, a Marine Dashboard online tool was developed that brings all major marine climate indicators and predictions into a single location.

## Water Resource Management

Vanuatu has a National Water Strategy 2008-2018<sup>35</sup> that calls for sustainable and equitable access to safe water and sanitation for the people of Vanuatu to support improved health and promote social and economic development. It explicitly recognizes that climate related changes could be expected

<sup>34</sup>[www.marineprotectedarea.com.vu](http://www.marineprotectedarea.com.vu)

<sup>35</sup>[http://www.nab.vu/sites/all/files/documents/03/04/2014%20-%2012%3A37/national\\_water\\_strategy\\_-\\_finalsmall.pdf](http://www.nab.vu/sites/all/files/documents/03/04/2014%20-%2012%3A37/national_water_strategy_-_finalsmall.pdf)

to limit the future availability of potable water, constrain its productive use and impact negatively on Vanuatu's pristine natural environment. Several programs and projects are supporting adaptation in the water sector:

The US Agency for International Development (USAID) Coastal Climate Adaptation Project (CCAP) is developing climate resilient water systems on North Efate and Tanna. The World Bank Increasing Resilience project is working along the Department of Geology, Mines and Water Resources to implement hundreds of rain fed water systems throughout the archipelago. The Vanuatu Red Cross Society is engaged in a major water, sanitation and health program, which includes climate proofing village water supply systems.

The Integrated Water Resource Management Project<sup>36</sup>, implemented by SPC and the GoV successfully developed a watershed approach to managing the Sarakata watershed on Santo Island.



## Water Resource Management

Vanuatu's formal education sector is guided by the National Curriculum Statement<sup>37</sup> which was fully climate mainstreamed in 2010 with the support of the SPC-GIZ program. It mandates that climate change adaptation and resilience must be incorporated into all subjects at all levels of the curriculum.

<sup>36</sup><http://www.pacific-iwrm.org/community/showthread.php?152-Snapshot-of-Pacific-IWRM-Progress-in-Vanuatu>

<sup>37</sup><http://www.nab.vu/projects/review-and-climate-mainstreaming-national-curriculum>

In 2013, the Curriculum Development Unit of the Ministry of Education completed Vanuatu's new English and French curriculum which fully mainstreams climate change and disaster risk reduction learning outcomes from levels K-13. The Vanuatu Institute of Teacher Education is now developing texts and learning materials and rolling out teacher trainings.

Key Climate Resources now being taught in Vanuatu schools and used in ni-Vanuatu communities include the Pou & Miri climate change series<sup>38</sup>, the Cloud Nasara Climate Animation<sup>39</sup>, Learning about Climate Change the Pacific Island Way<sup>40</sup> and the adaptation guidebooks, manuals and DVDs<sup>41</sup> produced by the SPC-GIZ CCCPIR Program.

In the non-formal sector, the Vanuatu Rural Development Training Centres Association looks after Vanuatu's rural training centres, and is currently finalizing a series of 7 units at the Certificate Level I on CC and DRR. These modules are being supported by an Industry Advisory Group for climate change.

## Transport and Infrastructure

Australia provided AUD\$17 million towards the Vanuatu transport sector support program, 2009–2012, and a further AUD\$3 million to help climate-proof the roads, by improvement of planning, construction, and maintenance of priority road links on the islands of Ambae, Tanna and Malekula. The PACC project assisted the GoV and key stakeholders on the island of Epi to develop their capacity to employ multi-stakeholder decision-making systems to design and implement relocation of road infrastructure so as to increase resilience to climate change related risks.

Those Major Projects (over 1 million USD) that are of relevance to the climate change adaptation and sustainable development are summarized below:

**Pacific Adaptation to Climate Change Project (PACC)**<sup>42</sup> The PACC project spans over 14 different Pacific island countries is funded by GEF, AusAID and UNDP, with SPREP as the implementing partner of the Project. The PACC project supports on the ground projects to help communities adapt to climate change in one of three key areas; food production and food security, water resource management, and coastal zone management.

**SPC-GIZ Coping with Climate Change in the Pacific Island Region Programme (CCCPIR)**<sup>43</sup> The SPC/GIZ CCCPIR program aims to strengthen the capacities of Pacific member countries and regional organisations to cope with the impacts of climate change. Changing rainfall patterns, longer drought periods, increased cyclone intensity and rising sea levels are likely to affect all communities and key

<sup>38</sup>[http://www.spc.int/lrd/ahp-publications/doc\\_download/1531-pou-and-miri-learn-to-tackle-climate-change](http://www.spc.int/lrd/ahp-publications/doc_download/1531-pou-and-miri-learn-to-tackle-climate-change)

<sup>39</sup><http://www.pacificclimatechangescience.org/animations/cloudnasara/>

<sup>40</sup><http://www.spc.int/cc-project/>

<sup>41</sup><http://www.nab.vu/projects/coping-climate-change-pacific-island-region-spc-giz>

<sup>42</sup><http://www.nab.vu/projects/pacific-adaptation-climate-change-project>

<sup>43</sup><http://www.nab.vu/projects/coping-climate-change-pacific-island-region-spc-giz>

economic sectors such as agriculture, forestry, fisheries and tourism. The Program commenced work in Vanuatu in 2009. Recognising the particular vulnerabilities of Pacific countries, the Government of the Federal Republic of Germany through the Federal Ministry for Economic Cooperation and Development (BMZ) has extended its commitment to support Pacific Island Countries to cope with the effects of climate change. It has allocated a total overall financial envelope to € 17.2 Million .

**Aus-Pacific Climate Change Science Program (PCCSP)<sup>44</sup>** PCCSP was funded by AusAID, managed by the Department of the Environment (DOE) and delivered by a partnership between the Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation (CSIRO) during the period 2009 - 2011. It provided critical climate scientific research and commenced important steps in capacity building in Pacific Island countries. Building on the success of PCCSP and with further support from AusAID and DOE, the Australian Bureau of Meteorology and the CSIRO are continuing to work with 15 partner countries to help generate scientific insight into the state of climate change in the Pacific now and in the future, under the Pacific-Australia Climate Change Science Adaptation Planning program (PACCSAP).

**WB Increasing Resilience to Climate Change & Natural Hazards Project<sup>45</sup>** The objective is to help increase the resilience of communities in Vanuatu to the impacts of climate variability and change and natural hazards on food and water security as well as livelihoods. There are four components to the project. The first component of the project is institutional strengthening for climate change adaptation and disaster risk management. This component supporting the recipient to operationalize project management functions by: strengthening of the NAB Secretariat, strengthening the NDMO, and strengthening early warning systems. The second component of the project is increasing community resilience on active volcanic islands and in coastal areas. This component increases the ability of national, regional and community-level stakeholders to work together to enhance disaster and climate resilience in rural communities. The third component of the project is promotion of improved technologies for food crop production and resilience to climate change. This component supports the project implementing entity and the recipient to develop approaches, strategies and technologies for adapting to climate change and responding to food security and market demands. The fourth component of the project is rural water security. This component supports the recipient to increase access to secure water supply.

**USP-EU Global Climate Change Alliance (GCCA) Project<sup>46</sup>** This is a 4-year project to which EU had allocated 8million Euros to meet the challenges of climate change in the 15 Pacific African Caribbean Pacific (ACP) countries, including Vanuatu. The University of the South Pacific's Pacific Centre for Environment and Sustainable Development (PaCE-SD) manages the project with the objective to develop and strengthen the Pacific ACP countries' capacity to adapt to the impacts of climate change. This will be achieved through training of local, national, and regional experts on climate change and adaptation, the development and implementation of sustainable strategies for community adaptation to climate change, based on improved understanding of climate change and variability in the Pacific region. The project also aims to contribute to the establishment of a network of local, national and regional specialists on climate change who will support communities, governments within Pacific ACP countries, NGO's, and regional organizations in their efforts to address climate change through a long term, sustainable approach. The main components of the project are 1) Capacity Building - that

<sup>44</sup><http://www.pacificclimatechangescience.org/>

<sup>45</sup><http://www.worldbank.org/projects/P112611/increasing-resilience-climate-change-natural-hazards-vanuatu?lang=en>

<sup>46</sup>[http://www.usp.ac.fj/index.php?id=9878&tx\\_ttnews%5Btt\\_news%5D=1020&cHash=bc52c221fe4d8b9c54b5d9a1f94341a0](http://www.usp.ac.fj/index.php?id=9878&tx_ttnews%5Btt_news%5D=1020&cHash=bc52c221fe4d8b9c54b5d9a1f94341a0)

will cover both non-formal and formal training 2) Applied Research and 3) Community Engagement which will help about 40 communities (pilot sites) within the 15 Pacific ACP countries adapt to climate change.

**GEF Integrated Water Resource Management Project<sup>47</sup>** Vanuatu's GEF Pacific IWRM Demonstration Project titled "Sustainable Management of the Sarakata Watershed" has strengthened arrangements for improved watershed management and community engagement. The project is also successfully testing various measures to reduce stress on the Sarakata watershed. Key project results include: establishment of the Sarakata Basin Integrated Flood Management Plan; establishment of Water Protected Zones; increase in community engagement with national Government on water issues; and successful trials of sustainable forest and land management practices with landowners.

**WB Mainstreaming Disaster Risk Reduction Project<sup>48</sup>** The overall goal of the program is to strengthen urban planning and tsunami preparedness in the main urban areas of Vanuatu.

**UNDP Pacific Risk Resilience Program<sup>49</sup>** The goal of the program is to strengthen the resilience of Pacific Island communities to disasters and climate change related risk. The Pacific Risk Resilience Program will operate across four countries initially: Fiji, Solomon Islands, Tonga and Vanuatu. The program is implemented by the UNDP Pacific Centre and will also involve an international non-government organisation. The program has two components: 1. Risk governance: supporting mainstreaming of disaster and climate change risk into development planning and budgeting at all levels of government. 2. Community level risk management: strengthening community resilience through targeted and inclusive community based disaster and climate change risk management, and integration of risk management into local level governance mechanisms.

**IUCN MESCAL Project<sup>50</sup>** The project goal is to increase the climate change resilience of Pacific Islanders as well as improve their livelihoods through selected capacity support in adaptive co-management and restoration of mangroves and associated ecosystems in five countries: Fiji, Samoa, Solomon Islands, Tonga and Vanuatu by 1. National Baseline Information about climate change scenarios, use and values of mangroves and associated ecosystems 2. Co-management of mangroves for adaptation to climate change governance 3. Improved conservation and/or restoration of mangroves at selected demonstration sites 4. Increased awareness, advocacy and capacity development.

**EU Global Climate Change Alliance Project<sup>51</sup>** Mainstream climate change adaptation and climate-related disaster risk reduction into core aspects of Vanuatu's economy and resource management system. Increase Vanuatu's capabilities to cope with the effects of climate change by improving its overall understanding of the effects of climate change, and strengthening climate resilience and disaster risk reduction in key sectors through 1. Policy Development and 2. NAPA implementation.

**USAID Coastal Climate Adaptation Project (CCAP)<sup>52</sup>** This project is for the countries of Fiji, Kiribati, Nauru, Palau, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu, and the Federated States of Micronesia. Its aim is to build the resilience of vulnerable coastal communities to withstand more intense and frequent weather events and ecosystem degradation in the short term, and sea level rise in the long term.

<sup>47</sup><http://www.pacific-iwrm.org/community/showthread.php?152-Snapshot-of-Pacific-IWRM-Progress-in-Vanuatu>

<sup>48</sup><http://www.worldbank.org/projects/P129376/mainstreaming-disaster-risk-reduction?lang=en>

<sup>49</sup><http://aid.dfat.gov.au/countries/pacific/rp/Pages/initiative-pacific-risk-resilience-program.aspx>

<sup>50</sup>[https://www.iucn.org/about/union/secretariat/offices/oceania/priorities/priority\\_naturebasedsolutions/water\\_wetlands/about/](https://www.iucn.org/about/union/secretariat/offices/oceania/priorities/priority_naturebasedsolutions/water_wetlands/about/)

<sup>51</sup><http://www.gcca.eu/national-programmes/pacific/gcca-thematic-support-programme-for-vanuatu>

<sup>52</sup><http://dai.com/our-work/projects/south-pacific-islands%E2%80%94coastal-community-adaptation-project-c-cap>

**UNDP Vanuatu Coastal Climate Adaptation Project**<sup>53</sup> This UNDP-supported, GEF-LDCF funded project, “**Adaptation to Climate Change in the Coastal Zone of Vanuatu**”, will focus on methods of improving this resilience through sustaining livelihoods, food production and preserve and improve the quality of life in targeted vulnerable areas in the coastal zone of the island nation.

**SPC-USAID Enhanced climate change resilience of food production systems in Pacific Island countries and territories**<sup>54</sup> SPC and the USAID, in collaboration with partner agencies, are supporting the governments of six Pacific countries – Fiji, Kiribati, Samoa, Solomon Islands, Tonga and Vanuatu – in their efforts to tackle the adverse effects of climate change on food production. The support includes updating vegetation and land cover maps at the national level, and working with local communities to implement appropriate adaptation measures to build their resilience to climate change. The initiative will evaluate and increase the resilience of land-based food production systems. The project harnesses an innovative partnership between two SPC divisions, the Applied Geoscience and Technology Division (SOPAC) and the Land Resources Division (LRD). SOPAC is providing geographic information system (GIS) data to LRD enabling more accurate and informed implementation of climate change resilience activities on the ground

**SPC-USAID Vegetation and land cover mapping and improving food security for building resilience to a changing climate in Pacific Island communities**<sup>55</sup>. The goal of this regional project is to evaluate and implement innovative techniques and management approaches to increasing the climate change resilience of terrestrial food production systems for communities in selected PICTS (Fiji, Kiribati, Samoa, Solomon Islands, Tonga and Vanuatu). The project will do this through the introduction of integrated agricultural production systems based on assessments of the climate resilience of existing systems at selected sites. Improved land-system data and analysis tools, such as vegetation and land use mapping and the application of GIS, will support this. It will build the capacity of participating countries to utilise GIS tools and techniques to help identify key areas of food supply vulnerability, monitor vegetation and land cover change overtime. These assessments will be based on the most up-to-date country level climate change projections available. The project outputs will also be used to help inform the development and national and agriculture sector climate change adaptation response strategies in the recipient countries and other PICTs.

**Capacity Building for the Development of Adaptation Measures Project (CBDAMPIC):** The objective of the CBDAMPIC project is to demonstrate mainstreaming of adaptation measures as a practical means toward protecting, building and maintaining sustainable ni-Vanuatu communities and values in the face of present and future climate change and other human induced and natural global climate change. The projects goal is to enable Vanuatu to protect its environment through enhancement of national and community level capacity in pursuance of sustainable development and achievement of improved livelihoods. The project has seen the implementation of the first ever-global climate change adaptation project in Vanuatu. This was the relocation of a settlement Lateau on Tegua, an island in Torba province in the Northern part of Vanuatu. This relocation was possible after vulnerability and adaptation assessment, community education and awareness workshops were carried out with the participation of the community.

<sup>53</sup><http://www.undp-alm.org/projects/lDCF-vanuatu>

<sup>54</sup><http://www.spc.int/lrd/focus-areas/climate-change/34/building-resilience-to-climate-change-for-food-security-in-the-pacific-region>

<sup>55</sup><http://www.nab.vu/projects/vegetation-and-land-cover-mapping-and-improving-food-security-building-resilience-changing>

**Regional Programme for Food Security and Sustainable Livelihoods in the Pacific Islands:** The program is supported by Food and Agriculture Organization (FAO). The Sub-Programme – Natural Disasters and Climate Change Preparedness, Adaptation and Mitigation – has four components dealing with (i) Agriculture Diversification; (ii) Integrated Coastal Management; (iii) Land and Water Management and Use and (iv) Technical Coordination Support.

**Pacific Islands Global Climate Observation System (PI-GCOS):** The programme started in Apia, Samoa, in 2000 as a result of the first regional Global Climate Observing System (GCOS) workshop organised by SPREP and the international GCOS Secretariat. It is a sub-programme of the GCOS aimed specifically at meeting the observing needs of Pacific Islands. The program has been designed to enhance observations of climate and provide a more comprehensive database for more accurate predictions and decision-making.

**Vanuatu NGO Climate Change Adaptation Program:** funded by the Australian Government, is implemented by a consortium of six organisations: Save the Children Australia, CARE International in Vanuatu, Vanuatu Red Cross Society, Vanuatu Rural Development Training Centres Association, SPC/GIZ and coordinated by Oxfam. The program works with communities in nine islands across four provinces. It takes a broad view of resilience as the ability of women, men and children to realise their rights and improve their wellbeing despite shocks, stresses, and uncertainty. Community members are supported to plan and implement activities to strengthen DRR, Water, Sanitation And Hygiene (WASH), Natural Resource Management (NRM), agriculture, nutrition, traditional knowledge, women's leadership and education. This program also established the Vanuatu Climate Action Network (VCAN), which facilitates the sharing of lessons and good practice approaches among over 20 civil society organisations and with the government.

### 3.7 Climate Change Adaptation Options and National Priorities

National adaptation options for Vanuatu have been identified for each of the vulnerable sectors, stressing the need for “no regrets” strategies, which make good sense regardless of impending climate change. These potential adaptation strategies were developed in a major national consultation undertaken throughout the six provinces of Vanuatu. The adaptation action options are organized in matrix form by both sector and climate impact, and are accessible online on the NAB Portal ([www.nab.vu](http://www.nab.vu)).

### 3.8 Barriers and Opportunities

The 2013 Vanuatu Risk Governance Assessment has identified key barriers and opportunities for improved climate change governance. It was designed to critically analyse the NAB structure including roles, while also expanding its focus to assess the capacities of agencies undertaking CC/DRR activities.

Several weaknesses have been identified including:

- There is an inconsistent of engagement of senior officials,
- Lack of transparency in climate change decision making,

- A need to position climate change governance institutions as value-adding entities within the broader development agenda
- Inadequate climate governance reporting.
- The major observations in relation to the consultations included:
  - A number of legislative changes are required to reflect the current climate and disaster governance arrangements and clarify the full range of climate and disaster risk responsibilities.
  - The current Corporate, Strategic and Business planning process of different Ministries and Departments are weak with many agencies not having plans.
  - The Millennium Challenge Corporation (MCC) does not yet have an approved long term Corporate Plan, although it is acknowledged that efforts are on-going to complete this task. The lack of a formal plan is sending the wrong signals to the Council of Ministers (COM) that the Ministry is not demonstrating alignment with the national priorities contained within the Priorities and Action Agenda (PAA) and Planning Long, Acting Short 2009–12 (PLAS<sup>56</sup>). This means that the medium term plan related to CC/DRR is either not implemented or, if implemented, it is not reported well.
  - No systematic assessment has been carried out to understand the required skills set, existing skills set and the gaps for implementing CC/DRR initiatives. No human resource development plan has been developed. Most training is ad hoc in nature and not linked to a formal professional development strategy
  - M&E systems are weak or non-existent in most agencies. Therefore the CC/DRR achievements may not be adequately highlighted in the Government Annual Development Report prepared by the Prime Ministers Office (PMO).
  - Information and knowledge management systems are lacking within the NAB and most agencies make information sharing and the concept of “lessons learnt” almost impossible.

As a response to these assessments of challenges, the Vanuatu Government is currently undertaking a major reform of the NAB, specifically by establishing a new and dedicated Secretariat and also building the capacity of Provincial authorities.

Vanuatu being a least-developed country has limited financial and infrastructure capacity to implement costly adaptation measures. Limited financial capacity is the most obvious and important barrier to Vanuatu’s implementing vital adaptation measures. Neither the government of Vanuatu nor the private sector has the means to invest in climate-change activities. In 2013, Vanuatu made a submission to the UNFCCC Secretariat<sup>57</sup> requesting that Direct Access to climate finance be considered for countries like Vanuatu. However, apart from financial constraints there are some serious constraints in the implementation of adaptation measures in Vanuatu.

<sup>56</sup>Government of Vanuatu’s four-year work program for administrative reforms and policies 2009-12.

<sup>57</sup>[https://unfccc.int/files/documentation/submissions\\_from\\_parties/application/pdf/cop\\_operating\\_entities\\_vanuatu\\_03092013.pdf](https://unfccc.int/files/documentation/submissions_from_parties/application/pdf/cop_operating_entities_vanuatu_03092013.pdf)

## 3.9 Conclusion

Climate change and changing weather patterns are already having a negative impact on all the priority sectors in Vanuatu and most evidence points to the fact that they will be exacerbated by climate change related events in the future. Climate related disasters are one of the main hindrances to economic development in Vanuatu and this will certainly continue.

Vanuatu is one of the countries most vulnerable to climate change among the other Pacific island nations. The effects of climate change on agriculture production, fisheries, human health, tourism and well-being will have the consequences of decreasing national income while increasing key social and infrastructure costs. Climate change may affect all areas of life for Ni-Vanuatu people and impact women, men and young people in different ways.

Adapting to climate change and variability is a serious and urgent need for Vanuatu, which is progressing rapidly with the collaboration of many government and non-government partners. Vanuatu takes great pride in the progress it is making towards fulfilling its obligations under the UNFCCC and providing real solutions to its population. The ideal approach to adaptation for Vanuatu continues to be a pro-active, no-regrets approach which encompasses measures and strategies that can be implemented now with the aim of reducing vulnerability in the future. At the community level, women, men and young people need to be supported to increase their resilience and ability to plan for and adapt to an uncertain future.

The main problem with assessing the impact of climate change and in identifying a cost-effective response is the uncertainty surrounding estimates of the time and magnitude of the changes to be expected. The difficulty lies in the complexity of predicting the changes, uncertainty over future global emission pathways, the short history and variability of the historical data, and the problem of clearly distinguishing between cyclical effects (climate variability) and long-run climate change impacts. Identifying the hotspots and key vulnerable areas will continue to be a challenge until a nation-wide approach to vulnerability assessments is adopted and implemented. Given these uncertainties, the “no-regrets” measures adopted by the Government of Vanuatu make sound economic and financial sense.

Despite the great success of literally thousands of adaptation actions taken by a myriad of partners in Vanuatu, much still needs to be done to ensure that Vanuatu is able to reduce the impact of climate change on areas that are already vulnerable and at the same time effectively protect others that are at risk from future changes.

## 4. Mitigation

### 4.1 Background

Climate Change Mitigation by reducing GHG emissions and enhancing sinks and reservoirs is essential to meet the UNFCCC's objective of stabilizing GHG concentrations in the atmosphere. The mitigation measures are defined as any anthropogenic intervention that can either reduce the sources of greenhouse gas emissions or enhance their sinks (abatement or sequestration).

The Pacific Islands Climate Change Program (PICCAP) has addressed mitigation measures at a regional level to help Pacific Island countries to implement the UNFCCC. A range of policies and various economy-wide packages of policy instruments have been effective in reducing GHG emissions in different sectors. However it is crucial that developed countries take the lead in the global mitigation efforts. Adequate levels of financial and technical support must also be provided to developing countries so that they can likewise reduce emissions.

The total GHG emissions by source for Vanuatu for the year 2000 was 585.39Gg CO<sub>2</sub>equivalent (excluding removals from Agriculture, Forestry and other land uses). The contribution of each sector includes Energy (70.34Gg CO<sub>2</sub>e) 12%; Industrial Processes & Product Use (0Gg CO<sub>2</sub>e) 0%; Agriculture, Forestry & Other Land Use (excl. removals) (502.83Gg CO<sub>2</sub>e) 85.6 % and Waste (12.21Gg CO<sub>2</sub>e) 2.1 %. The concentration of individual GHGs includes Carbon Dioxide (CO<sub>2</sub>) 12%; Methane (CH<sub>4</sub>) 57%; Nitrous Oxide (N<sub>2</sub>O) 31%; Emissions from per fluorocarbons (PFCs), hydro fluorocarbons (HFCs) and sulphurs hexafluoride (SF<sub>6</sub>) in Vanuatu are negligible, as the products containing these gases are not produced in the country. The primary sources for CO<sub>2</sub> emissions are from combustion of fossil fuels for power generation and transportation; and for CH<sub>4</sub> and nitrous oxide (N<sub>2</sub>O) are primarily due to agricultural activity and waste disposal.

Vanuatu is committed to formulating strategies, national policies and best practices for addressing GHG emissions and making a practical contribution to the global mitigation efforts, while at the same time pursuing its national and regional development priorities and sustainable development objectives. It plans to achieve this by integrating GHG abatement efforts with other social, environmental and economic priorities.

This chapter outlines Vanuatu's contribution to global climatic change mitigation efforts, addresses GHG emissions and removals including contribution and effectiveness of potential greenhouse gas abatement actions to long-term sustainable development. This chapter also outlines priority climate change mitigation areas that require international support.

### 4.2 Potential Climate Change Mitigation Sectors

The following section includes the mitigation assessment of the main GHG emission sectors, various technologies, national and sectoral policies and practices with aim to present Vanuatu's capacity to mitigate climate change and long-term mitigation scenarios.

**Energy Sector:** Energy is one of the crucial development indicators in any country and like the other Pacific Island Countries; Vanuatu's primary energy needs are met by imported petroleum fuel. Fuel wood is the principal source of energy for rural households and charcoal, a minor fuel in rural areas. However the commercial energy supply is predominantly based on imported petroleum products.

At present, electricity in Vanuatu is produced mainly by diesel generators, supplemented by variety of other sources including hydroelectric, wind, solar and copra oil. The data for electricity produced in Vanuatu from January to October-2013 indicates that majority of electricity was generated from Diesel (67%) followed by Copra oil (14.3%), Hydro Power (10.3%), Wind Power (8.1%) and Solar Power (0.2%).

**Table 4.1: Electricity Generated by source in Vanuatu (January to October-2013)**

	Port Vila	Luganville	Malekula	Tanna	Total
Electricity Generated (kWh)	49,090,596	7,469,979	601,528	585,464	57,747,567
Diesel	36,217,382	1,498,134	428,288	561,237	67%
Copra Oil	8,103,880	753	147,594	0	14.3%
Hydro	0	5,968,851	0	0	10.3%
Wind	4,681,068	0	0	0	8.1%
Solar	88,266	2,241	25,646	24,227	0.2%

Source: [www.ura.gov.vu](http://www.ura.gov.vu)

The assessment of electricity produced for the Port Vila grid in Vanuatu for 5 years (2008-2012) shows that the electricity generation is dominated by diesel based generators. The share of renewable energy sources including the low-cost/must-run power plants increased from 2% (2008) to 14% (2012).

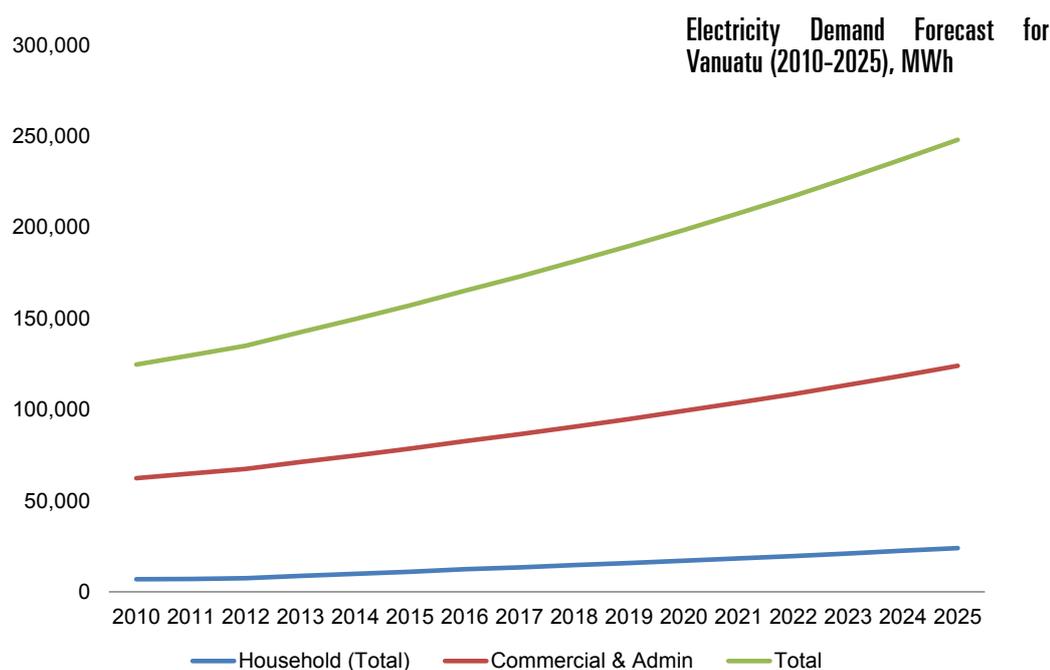
**Table 4.2: Electricity Generated in Port Villa Grid, Vanuatu (2008-2012)**

Electricity Generated (MWh)	2008	2009	2010	2011	2012
Thermal Power Plants	48,551	45,462	50,965	52,881	48,070
Renewable Energy Power Plants	777	5,804	5,960	5,147	8,091
Total	49,328	51,266	56,925	58,028	56,162
CO <sub>2</sub> Emission based on Fuel Consumption (tCO <sub>2</sub> e)	31,992	29,897	32,183	34,156	31,114

It is also estimated that the electricity demand will increase rapidly in the near future due to grid expansion, new connection and rapidly changing consumer behaviour that impacts the electricity use in Vanuatu. Also, it is envisaged that the growth in aggregate electricity demand across the four concession areas will grow as the number of households as well as commercial and public customers increase in line with implementation of the new policies and rising income levels. The forecast also indicates that by 2015, 1000 additional households that are currently outside the existing concession areas would be most efficiently served by a grid extension.

The electricity demand forecast for Vanuatu has been estimated assuming the current demand from commercial customers; public administration and households that are already connected grow at 4% per annum and the implementation of national energy roadmap done successfully. In reality, demand from commercial customers could change substantially due to one or more new commercial customers establishing in any of the concession areas or shutting down their facilities as presented below:

**Figure 4.1 Electricity Demand Forecast for Vanuatu, 2010-2025**



The electricity demand forecasts for each concession area (Port Vila, Luganville, Malekula and Tanna) have been estimated with reference to 2010 UNELCO annual technical report and the projected increase in household connections. According to the records for the year 2010 the electricity demand for household and commercial sector was about 6,888 MWh and 62,435 MWh respectively. The electricity demand forecast for household and commercial energy consumption shows average

growth of 17% and 7% respectively over a period of 15 years and respective demand will be about 24,048MWh and 124,084MWh in the year 2025. This forecast shows an increasing trend in GHG emissions in the energy sector.

Vanuatu is well endowed with renewable energy sources such as hydro, solar, biomass, wind, coconut bio-fuel and geothermal. These resources offer considerable potential to provide Vanuatu with diverse energy supply sources and reduce its dependence on imported fossil fuels. GoV has taken various initiatives to mitigate GHG emissions of the energy sector as discussed later in this chapter.

**Transport Sector:** The transport sector has the largest share of 5.9% (34.69Gg CO<sub>2</sub>e) in GHG emissions for the base year 2000. The transport sector GHG emission includes emission from road transportation, domestic aviation and navigation. The GHG emission from this sector mainly includes the CO<sub>2</sub> emissions from combustion of fossil fuel (Gasoline) used in internal combustion engines. The road sector constitutes 85% of GHG emissions under transportation which is dominated by cars and other light multi-utility vehicles. The domestic aviation and national navigation contributed about 4.08% and 1.73% respectively.

The Vanuatu's major transport infrastructure assets include the 1,767km of roads (73km paved, 1,303 gravel and 400km earth), 26 airstrips (4 sealed, 5 coral, and 19 grass; 3 international airports Bauerfield, Pekoa and White Grass are maintained by Air Vanuatu Limited) and 36 wharves, jetties and landing stages. The aviation sector has total dependence on Air Vanuatu to connect the islands. International Flights have become more frequent since Vanuatu decided to follow the Open Sky Policy in 2005.

The road infrastructure and transport service in Vanuatu is particularly challenging and concentrated in the main urban areas of Port Vila (island of Efate) and Luganville (island of Espiritu Santo). The rural areas have limited and inadequately maintained transport infrastructure and services. Poor road conditions are driving up transport costs and adding to inefficiencies in the transportation sector. Further, the national roads are of highly variable standards and capacities, ranging from low traffic volume earth roads with less than 20 vehicles a day to major roads with traffic volumes greater than 100 vehicles a day and servicing significant proportions of the national population.

Vanuatu has all motor vehicles imported, as of 2011, the total numbers of registered vehicles in Vanuatu were 5,153 including 3,974 cars and 4-wheeled light vehicles, 118 motorized 2- and 3-wheelers, 227 heavy trucks and 834 buses. The average vehicle density is 54 motor vehicles per 100 people.

The main mode of transport in Vanuatu is by sea, via small craft in coastal areas and combined passenger and freight vessels for inter-island movements. Outside of Port Vila and Luganville, shipping services call at about 36 small jetties or wharves and many more informal anchorages or beach landing sites.

Transportation infrastructure development is one of the priority sectors for GoV and with this view the Government has initiated long term Vanuatu Transport Sector Support Program (VTSSP). GoV is also focusing on mitigation options for emissions from land, sea and air transport sectors. Measures include public transportation awareness programmes, vehicle emission standards, promoting fuel-efficient and alternative fuel vehicles, improving public transport services, introducing financial incentives to encourage energy efficiency and promoting non-motorized transport.

**Agriculture, Forestry & Other Land Use:** The Agriculture, Forestry and Livestock are the biggest source of GHG emission as well as acting as a sink in Vanuatu. In the year 2000, the GHG emissions from Agriculture, Forestry & Other Land Use (excluding removals) contributed about 85.9% of total GHG emissions (502.83 tCO<sub>2</sub>e). GHG emissions (primarily CH<sub>4</sub> and N<sub>2</sub>O) from these sectors are mainly attributed to livestock farming, Enteric Fermentation, Manure Management and N<sub>2</sub>O Emissions from managed soils.

As per the agriculture census conducted by the Vanuatu National Statistics Office (VNSO, 2007), the total number of cattle in the smallholder sector increased by 112% from 82,140 in 1983 to 174,000 in 2007 including substantial increment in the livestock other than cattle (pigs, goats, chickens). This large increase in stock numbers has led to substantial increase in methane emissions from livestock farming and nitrous oxide emissions from agricultural soils. The GHG emissions from this sector are mainly attributed to poor infrastructure and land use practices (shifting cultivation), inadequate and unsystematic manure management. Due to lack of data, it is difficult to gauge the contribution forests make to Vanuatu's GHG emissions profile. However, the GHG inventory for year 2000 includes the FOLU sector, wherein the CO<sub>2</sub> emissions/removals are estimated for changes in forest and other woody biomass stock including commercial logging. From the available data, Vanuatu's forests appear to be a net carbon sink.

**Waste Sector:** The GHG emissions from the Waste sector include, emissions from (a) solid waste management and disposal and (b) domestic and commercial wastewater handling. The GHG emission from waste disposal in Vanuatu for the year 2000 was about 2.1% (12.21Gg CO<sub>2</sub>e). Solid waste disposal on land accounted for 51.6% (6.3Gg CO<sub>2</sub>e) of total waste-related emissions followed by domestic wastewater handling accounting for 48.4% (5.92Gg CO<sub>2</sub>e). The GHG emission from the waste sector are mainly from the main population centres (Port Vila and Luganville) of Vanuatu.

Landfills are used for disposal of domestic, commercial and industrial wastes collected by the municipal council as well as for wastes dumped by the general public. Unmanaged solid waste and wastewater sites lead to methane emissions. Most wastewater in Vanuatu is treated on site in septic tanks and sludge is discharged at the landfill by the tanker operators. This means there is little scope for GHG abatement. However, there are several options for reducing emissions from the disposal of solid waste. There are currently no regulations for wastewater management or monitoring of receiving environments in the country.

### 4.3 Vanuatu's GHG Emissions Scenario

This GHG emission scenario for Vanuatu presents business as usual total GHG emissions (excluding the removals) between the year 2000 and 2025. The sectoral GHG emissions calculated for the base year 2000, 2005 and 2010 presented in the figure below:

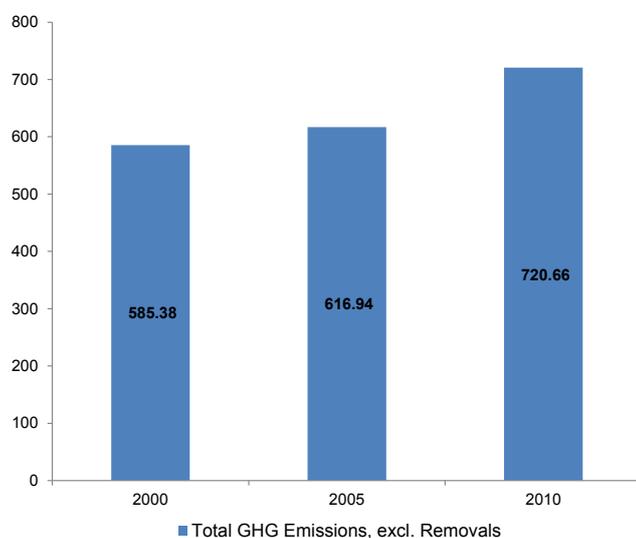
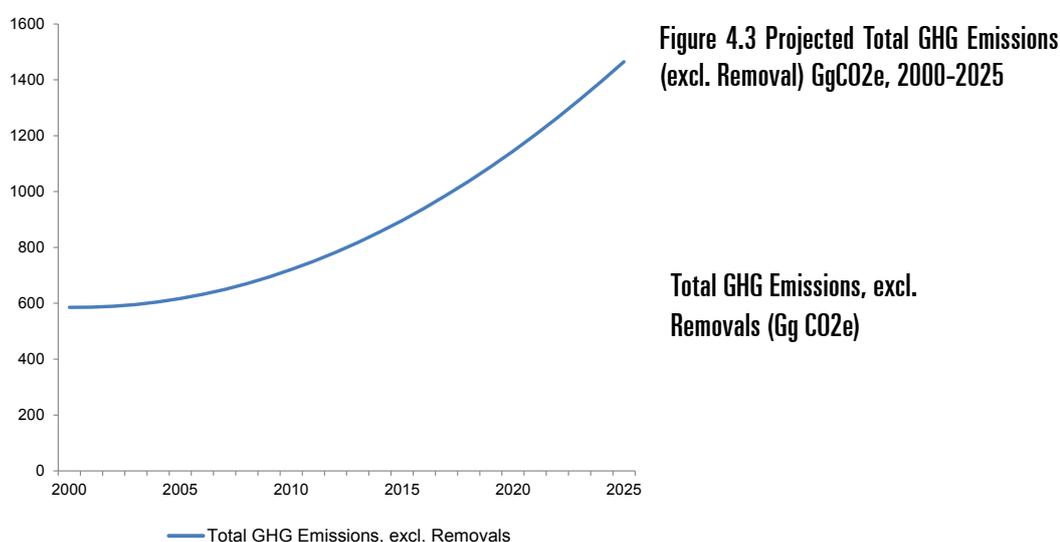


Figure 4.2 Total GHG Emissions (excluding Removal) GgCO<sub>2</sub>e, 2000-2010

Total GHG Emissions, excl. Removals (Gg CO<sub>2</sub>e)

Based on the input data available for the year 2000, 2005 and 2010, GHG emissions profile (excl. removals) for Vanuatu has been prepared for year 2025. Under the baseline scenario, Vanuatu's total GHG emissions (excluding removals) were projected to increase by 150% between 2000 and 2025. The Vanuatu's GHG emission profile shows the largest increase in emissions to occur in the energy sector, which will rise by 230%, followed by emissions from agriculture and waste sector, which is likely to rise by 228% and 137% with respect to baseline emission of year 2000. The GHG emission from the energy sector is evidenced by the increase in electricity demand and Vanuatu's ambitious energy plan. The GHG emission profile of Vanuatu is presented in the figure below:



The presented GHG emissions projection for Vanuatu does not include sinks and removals and thus overall GHG emissions from Vanuatu will be negative considering the removals and sinks. Further, the projected GHG emission is envisaged to be reduced with intervention of various GHG mitigation options proposed by GoV.

The emissions scenarios illustrate that without intervention, emissions are projected to rise sharply over the next decade. It is important, however, to note that even with this growth Vanuatu's emissions will still be small compared to other developing countries, in both absolute and per capita terms. There is significant potential for Vanuatu to reduce the GHG emissions by implementing renewable energy technology in the energy sector. This investment is largely beyond Vanuatu's financial capacity and is only achievable with support from development partners. New breakthroughs will be needed to tackle agricultural emissions. Under all scenarios, agricultural emissions will continue to grow sharply, particularly in the first half of the assessment period. This will also depend largely on progress made in developing viable options for the reduction of emissions from livestock farming.

## 4.4 Mitigation Related National/Regional Policies and Programs

In accordance with the principles of common but differentiated responsibilities and capabilities; it is crucial that developed countries take the lead in the global mitigation efforts. The GoV is committed to making a practical contribution to global climate change mitigation efforts and has taken various

policies, legislations and program based initiatives towards climate change mitigation and GHG emission reduction with the support of various development partners and agencies. The main mitigation policy and programs of Vanuatu government are discussed in the following section.

**Vanuatu National Energy Road Map (NERM) 2013-2020:** The GoV has an ambitious plan for developing the energy sector in a systematic, rational, strategic and sustainable manner over the medium term, for the benefit of all its citizens nationwide. The Government has developed a NERM 2013-2020; this roadmap was first published in March 2013 and endorsed by the Vanuatu Council of Ministers in June 2013. It has the overall vision to “*energize Vanuatu’s growth and development through the provision of secure, affordable, widely accessible, high quality, clean energy services for an educated, healthy, and wealthy nation*”. The roadmap focuses on the five key energy priorities:

#### Box 4.1: Vanuatu’s Key Energy Priorities

- (i). Achieving access to secure, reliable and affordable electricity for all citizens by 2030 through connection to electricity of 75% of household within concession areas by 2015, 90% by 2020 and 100% by 2030. For households close to concession areas, the corresponding figures are 33%, 90% and 100% respectively, while for off-grid areas the target is 100% of households having access to modern electricity via individual home systems and basic power products by 2020.
- (ii). Achieving energy security for Vanuatu at all times through diversifying energy sources and providing the enabling framework for investments in energy. The target to diversify energy sources includes increasing the share of renewables in power generation mix by 40% by 2015 and 65% by 2020.
- (iii). Mitigating climate through enhanced deployment of renewable energy technologies and energy efficiency.
- (iv). Ensuring that energy services in Vanuatu are affordable and low-cost
- (v). Reducing reliance on imported fossil fuels and ensuring that needed petroleum supply is reliable, secure and affordable throughout Vanuatu.

To achieve the high-level strategic vision, the Government has identified priorities, which will focus on the future performance of the sector. The road map has addressed each of the five priorities in urban and rural areas. The road map also presents the actions required to achieve the priorities set for the energy sector, including the enabling initiatives needed to ensure that the actions can be implemented like funding and financing to transform investment plans into reality, effective implementation plans for delivering the actions and monitoring and evaluation of the actions.

Based on the input data available for the year 2000, 2005 and 2010, GHG emissions profile (excl. removals) for Vanuatu has been prepared for year 2025. Under the baseline scenario, Vanuatu’s total GHG emissions (excluding removals) were projected to increase by 150% between 2000 and 2025. The Vanuatu’s GHG emission profile shows the largest increase in emissions to occur in the energy sector, which will rise by 230%, followed by emissions from agriculture and waste sector, which is likely to rise by 228% and 137% with respect to baseline emission of year 2000. The GHG emission from the energy sector is evidenced by the increase in electricity demand and Vanuatu’s ambitious energy plan. The GHG emission profile of Vanuatu is presented in the figure below:

**Table 4.3: Overview of Energy Sector Priorities**

Priority Sector	Description
<b>Petroleum Supply</b>	<ul style="list-style-type: none"> <li>▪ Reduce reliance on imported diesel and petroleum products through efficiency improvements in the transport sector and through investment in renewable energy in the power generation sector.</li> <li>▪ Strengthen legislative and regulatory framework.</li> <li>▪ Hedge fuel costs (physical storage and financial hedges).</li> <li>▪ Improve efficiency and reliability of fuel distribution within Vanuatu by shifting away from deliveries of fuel in drums and towards the use of regular bulk deliveries to outer islands.</li> </ul>
<b>Access</b>	<ul style="list-style-type: none"> <li>▪ Increase the rate of connections to electricity, which currently stands at an estimated 27% (16.7% of rural homes, 25% of health centres, 42% of schools).</li> </ul>
<b>Affordability</b>	<ul style="list-style-type: none"> <li>▪ Address consumers' current ability to pay for connection and on-going tariffs.</li> <li>▪ Explore options (financial and technical) to increase affordability for both on-grid and off-grid consumers.</li> <li>▪ Promote least cost investment in the electricity sector.</li> <li>▪ Introduce price monitoring for petrol, kerosene, and diesel fuels.</li> <li>▪ Introduce price regulation for LPG.</li> </ul>
<b>Energy Security</b>	<ul style="list-style-type: none"> <li>▪ Achieve a greater diversity of energy sources.</li> <li>▪ Provide a framework for investment.</li> <li>▪ Develop petroleum energy security policy and work with industry to optimize petroleum storage capacity and shipping schedules to ensure national energy security is maintained.</li> </ul>
<b>Climate Change</b>	<ul style="list-style-type: none"> <li>▪ Examine options for increasing renewable energy and improving energy efficiency and conservation.</li> </ul>

Priorities and Action Agenda (PAA) 2006 – 2015: The GoV's priorities and action agenda (2006 – 2015) has seven strategic priorities to achieve the national vision, which include: (1) Private Sector Development and Employment Creation; (2) Macroeconomic Stability and Equitable Growth; (3) Good Governance and Public Sector Reform; (4) Primary Sector Development, Environment, Climate Change, and Disaster Risk Management; (5) Provision of Better Health Services, especially in rural areas; (6) Education and Human Resource Development and (7) Economic Infrastructure and Support Services. There are policy objectives with associated strategies to achieve the objectives. The government has also prioritized various strategies which could lead to climate change mitigation like better transport services and infrastructure, sustainable utilization and management of land, improvement and strengthening of research and development in agriculture, livestock, fisheries and forestry along with finalization and implementation of the Vanuatu climate change policy including its integration in the PAA, sector plans and ministry corporate plans etc.

Vanuatu Forest Policy 2011 – 2020: The GoV has given priority to the forestry sector and integrated the impacts of climate change, downstream processing, marketing and trade, revenue generation, ni-

Vanuatu participation, reforestation and forest conservation into the Forest Policy. The GoV has also revised the 1997 National Forest Policy and prepared the new “Vanuatu Forest Policy 2011 – 2020” for the sustainable development and management of the entire forestry sector. The new forestry policy presents clear directives (urgent, short-term, medium-term, and long-term) supported by implementation strategies including timelines and responsibilities. The new policy has been developed through addressing gaps or pitfalls of the existing policy through a broad consultation process with various stakeholders.

The “Vanuatu Forest Policy 2011 – 2020” has also placed great emphasis on linkage and harmonization with existing sectoral policies and sustainable development of ni-Vanuatu community. The stakeholder engagement and participation of ni-Vanuatu landowners and communities was one of the prerequisites for the sustainable management and use of Vanuatu’s forest resources. The policy is focused on forest-based rural development, conservation of ecosystems, biological diversity and the silviculture of the indigenous species thereby enhancing economic growth, well being and livelihood of Ni-Vanuatu people. The policy directives and brief specific objectives are presented in the table below:

**Table 4.4: Vanuatu Forest Policy 2011 – 2020 (Directives, Specific objectives and Activities)**

Policy Directives	Specific Objectives	Activities
Sustainable Forest Management	Vanuatu’s forests are sustainably developed and managed. Deforested areas are rehabilitated and reforested.	<ol style="list-style-type: none"> <li>1. Undertake a National Forest Resources Assessment every ten years</li> <li>2. Sustainably manage forests using internationally accepted mechanisms and tools and incorporating traditional and cultural practices.</li> <li>3. Manage native forests through various silvicultural systems.</li> <li>4. Protect, develop, and manage non-wood forest products and medicinal plants</li> <li>5. Discourage conversion of natural forest</li> <li>6. Implement and strictly observe forest health surveillance systems</li> <li>7. Apply for, issue and obtain Government permits for all forestry harvesting and prospecting activities.</li> <li>8. Develop planted forests as the basis for Vanuatu’s forest resources and timber supply.</li> <li>9. Prescribe and follow guidelines for harvesting of planted forest.</li> <li>10. Establish 20,000 ha of planted forests by 2020 by way of large-scale plantations, community forestry plantations and woodlots.</li> </ol>

Policy Directives	Specific Objectives	Activities
		<ul style="list-style-type: none"> <li>11. Undertake compensatory replanting.</li> <li>12. Identify, manage, and protect all watershed and catchment areas.</li> <li>13. Manage and protect all areas vulnerable to erosion</li> <li>14. Maintain soil quality</li> <li>15. Protect and manage wetland, coastal and mangrove forest areas</li> <li>16. Develop and implement land use plans including forestry activities</li> </ul>
<p>Small- Holder Farmer and Community Based Forestry</p>	<p>Stakeholders and communities actively participate in sustainable forest management and utilization.</p> <p>The forestry sector contributes increasingly and equitably to the welfare and livelihoods of landowners, farmers, industry and communities.</p>	<ul style="list-style-type: none"> <li>17. Actively participate and engage with communities on forestry initiatives.</li> <li>18. Design and implement programs and projects for integrated and sustainable forest management jointly with community stakeholders</li> </ul>
<p>Forest Conservation and Environment</p>	<p>Forests with high biological, cultural, spiritual, and historical values are conserved and protected</p>	<ul style="list-style-type: none"> <li>19. Actively manage and protect 30% of Vanuatu's natural forests</li> <li>20. Maintain the biodiversity and ecological integrity of forests and trees</li> </ul>
<p>Climate Change</p>	<p>The forestry sector proactively incorporates climate change adaptation and mitigation challenges and opportunities.</p> <p>The forestry sector embraces climate change mitigation and GHG emissions reduction.</p> <p>Through reducing deforestation and degradation, and increasing afforestation and reforestation.</p>	<ul style="list-style-type: none"> <li>21. Integrate climate change adaptation issues into forestry sector planning and activities.</li> <li>22. Integrate climate change mitigation issues into forestry sector planning and activities.</li> </ul>

Policy Directives	Specific Objectives	Activities
Forest Industries	<p>Forest industries are modernized and utilize appropriate technologies.</p> <p>Forests are managed in an integrated manner to provide economic, social and environmental services.</p> <p>Forest products and services are marketable and tradable.</p> <p>Prices for forest products and services are nationally and internationally competitive.</p> <p>Forest production is sufficient for local consumption and export of surplus.</p> <p>Forest industries are increasingly Ni-Vanuatu owned and operated</p>	<p>23. Develop the adequate infrastructure to facilitate the development of forest products and services</p> <p>24. Modernize the forestry sector to deliver efficiency, innovation, quantity, quality of products and services.</p> <p>25. Grade logs and timber to internationally accepted practices and standards.</p> <p>26. Modernize the forestry sector by developing joint ventures and arrangements</p> <p>27. Promote domestic processing and value adding of wood and non-wood forest products</p> <p>28. Increase the production of wood products.</p> <p>29. Increase the production of non-wood forest products.</p> <p>30. Seek new markets for products of priority species, particularly value-added products.</p> <p>31. Position forest products and services to be competitive in national and international markets and trades.</p> <p>32. Regulate the import and export of timber, logs and flitches.</p> <p>33. Expand the utilization of local timber as an economically valuable, durable and renewable commodity for housing and construction purposes.</p> <p>34. Create a conducive business and investment environment to enable competitive forest industries.</p> <p>35. Improve the access of Ni-Vanuatu to forest industries.</p>
Finance	<p>The forestry sector is efficient, well organized and resourced (both financial and human).</p> <p>The forestry sector is a primary source of income generation.</p>	<p>36. Allocate sufficient funds to DoF and forestry sector in order to adequately carry out legislative responsibilities and to ensure the sustainable management of forests.</p> <p>37. Establish a forestry project fund for the purpose of financing priority activities and initiatives.</p> <p>38. Establish a Biodiversity Conservation Fund (BCF) to support biodiversity conservation activities related to Forests.</p> <p>39. Establish a forest and climate change fund</p> <p>40. Contribute a portion of Industry revenues to the development of the sector</p> <p>41. Establish credit and financing opportunities for forestry enterprises.</p>

Policy Directives	Specific Objectives	Activities
		<p>42. Coordinate donor partners' contribution to the financial capital available to the forest sector.</p> <p>43. Develop and promote forestry sector. investment opportunities for private and institutional investors.</p> <p>44. Reduce costs of doing business.</p> <p>45. Vigorously promote forestry as a primary income generating activity throughout Vanuatu.</p> <p>46. Collect annual license fees from all operators according to the maximum output permitted under the license</p> <p>47. Apply Forest Management Charges to all licensees</p> <p>48. Register all forest product-processing facilities with the Department of Forests.</p> <p>49. Collect royalties for all forest resources.</p> <p>50. Pay an annual holding fee to landowners</p>
Institutional Setup	<p>The forestry sector is well governed and guided by effective legislation and strong compliance.</p> <p>The forestry sector is well coordinated and collaborates with other sectors.</p>	<p>51. The National Government is responsible for regulating and administering the forestry sector in Vanuatu.</p> <p>52. The Department of Forests is responsible for the management of forestry sector activities in Vanuatu.</p> <p>53. Establish mechanisms to provide sound advice to Government on forestry issues.</p> <p>54. Improve the administration of forestry stakeholders.</p> <p>55. Strengthen cooperation and collaboration among all forestry sector stakeholders.</p> <p>56. Develop and clarify the roles and responsibilities of different actors within the forestry sector.</p> <p>57. Clearly define the responsibilities for Land Use Planning as it relates to forestry; Establish forestry-related associations to strengthen the implementation of forestry activities.</p> <p>58. Devolve and decentralize forestry operations and implementation to communities and the private sector</p>

Policy Directives	Specific Objectives	Activities
		<p>59. Equitably identify, determine and share forestry rights and benefits (across diverse users, products and services).</p> <p>60. Protect and document indigenous knowledge and rights regarding forests.</p> <p>61. Compensate appropriately all undue damages to forests, operations, infrastructure, communities, cultural sites, industries and the environment.</p> <p>62. Consider gender balance and gender equality in all forest operations and activities.</p> <p>63. Develop, harmonize, and enforce forestry sector legislative frameworks.</p> <p>64. Effectively monitor and enforce the forestry Act and National Forest Policy to ensure compliance</p> <p>65. Undertake Environmental Impact Assessment for relevant forestry activities and operations.</p> <p>66. Regulate the collection and export of forest biological materials.</p> <p>67. Minimize the impact of land disputes and land ownership issues on forest production.</p>
<p>Awareness, Training, Capacity Development, and Research</p>	<p>Forestry stakeholders are competent and qualified.</p> <p>The public is well-informed and educated on all forestry issues.</p> <p>The forestry sector is well guided by collaborative research and abides by internationally recognized Standards.</p>	<p>68. Provide adequate training for all forestry sector stakeholders.</p> <p>69. Secure adequate funds for training on forestry issues</p> <p>70. Provide work experience in the forestry sector for trained stakeholders</p> <p>71. Introduce forestry education in schools</p> <p>72. Conduct forestry awareness campaigns across all levels of Vanuatu society.</p> <p>73. Conduct targeted and applied research in all aspects of the forestry sector</p> <p>74. Return to Vanuatu the outputs and results of scientific research undertaken in Vanuatu and share these equitably with resource owners.</p>

## **Pacific Island Regional Policies and Programs**

Vanuatu is an active participant in Pacific island regional affairs and has signed on to a number of regional policies and initiatives that have implications for climate change mitigation. These are briefly outlined below:

**Pacific Plan for Strengthening Regional Cooperation and Integration (PPSRCI):** Endorsed by Pacific Island leaders in October 2005, the PPSRCI includes some strategies to help promote environmentally sound energy options and facilitate international financing for action on climate change.

**Pacific Island Framework for Action on Climate Change (PIFACC):** Approved by Pacific island leaders in June 2005, the PIFACC includes regional activities aimed at contributing to global greenhouse gas reduction. Expected mitigation outcomes by 2015 include:

- Promotion of improved energy efficiency in all sectors
- Introduction of cost-effective renewable energy technologies
- Promotion of local sources and knowledge
- Development and implementation of Clean Development Mechanisms.

**Pacific Islands Energy Policy:** Adopted in November 2004, the policy includes a number of important goals relevant to mitigation such as efficient power generation, environmentally clean and efficient transportation, development of renewable energy and improved energy efficiency.

**Solid Waste Management Strategy for the Pacific Region:** Developed by SPREP and adopted by Pacific Island countries and territories in 2005, the Strategy does not make specific references to GHG emissions. Its implementation, however, may help promote recycling and reduce the amount of waste going to landfills, which in turn may contribute to GHG abatement.

**Promoting Energy Efficiency in the Pacific - Phase 2 Project (PEEP2):** The PEEP2 project is sponsored by the ADB in cooperation with the GEF and the Government of Australia. The objective of this three year program is to promote and implement energy efficiency in the use of electrical power for consumers in five Pacific Developing Member Countries (PDMCs) - the Cook Islands, Papua New Guinea (PNG), Samoa, Tonga, and Vanuatu - through demand-side energy efficiency improvements in the residential, commercial, and government sectors of each country. The project components include; development of energy use database, development of energy efficiency policies and procedures, implementation of energy efficiency programs, information dissemination and public awareness. The project focuses on reducing the energy intensity of the PDMCs economies and thereby enhancing energy security, making energy services more affordable to end-users, and reducing GHG emissions. The Department of Energy, Mines and Minerals of the Ministry of Lands and Natural Resources is the designated PEEP2 implementing agency for Vanuatu.

**Table 4.5: Energy efficiency projects<sup>58</sup> (PEEP: Phase2)**

1	Energy Efficient Lighting for Provincial, Local Public Sector and School Buildings in Vanuatu Energy Efficient Lighting in Residential, Commercial and Government Sectors
2	Residential Energy Efficient Lighting, Luganville Energy Efficient Lighting in Residential, Commercial and Government Sectors
3	Energy Efficient Street Lighting Project in Port Vila, Vanuatu Energy Efficient Street Lighting Program
4	Energy Efficient Street Lighting Project in Luganville, Vanuatu Energy Efficient Street Lighting Program
5	Energy Efficient Air-Conditioning System Using Variable Refrigerant Volume/Flow Technologies Implementation of Energy Efficiency Measures in the Public Sector
6	Implementation of Energy Efficient Lighting in Public Sector Buildings Energy Efficient Lighting in Residential, Commercial and Government Sectors

## 4.5 Existing and Identified Mitigation Options

The GoV has implemented and identified various GHG mitigation projects in energy, transportation, and waste and forestry sector. The key GHG mitigation options and potential CDM projects<sup>59</sup> have been identified for each sector; potential projects and opportunities are discussed below:

**Renewable Energy Projects:** Electricity supply throughout Vanuatu is dominated by diesel generation, resulting in GHG emissions. The implementation of power generation and supply from renewable energy source would help in GHG emission reduction in Vanuatu. The potential and identified renewable energy projects are discussed below:

- **Brenwe River Mini- Hydropower Project in Malekula:** The proposed project activity is a run-of-river hydropower project located on the Brenwe River in the North West of Malekula Island, Malampa Province. The project will have installed capacity of 1200 kW with 20 KV transmission lines for a distance up to 30 km. The project is expected to be commissioned by 2014 and estimated annual emission reductions from the project activity will be about 4,241 tCO<sub>2</sub>e.
- **Wambu Hydropower Project, Santo Island:** The proposed Wambu River Mini Hydro Scheme is located at West of provincial capital Luganville in Santo Island. The project will have an estimated power generating capacity of 4 MW and equivalent annual energy production of 18.35 GWh. The project is expected to be commissioned by 2015 and estimated annual emission reductions from this project would be about 11,569 tCO<sub>2</sub>e.
- **Efate Geothermal Power Project:** The proposed project is 4 MW geothermal power stations located at Takara springs on Efate island of Vanuatu. The project is a binary cycle technology based geothermal power plant and the first of its kind in the country. The project is expected to be commissioned by 2015 and estimated annual emission reductions from this project would be about 19,237 tCO<sub>2</sub>e. Additional 4 MW geothermal unit capacity will be added in future.

<sup>58</sup>Reference: As on September 2013: <http://www.ee-pacific.net/index.php/projects>

<sup>59</sup>[http://www.acp-cd4cdm.org/media/339240/cdm\\_project\\_opportunities\\_vanuatu.pdf](http://www.acp-cd4cdm.org/media/339240/cdm_project_opportunities_vanuatu.pdf)

**Energy Efficiency in Generation:** The diesel based power generation efficiency in Vanuatu is ranked 6th out of 19 utilities in the Pacific; as per the study conducted by UNELCO in 2010. The specific fuel consumption per unit electricity in Vanuatu ranges from 213.32 g/kWh in Port Vila to 288.28 g/kWh in Malekula; which is high in comparison to the Pacific benchmark of good performance (between 168 and 210g/kWh). The GoV is confident that a 20% improvement in fuel efficiency can be achieved by 2020 by improving the operation. Any benefits from the improvements in efficiency of fuel use will lead GHG emission reductions.

**Demand Side Energy Efficiency:** The GoV is implanting various energy efficiency measures by promoting energy efficient lighting, HVAC, building code and other electrical appliances. In the absence of baseline data; it is difficult to project the GHG emission reduction potential from this sector; however, any improvement in energy efficiency would lead to GHG emission reduction. The key demand side energy efficiency measures are:

- **Appliance Labelling**—Energy rating labels to be provided with any electric appliance for sale, informing the consumer how much electricity the appliance will use.
- **Minimum Energy Performance Standards (MEPS)**—Products subject to MEPS are required to meet a minimum level of efficiency to be sold to consumers. This will ensure that the most inefficient energy using products sold to consumers are no longer available on the local market. Vanuatu is also interested in participating in the Pacific Appliance Labelling and Standards (PALS) programme, which supports the introduction of energy labelling and standards for electrical appliances throughout the Pacific region.
- **Amendments to the Building Code**—Incorporate minimum energy performance standards into the building code, to be enforced for all new construction, especially commercial buildings. Improved standards could result in the energy use for new buildings dropping by more than 25%.

**Efficient Cook Stoves Project:** The average household in Vanuatu is estimated to consume approximately 4.672 t/yr of fuel wood, mainly *Leucaenaleucocephala*, for cooking. About 85 % of all biomass used in Vanuatu is considered non-renewable, the established inefficient cooking practices are expected to lead to further deforestation and increasing anthropogenic emissions of CO<sub>2</sub> from the households sector. The new efficient cook stoves are expected to reduce fuel wood consumption by 50% and associated GHG emissions. The cook stoves are expected to annually consume approximately 1.387 t/yr of fuel wood each, which is around 30 % of the consumption with the prevalent three stone cooking. The implementation of this project is underway and the project has been taken up as a CDM program of activity. It is currently in the validation stage of the CDM registration cycle<sup>60</sup>.

**Port Vila Biogas Project:** The project aims at providing safer sanitation services to all the residents of Greater Port Vila. The existing highly unsatisfactory sludge disposal method shall be replaced by installing a well-designed and properly managed anaerobic sludge treatment facility. The biogas generated will be captured and utilized for electricity generation; on an average, it is estimated that 138,000 m<sup>3</sup> of biogas will be generated annually which is estimated to generate 275 MWh of electricity per year. The project is expected to be operational by 2015; and estimated annual emission reductions from the project activity are 4,200 tCO<sub>2</sub>e.

**REDD+ initiatives:** The REDD+ readiness process in Vanuatu began in 2007 with the establishment of the Vanuatu Carbon Credits Project (VCCP). The first phase of the VCCP included the: identification of the capacity building needs for national and project-based carbon monitoring; a national forest area change assessment; the initial identification of REDD activities to address the drivers of

<sup>60</sup><http://cdm.unfccc.int/ProgrammeOfActivities/Validation/DB/8BKLUMUAT1G84R85S48ACQO2WEHPXIV/view.html>

deforestation and forest degradation in Vanuatu; and, the design of potential incentive mechanisms to be incorporated into REDD projects of programmes. Vanuatu is in the early stages of preparing for the National REDD+ Scheme, including the preparation of Vanuatu's REDD+ Readiness Preparation Proposal (R-PP) accepted by the FCPF Participants Committee, enabling Vanuatu to access up to US\$ 3.6 million from the Readiness Fund.

The Live and Learn REDD+ pilot project is being implemented in a 400-hectare area on the East coast of Santo. A mixture of forest regeneration and agro forestry will provide the main carbon elements while the further livelihood benefits will be produced from agroforestry products such as Canarium nuts, food crops and timber. Like much of Vanuatu, an invasive vine (*Merremiapeltata*) has overtaken areas of disturbed forest. Agro forestry is a way of removing the invasive vine that aligns well with local resource needs and capacities. To this end, the project is providing a demonstration of potentially highly replicable REDD+ activities for the country.

The SPC-GIZ Regional REDD+ Program has funding of EUR 4.9 million over a four-year period from November 2010 to the end of October 2014. The project is supporting REDD+ readiness activities, which includes conservation, sustainable forest management and enhancement of forest carbon stocks in addition to reducing deforestation and forest degradation. The project's 3 components in Vanuatu include a: 1. Pacific Regional REDD+ Policy Framework 2. REDD+ Information and support platform 3. REDD+ readiness on national level. In 2014, the SPC-GIZ program supported the Vanuatu Department of Forests to undertake a full forest and carbon inventory on the largest island of Espiritu, Santo.

The REDD Desk recently published a Vanuatu page which includes information on all REDD+ activities in Vanuatu<sup>61</sup>.

## 4.6 Barriers and Opportunities

Opportunities for immediate GHG mitigation in Vanuatu are small given the imbalance in energy use (electricity and fossil fuels) between urban and rural ni-Vanuatu; the extremely low use of energy appliances at a national level; and the importance of access to energy for social development. However, the rapid increase in population and change in lifestyle will increase the GHG emissions in the country in future. Energy, Transport, Waste Management and Forestry are the key sectors considered strategic to low carbon development and GHG emission reduction in Vanuatu. The sector specific key mitigation options are illustrated on the page 106.

<sup>61</sup><http://theredddesk.org/countries/vanuatu>

**Table 4.6: Climate Change Mitigation Opportunities**

<b>Energy Sector</b>	<ul style="list-style-type: none"> <li>• Promotion of Renewable Energy technologies (Grid connected and off grid) i.e. mini and micro hydro, solar, wind, biomass etc.</li> <li>• Small and mini grid for renewable energy electrification</li> <li>• Promotion of Bio-Fuels</li> <li>• Promotion of Renewable Biomass based power generation (Gasifier)</li> <li>• Demand Side energy efficiency measures</li> <li>• Promotion of energy efficient appliances (standardization and labelling of energy consuming appliances)</li> <li>• Green and energy efficient building standards</li> <li>• Promotion of Building Energy Efficiency</li> <li>• Encourage public energy awareness to reduce use of high power consuming appliances</li> <li>• Promotion of cleaner fuels, efficient cook stove sand solar lanterns</li> <li>• Efficiency and Emission norm for Generators</li> <li>• Awareness, Training and capacity building programs</li> <li>• Provision of information on low carbon development and clean technologies</li> </ul>
<b>Transport Sector</b>	<ul style="list-style-type: none"> <li>• Promotion of fuel and pollution efficient vehicles, ships and planes</li> <li>• Norms for efficiency &amp; pollution for vehicles</li> <li>• Promote public transportation services</li> <li>• Upgrading of road network and Traffic Management</li> </ul>
<b>Agriculture Sector</b>	<ul style="list-style-type: none"> <li>• Labelling of energy consuming appliances (pumps etc.)</li> <li>• Promotion of Renewable energy technologies (Solar Dryers etc.)</li> <li>• Land use management</li> <li>• Awareness, Training and capacity building programs</li> </ul>
<b>Waste Sector</b>	<ul style="list-style-type: none"> <li>• Promotion of waste Management (Reduce, Reuse, Recycle)</li> <li>• Landfill or composting of solid waste</li> <li>• Waste water treatment</li> <li>• Promotion of Biogas technology</li> </ul>
<b>Forest Sector</b>	<ul style="list-style-type: none"> <li>• Forest conversion</li> <li>• Promotion of energy forestry</li> <li>• Reducing deforestation and degradation of forests</li> <li>• Awareness, Training and capacity building programs</li> </ul>

The majority of the proposed GHG mitigation initiatives are already under implementation. However, despite many projects led by the development partners and others over the past 20 years, large-scale adoption has yet to materialize due to a variety of context-specific barriers. Financing and working capital, private sector development and market mobilization remain major challenges, while lack of information, awareness, and cultural barriers are very common for consumers.

#### Box 4.2: Main issues and constraints in planning, implementation of mitigation measures

- Insufficient institutional and financial capacity, lack of resources to properly develop and implement the mitigation measures.
- Low energy demand and distributed community with large distances between consumers.
- Vanuatu consists of many islands and has inadequate transport facilities to reach remote rural villages.
- Low population density and limited outreach.
- Limited cash availability in rural areas to pay for high cost options and services.
- Limited technology know-how and very limited technical capacity in rural areas.
- Limited private sector development and limited capacity for rural energy businesses.
- Lack of standards and specifications.
- Infrastructure limitations and very limited market development.
- Land disputes hamper potential site development for renewable energy projects.
- Disputes about ownership of land and forest.
- Institutional weaknesses including shortage of funds hampers the availability and attraction of adequate qualified staff limits further development of skills as well as the implementation of mitigation activities.
- Coordination between public institutions and the private sector is weak to induce sustainable development.
- Knowledge of communities regarding economic and financial opportunities and business management is limited and requires attention and training.

## 4.7 Conclusion

The contribution of Vanuatu in the global GHG emission is very minor both in terms of total emissions and per capita emission. However GoV is extending all possible efforts to contribute to climate change mitigation. These efforts represent a fair share of the global mitigation task, in line with Vanuatu's responsibility, capabilities and right to sustainable development<sup>62</sup>. The potential to contribute to global climate change mitigation efforts by Vanuatu will not be realised without greater support from the international community. This includes financial support as well as technology transfer and capacity-building initiatives.

<sup>62</sup><http://www.gdrights.org/calculator>

## 5. Other Information

### 5.1 Background

This chapter provides an overview of Vanuatu's visionary National Energy Road Map (NERM), potential renewable energy opportunities including institutional framework for activities under the climate change and energy sectors. The section also details Vanuatu's capacity to respond to climate change including implementation strategies and key initiatives. This section also discusses issues and challenges to integrate climate change with long term sustainable development goals such as the need for technology transfer, appropriate policies, research, data and information gaps.

### 5.2 National Energy Road Map 2013–2020

The NERM presents the GoV's comprehensive action plan for developing the energy sector in a systematic, rational, strategic and sustainable manner over the medium term, for the benefit of all its citizens. The Road Map directly responds to objectives in the energy sector from a national development perspective, and addresses key constraints and projects financing requirements for the energy sector implementation program for the timeframe of 2013 - 2018.

**Petroleum Sector Targets:** Petroleum is fundamental to Vanuatu's energy sector and will play an important role in Vanuatu's transition to modern forms of energy. Petroleum is also the dominant fuel used in electricity generation and will remain so in the medium term and is the base for modern cooking fuels, such as kerosene and LPG. The GoV has identified targets for the petroleum sector to achieve the vision of more reliable, secure, and affordable petroleum supply by 2015 - 2020.

**Table 5.1: Targets for the Petroleum Sector**

5%	Local legislation and policies in place that comply with international standards
10%	All operators meeting the new standards

**Key actions include:**

1. Developing and passing new laws and regulations governing the downstream petroleum sector. These will include: i) specific licensing requirements for petroleum suppliers, distributors and retailers; ii) standards for handling of dangerous goods; iii) standards for health, safety and environmental risk assessment, monitoring and compliance requirements.

2. Empowering and holding accountable key energy sector institutions with oversight of the downstream petroleum sector.
3. Introducing fuel quality standards for Vanuatu.
4. Energy Security-Establishing in consultation with industry, fuel storage capacity and reserve stock levels that provide Vanuatu with energy security levels that are prudent and economically efficient.
5. Establishing quality standards for the construction, maintenance and operation of petroleum storage and transportation assets. Validation, verification and independent auditing of such assets will be part of the regulatory regime.
6. Improving the collection and analysis of petroleum data and the impacts petroleum product supply can have on the economy of Vanuatu
7. Re-establishing price monitoring of petrol, diesel and kerosene.
8. Introducing Price Regulation for LPG

Electricity Sector Targets and Actions: Electricity is essential to move towards better living standards and economic prospects for the people of Vanuatu. However, most citizens and many social institutions in Vanuatu lack access to secure, reliable and affordable electricity.

Expanding electricity access (100 % access by 2020): The Government's targets to ensure Vanuatu achieves universal electricity access by 2030 to households (estimated 53,000 households), social service institutions (health and education), as well as commercial establishments.

The 2015 access target of 75% in concession areas is projected to come from new connections to be made in Port Vila, Luganville and Malekula, where most of the unserved households reside within the reach of existing networks. By 2015, a targeted 1,000 additional households that are currently outside the existing concession areas would be most efficiently served by a grid extension. In the "off-grid areas" where the majority of the national population lives (about 31,500 HH), it is estimated that fewer than 10% of these households currently have some form of access to electricity; such as solar home systems, and portable generators. Off-grid energy supply options will include green-site small community networks where feasible (typically solar-PV diesel hybrid powered, small hydro or biomass fuelled in situations where a sufficiently compact geographically cluster of demand exists); individual solar home system solutions, and; basic power charging products.

**Table 5.2: Access Targets for the Electricity Sector\***

	<b>Current</b>	<b>2015</b>	<b>2020</b>	<b>2030</b>
Households within grid concession areas ~18,500 HH	<b>68%</b> (12,500 HH)	<b>75%</b>	<b>90%</b>	<b>100%</b>

Households close to concession areas - grid extensions ~3,000 HH	0%	33%	90%	100%
“Off –grid” Households ~ 31,500HH - Individual home systems Permanent electricity solutions** - Basic power products***	<10	TBD	100%	100%
Public institutions – grid and off-grid	50%	90%	100%	100%

\*Total number of households ~53,000 based on 2010 Census Update and national average of 4.5 persons/ HH

\*\*Individual home systems refers to solar panel installations and basic internal wiring that can supply several lights and charging facilities for phone, TV, radio etc.;

\*\*\*Basic power products refer to the cash-and-carry Pico lighting and charging products sold through retail shops and other establishments.

**Renewable Energy and Demand-Side Efficiency Targets:** investing in renewable energy technologies when they are relatively inexpensive is an effective way to meet new demand and improve electricity affordability as long as these efficiency gains and reduced generation costs are transparently passed through under the retail electricity tariffs charged to consumers. Improving the efficiency of electricity generation and electricity use will ensure that electricity is relatively more affordable and that households can extract more value from their energy budgets. This strategy, together with regulatory and subsidy policies to be introduced, will aim to reduce the cost of supply, lower electricity tariffs to the maximum extent feasible, while maintaining the financial viability of the service providers.

**Table 5.3: Renewable Energy and Efficiency Targets for the Electricity Sector**

19%	40%	65%
...	10%	20%
...	Comprehensive data collection established, set realistic targets and begin energy efficiency initiatives	

\* Renewable energy targets are based on the projected MWh of supply from a 4 MW geothermal plant installed by 2015 and an additional 4 MW geothermal unit (bringing the total geothermal capacity to 8 MW) and 1.2 MW and 2.2 MW hydro plants in Santo and Malekula by 2020. Diesel efficiency refers to meeting the Pacific benchmark for diesel generation units operated by the utilities. No efficiency estimations are available for the manufacturing and industrial industries

Improve the diesel generation efficiency in concession areas to match the Pacific benchmark of good performance between 168 and 210g/kWh. Trend of deteriorating efficiency needs to be reversed, and the Government is confident that a 20% improvement in fuel efficiency can be achieved by 2020.

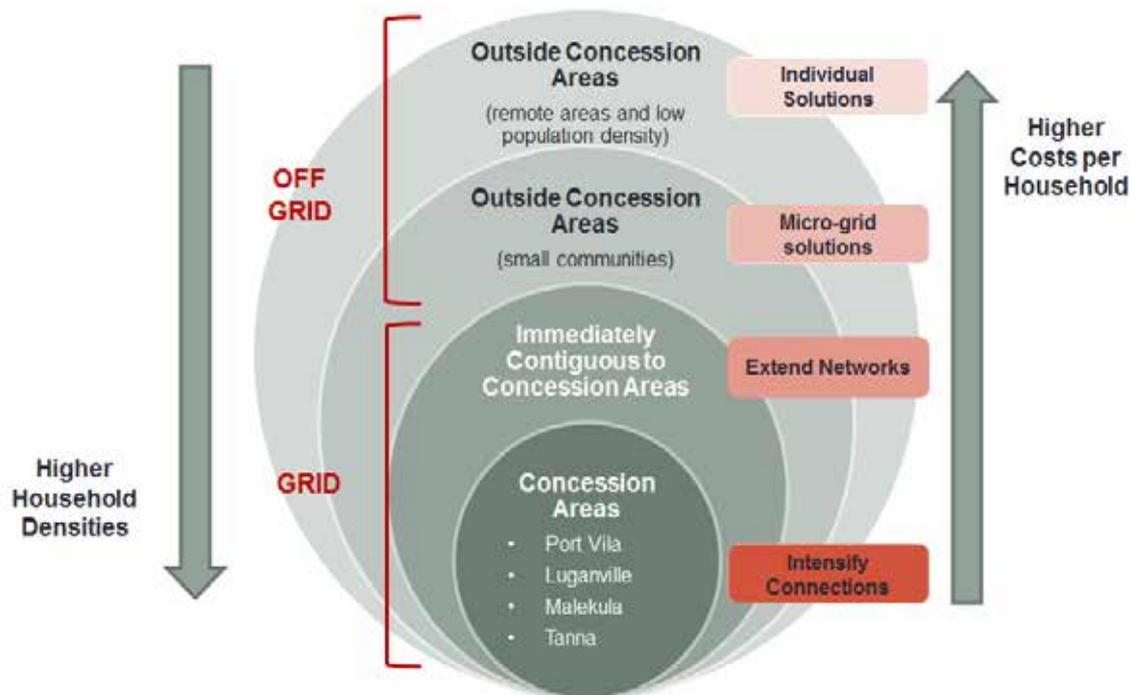
**Demand-side energy efficiency:** To ensure that energy efficiency improvements can be achieved in the future, comprehensive data collection needs to be established and in effect by 2015.

**Key actions include:**

1. Development and implementation of an overall subsidy policy framework and supporting financing policy platform for enabling affordable modern energy access to all by 2030;
2. Addressing key gaps and ambiguities present in the Electricity Supply Act, the URA Act, and the Geothermal Act and regulations, Government Tenders and Contracts Act, and other relevant legislation and regulations to enable timely and effective response from the energy sector institutions and participants in advancing the Road Map implementation;
3. Design and structuring of an effective risk-sharing framework under public-private partnership arrangements

**Strategic investment planning framework for expanding energy access to all:** The Government is committed to deliver vital social services and basic infrastructure including electricity to enable the well-being of all citizens – households, communities and institutions - and in a timely manner, irrespective of where they live. The least cost electrification strategic approach has been tailored considering the varied topography and varying degree of nucleation of the individual communities and households.

Figure 5.1 Strategic Framework for Scaling up Electricity Access Nationwide by 2030 – Least Cost Energy service delivery modalities by Four Population Segments



The strategic approach for electricity access scale up distinguishes broadly four target segments of the population:

**Existing concession areas** - These comprise the four existing service concession areas - Port Vila, Tanna, and Malekula (UNELCO), and Luganville, Santo (VUI) - depicted as the inner most circles in the figure. The specific action plan for scaling up access to the remaining unconnected households includes aggressive development of cost effective grid connected renewable energy for base load supply in a transparent manner and diesel fuel substitution to significantly lower the cost of power generation.

**Immediately contiguous extensions**—the second circle in the above figure conceptually represents areas (across Vanuatu) that are immediately and approximately contiguous to the four concession areas and where there is potential to extend the grid networks to expand access under a least-cost strategy. Pre-feasibility studies are to be undertaken (a study for Efate geothermal and ring network

development has been completed) to identify the least cost development framework to extend grid service into the areas contiguous to the four existing concessions, with additional generation from cost effective renewable energy sources.

**Off-grid Area:** Off-grid areas represent geospatially the population segments that fall outside the existing concession areas. Schematically, these are represented in the above figure by the third and the fourth largest circles, to differentiate between three distinct delivery mechanisms for least cost electricity access provision. Specifically, the Government is planning to develop a sound energy sector wide plan for off-grid areas - including renewable energy development, investments, supporting capacity building and enabling subsidy policy framework and financing mechanisms. This will underpin the design, financing, and effective implementation of a scaled up off-grid electrification program, which will be coordinated across donors to align with the plan.

The three key sub-program components of the “off-grid access” program can be broadly labelled as follows: Institutions universal access program - ensuring that all social institutions are equipped with reliable electricity supply facilities; Hybrid micro grids - for small and compactly clustered settlements/communities with sufficient load and powered by solar PV-battery-diesel, and as appropriate small hydro and other cost effective renewable energy source. “Basic electricity access for all” program to enable the powering the most essential energy needs for cell phone-charging and modern lighting (at a minimum). For the majority of the households in off-grid areas\in dispersed settlements well outside of four grid system footprint these relatively low-cost, user-friendly gadgets provide high-quality modern light-emitting diode (LED) lighting, and sufficient power for cell phone and small radio battery charging. Taken together, this ‘basic electricity’ service potential represents an immediate life-changing prospect.

**Table 5.4: Energy Access to All Targets and Action Plan**

Target Segments	Action Plan
Existing concession areas (Port Vila, Tanna, and Malekula (UNELCO), and Luganville, Santo (VUI))	Development of cost effective grid connected renewable energy for base load supply and diesel fuel substitution
Immediately contiguous extensions (areas immediately and proximately contiguous to the four concession areas with potential to extend the grid networks)	Pre-feasibility study for grid extension with additional generation from cost effective renewable energy sources.
Off-grid areas (outside the existing concession areas)	renewable energy development, off-grid electrification program, Hybrid micro grids, powering the most essential energy needs

## 5.2 Renewable Energy Opportunities

Renewable energy is envisaged to contribute to improving energy security, promoting local economic development, and lowering costs through reducing reliance imported fuels. In the off grid and remote areas of Vanuatu, on-going studies indicate that renewable energy can make a significant contribution to improve livelihoods of ni-Vanuatu. Renewable technologies (wind and hydro) have already been used to bring down the cost of generating electricity in Vanuatu. The hydro power plant on Espiritu Santo has reliably generated electricity at a lower cost than diesel generation since it was commissioned in 1995. The wind farm at Devils Point (commissioned in 2007) has saved more than VUV121 million (US\$1.3 million) in fuel costs in its first 3 years of operation.

**Geothermal power:** Twelve of Vanuatu's islands have thermal springs and, therefore, geothermal potential. Exploration of the potential of this renewable energy resource started as far back as in 1999 and has resulted in the identification of technical and economic potential for geothermal power development at Takara Springs in the north-east of Efate.

A license to further explore and develop geothermal power in the area was issued to an Australian company, KUTh Energy, in 2009. The company proposes to develop 8 MW of capacity in the area by 2019 in two stages, starting with a 4 MW plant, designed to displace an equivalent amount of existing diesel powered capacity, which is planned to be complete in 2015.

**Hydropower:** Vanuatu has some hydro potential for supplying urban grids and small rural demands. Studies suggest a technical potential on Efate, e.g. 1.2 MW at Teouma, but with prohibitively high development costs. There is potential for additional hydro on the Wambu River (4 MW) and Brenwei (1.2 MW) on Santo, although the resource has not been studied in detail. The Department of Energy, Mines and Minerals (DEMM) has used EU funding to investigate micro-hydro potential at 13 sites on six islands, establishing about 1.5 MW of total available power. Four of these sites – Lowanau in Tanna, MbeTapren in Vanua Lava, Waterfall in Pen-tecost, and Anivo in South Santo – have been assessed to be the most viable for further feasibility on techno-economic potential.

**Ocean Energy:** In the early 1990s, Oceanor of Norway monitored Vanuatu's sea wave potential. Data from buoys suggested an average potential of 13.5 kW per meter of wave front off Efate, while satellite data suggested between 9–20 kW/m at various sites. Other ocean energy potential includes ocean thermal energy (OTEC), have been undertaken. However, no measurements of deep sea versus surface water temperatures, which are necessary to determine near-shore potential of OTEC. If the deployment of ocean energy technologies was commercially available, Vanuatu could produce much of its demand from just a few small plants.

**Wind power:** There is very limited data on wind energy potential in Vanuatu. A PIFS project monitored wind speeds at a site on Efate in the mid-1990s, finding average speeds of 5.0 m/s in 1995 and 4.2 m/s in 1996, well below the 6 m/s generally considered to be necessary for economic electricity production. However, only 63% of data was recovered in 1996, so these results should be treated with caution.

The DEMM, with the support of the Pacific Island Green-house Gas Abatement and Renewable Energy Project (PIGGAREP) and the International Union for Conservation of Nature (IUCN), has installed wind-monitoring towers in each of Vanuatu's six provinces. The installations began operating in March 2012 and data collection is expected to be completed by the end of 2014. The project's objective is to produce a wind atlas for Vanuatu and identify favourable sites for turbines.

Solar power: There is substantial solar potential available in Vanuatu. Annual sunshine hours range from 2,000–2,300 hours per year, with a solar insolation of approximately 6 kWh/m<sup>2</sup>/day, although this needs to be further verified by ground measurements. Solar power can also contribute significantly in rural and off-grid electrification in Vanuatu. GoV has initiated a program of standalone and hybrid solar energy packages for social institutions and individual solar home system.

**Bio-energy:** Vanuatu is heavily forested. The amount of timber cut annually between 1996-1999, was 36,000-41,000 m<sup>3</sup>, although the figure fell considerably over the decade that followed as resources on the easily accessible eastern part of Santo were depleted. In 1995, the Food and Agriculture Organization of the United Nations (FAO) estimated forest cover at 73.8%, but this had dropped to 36.1% by 2005. Two large companies and a few dozen portable sawmills currently harvest logs. At the larger companies, wood recovery is about 40-45%, and so the volume of residue potentially available for energy is at least equal to the volume of timber produced. However, a significant portion of the residue is already used as compost or sold as fuel wood. With regards to biogas (methane from animal wastes) or energy from municipal wastes at landfills, there is very limited technical potential in Vanuatu.

#### Box 5.1: Challenges for Renewable Energy Deployment

- Insufficient capacity and financial resources to properly develop and implement renewable energy systems.
- Vanuatu consists of many islands and has inadequate transport facilities to reach remote rural villages. Limited land availability owing to land tenure issues.
- Very limited technical capacity in rural areas. Limited cash availability in rural areas to pay for services.
- Low population density making grid extensions uneconomic and the cost of access for maintenance high.
- Limited capacity for rural energy businesses.
- Lack of standard specifications for renewable energy components to help ensure that donor projects provide equipment suited for the maintenance capacity and environment of Vanuatu.
- Lack of local training available for the sustained availability of technical capacity in managing and maintaining renewable energy projects.

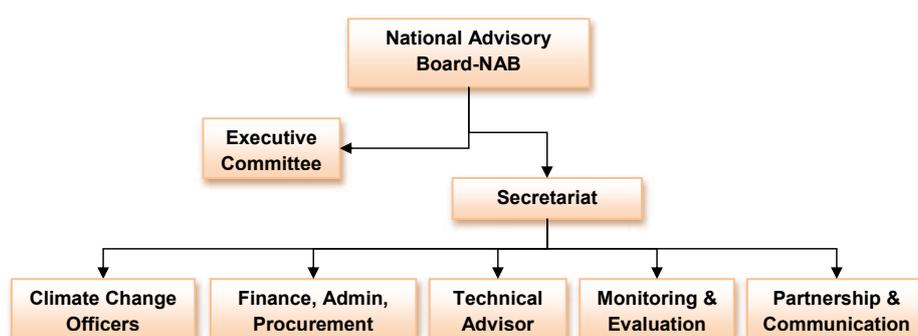
There is considerable experience in Vanuatu with the use of coconut oil as a biofuel to replace diesel fuel for electricity and transportation. In recent years, copra output exceeded 40,000 tonnes per year, sufficient to produce about 27,000 tonnes of coconut oil. In energy terms, this volume of coconut oil is equivalent to approximately 28 Million Litres of diesel, which, in principle, is enough to replace about 70% of Vanuatu's diesel fuel imports. However, the Vanuatu National Statistics reports a 50% drop in copra production between 2011 and 2012.

## 5.3 Climate Change and Energy Sector Institutional Framework

**National Advisory Board on Climate Change and Disaster Risk Reduction (NAB):** The primary purpose of NAB is to act as a focal point for climate change and DRR. NAB is also Vanuatu’s supreme policy making and advisory body for all disaster risk reduction and climate change programs, projects, initiatives and activities. Prior to mid-2012, there were two government bodies undertaking climate change and disaster risk reduction work: the National Advisory Committee on Climate Change (NACCC) and the National Task Force on Disaster Risk Reduction (NTF).

The NAB with its project management unit (NAB-PMU) acts as a coordinating body to discuss and develop integrated climate change and disaster risk reduction policy as well as decides positions for national action and international negotiations. The NAB-PMU is focused and works on three key areas: (i) Strategic Governance and Policy - including implementation of national obligations, development of positions for international summits, identification of priorities, and development of a national policy on climate change and disaster risk reduction; (ii) Technical Advice, Project Monitoring and Coordination- Including providing technical advice to government departments and NGOs, acting as the coordination point for climate change and disaster risk reduction matters, starting a ‘project endorsement process’ and ‘information materials endorsement process’ and working to support standardised approaches; and (iii) Project Management – Financing, Procurement & Administration - including secretariat duties for the NAB, investigating funding mechanisms for Vanuatu, providing support and advice on procurement for climate change and disaster risk reduction, and also implementing projects. The following chart represents the structure and function of NAB:

Figure 5.2: Structure of National Advisory Board (NAB)



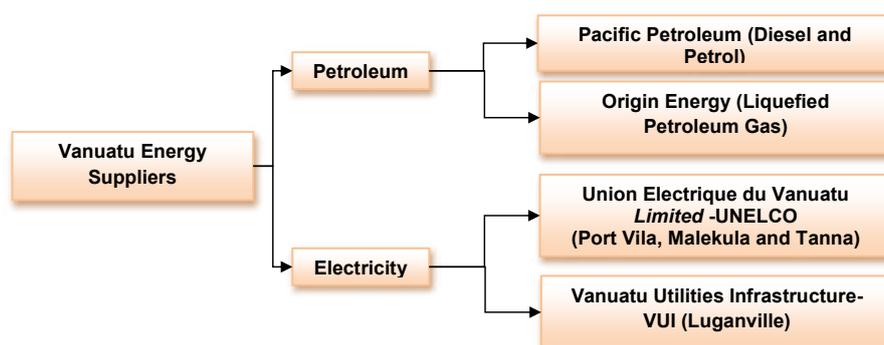
**Designated National Authority (DNA):** Vanuatu is classified as a non-Annex I country under the UNFCCC. The country has ratified the Climate Change Convention in 1993 and the Kyoto Protocol in 2001. Vanuatu has also appointed a Designated National Authority (DNA) to fulfil its obligations under the Kyoto Protocol, thereby supporting the implementation of sustainable development projects in Vanuatu under the Clean Development Mechanism (CDM) that will lead to the reduction of greenhouse gases regulated by the Kyoto Protocol.

**Utilities Regulatory Authority (URA):** In 2007, the Government passed the URA to establish an independent regulator to provide prices and regulatory oversight of the electricity and water sectors. The Utilities Regulation Authority (URA) was established in 2008 as a semi-autonomous body to mediate between the Government and electricity and water utilities. The URA also acts as an economic regulator for pricing, energy access, standards and monitoring of concession agreements.

**Department of Energy (DoE):** The DoE is charged with the responsibility of rural electrification and is responsible for access to energy in rural areas. The DoE plays a central role in coordinating energy sector development and policy in Vanuatu, including identifying and managing rural energy projects. Other Government Ministries involved in the electricity sector include the Ministry of Infrastructure and Public Utilities (MIPU), responsible for all the public infrastructure of the government, and the Ministries of Education and Health, which are involved in a program of solar energy packages for social institutions.

Vanuatu has had a long history of private sector involvement in the electricity sector. Currently two private utilities service the four concession areas.

**Figure 5.3 Structure of Energy Supply system in Vanuatu**



**Union Electrique du Vanuatu Limited (UNELCO):** UNELCO is a privately owned utility that has been providing electricity to Port Vila and Luganville for several decades and has recently extended its services to parts of East Malekula and Tanna. However, UNELCO's concession for Luganville ended in 2010, a new power utility, Vanuatu Utility Infrastructure (VUI), Ltd, won the concession.

**Vanuatu Utility Infrastructure (VUI), Ltd.:** VUI Pernix, a US-based company, is a more recent player in Vanuatu's power sector. In January 2011, through competitive bidding the company won the concession for power generation and supply for Luganville, on the island of Espiritu Santo after UNELCO's concession expired. VUI's installed capacity in 2011 was 4.1 MW and generation was approximately 8,570 MWh. Demand was 7,600 MWh and forecast to grow at 2–3% annually. There are 2,302 customers, of which 614 are high consumers. The customer base is growing at around 300 customers per year.

**Petroleum Supply:** Consumers of petroleum in Vanuatu are currently served predominantly by two private suppliers - Pacific Petroleum (diesel, petrol, kerosene and lubricants) and Origin Energy (LPG). Both are supported by a few private retailers and distributors throughout the country. The sector is largely self-governing, and although both private companies adhere to many international standards, the regulatory framework needs substantial strengthening. The Price Control Act 1974 provides the enabling framework to monitor petroleum product prices but this has not been undertaken since the early 1990s. Additionally, the security of supply (in terms of prices and physical supply) of petroleum products is a large concern for the many businesses and households reliant on petroleum products.

**Other Organizations and NGOs:** The Vanuatu Energy for Rural Development (VERD) programme by the AusAID is a project aimed at expanding rural electricity access and promoting economic development. VERD is designed to support the Government in accessing, coordinating and implementing rural energy projects and developments over the next six years.

Vanuatu Renewable Energy and Power Association (VANREPA), an NGO, has been active since 2003 in bringing wind power to rural areas, managing renewable energy projects for donors and selling solar lighting kits and energy-efficient stoves through Green Power, a retail spinoff. Through Green Power, VANREPA has teamed up with the Vanuatu Women's Development Scheme (VANWODS) to provide micro-finance for pico-solar kits. VANREPA also provides renewable energy generating systems to communities under its Community Powerhouse model.

The Government is committed to ensuring that the DoE, the MIPU, the URA and other organizations respectively are accorded the appropriate and requisite mandate by the Government as well as, accountability, and capability for policy setting, monitoring and enforcement oversight for sector initiatives that underpin Road Map implementation aimed at meeting the targets and expectations set.

## 5.4 Capacity Building, Education & Training

While GoV is making various efforts and prioritising both climate change mitigation and adaptation as one of the core development issues, it has been observed that same level of awareness and commitment is not shared by many in-country organisations and individuals. The majority of the population including many policy and decision makers within government, private and NGOs in Vanuatu have minimal understanding of the various aspects of global climate change, its implications and ramifications at local and national level.

To address the capacity building issues, GoV in association with various development partners has been conducting many short term capacity development training programs and workshops for the policy makers, government and non-government staffs, students and local population. Both government and non-government institutions in Vanuatu have effectively stimulated interest and understanding of environmental issues through workshops, quiz contests, role-plays, theatre, radio, TV and Video shows.

GoV is seeking financial and infrastructure support to expand the capacity building and awareness raising at various levels. There are barriers in dissemination of the right information to the right target audience, alongside complications that can arise when specialised English terminology is

used during consultation and awareness programmes. The key issues, barriers and opportunities are discussed below:

- The capacity building and public awareness program and activities need to be focused and relevant in the local context. Efforts should be focussed on making climate-change information available to a wider audience.
- Topics related to global climate change needs to be incorporated in the curricula of primary and secondary schools and appropriate training of teachers in environmental education.
- Provide incentives to the students for choosing higher education in environment, climate change and related development studies.
- Creating easy access to climate change information (e.g. the new NAB portal central database [www.nab.vu](http://www.nab.vu).) and make this information available in local languages
- Periodic assessment of impact and effectiveness of current awareness programmes should be undertaken.

## 5.5 Need for Technology Transfer

Technology transfer is a priority action under the UNFCCC. Decision 4CP/7 (Development and transfer of technologies) provides the framework for increasing and improving the transfer of and access to environmentally sound technologies (ESTs) and know-how. The framework has an overall approach that the successful development and transfer of ESTs and know-how requires a country-driven, integrated approach, at a national and sectoral level. The key themes and areas for meaningful and effective actions under this include five elements:

- Technology needs and needs assessments
- Technology information
- Enabling environments
- Capacity building
- Mechanisms for technology transfer

Technology Needs Assessment (TNA) is the first step in understanding the needs for technology transfer in the host country. TNA is a country driven activity to assist in identifying and analysing the priority technology needs for mitigating and adapting to climate change. However, TNA has not been initiated in Vanuatu due to various constraints including lack of institutional and financial capacity. Carrying out the TNA could provide an opportunity to realize the need for new techniques, equipment, knowledge and skills for mitigating GHG emissions and reducing vulnerability to climate change.

## 5.6 Gaps in Climate Change Policy and Information

Vanuatu continues to face several barriers as it strives to meet its UNFCCC and the Kyoto Protocol obligations. The various obstacles include insufficient institutional and financial resources; lack of research data; information management problems and; inadequate human resources and infrastructure. More must be done to build awareness both within the Government and the community about Vanuatu's vulnerability to climate change. There is also an apparent need to feed information, knowledge and technologies to enable improved decision-making and environmental management. The major institutional, policy, research, data and Information gaps are discussed below: used during consultation and awareness programmes. The key issues, barriers and opportunities are discussed below:

- The capacity building and public awareness program and activities need to be focused and relevant in the local context. Efforts should be focussed on making climate-change information available to a wider audience.
- Topics related to global climate change needs to be incorporated in the curricula of primary and secondary schools and appropriate training of teachers in environmental education.
- Provide incentives to the students for choosing higher education in environment, climate change and related development studies.
- Creating easy access to climate change information (e.g. the new NAB portal central database [www.nab.vu](http://www.nab.vu).) and make this information available in local languages
- Periodic assessment of impact and effectiveness of current awareness programmes should be undertaken.

### 5.6.1 Institutional and Policy Gaps

In Vanuatu, climate change vulnerability is exacerbated by the fact that rapid development activities have outpaced traditional conservation and coping practices, which, furthermore, have been limited by resource availability. While it is clear that climate impacts are already being felt across the country, a specific focus on climate change has been missing from many of the current development activities.

- The limited integration of climate change considerations into current development activities needs to be addressed by strengthening coordination among the country's relevant institutions. This includes improving the country's capacity for emergency preparedness and response at all levels.
- Responding to climate change requires that a significant effort be made to raise education activities and awareness regarding current and projected climate variability and change. Integrating climate change into formal education curricula as well as community awareness programs could help in meeting these goals.

- The technical and financial capacity of existing institutions needs to be augmented to address the needs of the country's more remote islands. In particular, there is a need to adequately train and equip those responsible for addressing climate change risks, as well as those who will be tasked with managing new projects on climate change.
- Legislative policies and development activities need to take into account climate change. For example, existing infrastructure projects need to be properly climate-proofed to deal with projected climate risks.

### 5.6.2 Research, Data and Information Gaps

Vanuatu, like all small island states, faces a unique set of challenges in dealing with climate variability and change. While a number of climate change and adaptation activities are on-going, the country's official communications to the UNFCCC and the Government's Priorities and Action Agenda 2006 - 2015 point to significant research, data, and information gaps that will need to be addressed in light of projected changes in climate. Additionally, lack of specific information and data on current and future vulnerability and risks across the country hamper the country's ability to respond to current and future climate risks.

#### **Research Gaps:**

- Community and participatory risk assessment methodologies needs to be promoted with a direct link to appropriate activities and planning at the sub national and local levels.
- An often ignored research gap is understanding what's needed (particularly at the community level) to build the socio-economic capacity to adapt and to manage disaster risks. A better understanding of the differential nature of vulnerability within the country's high-risk geographic regions is needed. Analyses of sector impacts must be complemented by social, economic and political assessments of vulnerability and resilience.
- Water supply and demand studies need to be conducted across the country. A limited understanding of how water supplies will be impacted by rising temperatures hampers response to climate change in the water sector.
- Modelling of storm-surge zones, taking into consideration possible sea-level rise. Planning mechanisms can subsequently be used to direct all new investments in infrastructure, housing construction, and agriculture outside this zone to minimize vulnerability, reduce repair costs and decrease disruption to economic activities.
- Detailed assessments of climate change impacts and risks across a variety of sectors are required in order to develop sound response strategies, in particular focusing on food security, water resources, and coastal resources.
- Almost no work has been done to downscale climate models to individual islands. Realistically, it may not be possible to derive more accurate climate change information due to the small size of these islands. However, more work needs to be done to address the "island dilemma". New information should be made available in an accessible, credible, and useful format at the island scale.

- Establishing a robust observation network is a critical first step towards addressing potential cyclone risks.
- Overall applied research assistance is required to properly establish an island-specific and robust baseline from which to gauge projected changes and impacts.
- Comprehensive vulnerability maps identifying the locations of high vulnerability could support disaster planners in preparing communities for worst case impacts as well as in helping local communities take an active role in identifying appropriate response mechanisms.

#### **Data and Information Gaps**

- Improving the country's meteorological services including restoring and upgrading the basic infrastructure and operations,
- Putting in place an appropriate local capacity-building program to improve scientific/ technical staff resource levels and to upgrade skills, and building climate change issues into national development plans.
- The use of existing meteorological information is limited to specific agencies, and this information needs to be tailored to decision makers across a wider series of sectors.

## Appendix A 2000 Emissions UNFCCC Reporting Tables

Table A-1: Vanuatu's National greenhouse gas inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol and greenhouse gas precursors (2000)

<b>Total National Emissions and Removals</b>	<b>69.61</b>	<b>-7,913.16</b>	<b>15.85</b>	<b>0.58</b>	<b>0.45</b>	<b>1.69</b>	<b>0.29</b>	<b>0.00</b>
<b>1 Energy</b>	<b>69.61</b>	<b>-7,913.16</b>	<b>16.03</b>	<b>0.58</b>	<b>0.45</b>	<b>1.41</b>	<b>0.25</b>	<b>0.00</b>
<b>A Fuel Combustion (Sectoral Approach)</b>	<b>69.61</b>	<b>0.00</b>	<b>0.02</b>	<b>0.00</b>	<b>0.45</b>	<b>1.41</b>	<b>0.25</b>	<b>0.00</b>
1 Energy Industries	69.61		0.02	0.00	0.45	1.41	0.25	0.00
2 Manufacturing Industries and Construction	30.10		0.00	0.00	0.08	0.01	0.00	0.00
3 Transport	1.07		0.00	0.00	0.00	0.00	0.00	0.00
4 Other Sectors	34.51		0.00	0.00	0.35	1.12	0.21	0.00
5 Other (please specify)	3.92		0.02	0.00	0.01	0.29	0.03	0.00
<b>B Fugitive Emissions from Fuels</b>	<b>0.00</b>		<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
1 Solid Fuels	0.00		0.00		0.00	0.00	0.00	0.00
2 Oil and Natural Gas	NO		NO	NO	NO	NO	NO	NO
<b>2 Industrial Processes</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
A Mineral Products	NE		NE	NE	NE	NE	NE	NE
B Chemical Industry	NO		NO	NO	NO	NO	NO	NO
C Metal Production	NO		NO	NO	NO	NO	NO	NO
D Other Production	NO		NO	NO	NO	NO	NO	NO
E Production of Halocarbons and Sulphur Hexafluoride	NO		NO	NO	NO	NO	NO	NO
F Consumption of Halocarbons and Sulphur Hexafluoride	NE		NE	NE	NE	NE	NE	NE
G Other (please specify)	NO		NO	NO	NO	NO	NO	NO
<b>3 Solvent and Other Product Use</b>	<b>NE</b>		<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>
<b>4 Agriculture</b>	<b>15.59</b>	<b>0.57</b>	<b>0.00</b>	<b>0.00</b>				
A Enteric Fermentation	9.70							
B Manure Management	5.89	0.01						
C Rice Cultivation	NO		NO	NO	NO	NO	NO	NO
D Agricultural Soils	0.56							
E Prescribed Burning of Savannas	NO		NO	NO	NO	NO	NO	NO
F Field Burning of Agricultural Residues	NE		NE	NE	NE	NE	NE	NE
G Other (please specify)	NO		NO	NO	NO	NO	NO	NO
<b>5 Land-Use Change &amp; Forestry (2)</b>	<b>0</b>	<b>-7,913.16</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>		
A Changes in Forest and Other Woody Biomass Stocks	0	-7,913.16	NE	NE	NE	NE	NE	NE
B Forest and Grassland Conversion	NE		NE	NE	NE	NE	NE	NE
C Abandonment of Managed Lands	NE	0.00	NE	NE	NE	NE	NE	NE
D CO2 Emissions and Removals from Soil	NE	0.00	NE	NE	NE	NE	NE	NE
E Other (please specify)	NO	0.00	NO	NO	NO	NO	NO	NO
<b>6 Waste</b>	<b>0.42</b>	<b>0.01</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>		
A Solid Waste Disposal on Land	NA		0.30	NE	NE	NE	NE	NE
B Wastewater Handling	NA		0.13	0.01	NE	NE	NE	NE
C Waste Incineration	NE		NE	NE	NE	NE	NE	NE
D Other (please specify)	NO		NO	NO	NO	NO	NO	NO
<b>7 Other (please specify)</b>	<b>NO</b>		<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
Memo Items								
International Bunkers	5.90		0.00	0.00	0.03	0.01	0.00	0.00
Aviation	5.90		0.00	0.00	0.03	0.01	0.00	0.00
Marine	0.00		0.00	0.00	0.00	0.00	0.00	0.00
CO2 Emissions from Biomass	5.96							

**Table A-2: Vanuatu's National greenhouse gas inventory of anthropogenic emissions of HFCs, PFCs and SF6 (2000)**

<b>Total National Emissions and Removals</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
<b>1 Energy</b>									
A Fuel Combustion									
B Fugitive Emissions from Fuels									
C Carbon Dioxide transport and storage									
<b>2 Industrial Processes</b>									
A Mineral Products	<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
B Chemical Industry									
C Metal Production									
D Non Energy Products from fuels and solvent use									
E Electronics Industry									
F Product Uses as Substitutes for Ozone									
Depleting Substances	NE								
F1 Refrigeration and Air Conditioning	NE	NE	NE	NE	NE	NE	NO	NO	NO
F2 Foam Blowing Agents	NE								
F3 Fire Protection	NE								
F4 Aerosols	NE								
F5 Solvents	NE								
F6 Other Applications NE	NE	NE	NE	NE	NE	NE	NE	NE	
G Other Product Manufacture and Use									
H Other (please specify)									
<b>3 Agriculture, Forestry and Other Land Use</b>									
A Livestock									
B Land									
C Aggregate Sources and Non-CO2 Emissions Sources on Land									
D Other									
<b>4 Waste</b>									
A Solid Waste Disposal									
B Biological Treatment of Solid Waste									
C Incineration and Open Burning of Waste									
D Wastewater Treatment and Discharge									
E Other (please specify)									
<b>5 Other</b>									
A Indirect N2O Emissions from the Atmospheric Deposition of Nitrogen in NOx and NH3									
B Other (please specify)									
Memo items (5)									
International Bunkers (subtotal)									
International Aviation (International Bunkers)									
International Water-borne Transport (International Bunkers)									
Multilateral Operations									

## Appendix B Sector wise Direct Climate Change Impacts

<b>Average minimum, mean and maximum daily temperatures will increase</b>	Shifts in crop-seasons: all phases will happen earlier and faster Increase in water demand, both for irrigation and cattle Potentially new pests with new temperature regimes	May impact aquaculture (faster growth, but also quicker oxygen depletion) Fish migration routes might shift	Increased fire-risk, increased vapotranspiration (increasing water-demand) New pests	No major impacts	Decrease in efficiency of power generation and distribution (higher temperatures increase the resistance in the network) Increase in power-demand for air-conditioning	Increase in temperature related diseases and conditions	As temperature increase are lower than global, Vanuatu is likely to remain a favourite tourist destination in spite of modest changes in climate
<b>Average and high sea surface temperatures will increase</b>	Increased food demand, as fisheries is impacted negatively	Negative impacts through coral reef deterioration from coral bleaching (including spawning, breeding, proving hiding places)	No major impacts	No major impacts	No major impacts	Food security issues	Tourists coming (also) for coral reefs and fish/fishing experience might switch to alternatives
<b>Change in precipitation (Impacts of 10% lower average rainfall)</b>	More irrigation needed for crops More water supply to cattle Change in best crops More stress on crops and cattle	No major impacts	Some species might suffer	No major impacts	Drinking water utility impacted	Water-security issues	No major impacts
<b>Change in precipitation (Impacts of 10% higher average rainfall)</b>	Some crops impacted	No major impacts	No major impacts	No major impacts	Drainage needs to be improved	No major impacts	No major impacts
<b>Sea level rise will continue and accelerate</b>	Some operations close to the coast might need relocation as inundation might happen more frequently, while the groundwater table (fresh water lens) is impacted	Loss of deeper coral habitats	Impact on mangrove areas, shifting more inland (where opportune)	Coastal roads need to be relocated or a change in road level will be required	Coastal operations (power plants, sewage treatment plants, sewage pipes, wharves, landings) might need redesign and possibly relocation. Water intakes may need to be shifted inland Coastal defences needed in places	Water insecurity (impact on groundwater) Some villages might need to relocate	Lot of tourist resources (hotels, resorts, recreation, beaches) is on or very close to the coast line. Potentially extensive relocation or defence measures might need to be taken
<b>Ocean acidification will reach damaging levels</b>	Impacts on food demand as fishery is impacted	Impact on fish availability as coral reef is impacted Impact of shell-building organisms (trochus, clams, crustaceans)	No major impacts	Coral aggregate availability greatly reduced for road construction	Threats to coastal infrastructure with loss of coastal defence from coral reef	Food-security and impacts on safety for coastal communities	Impacts through coral reefs (quality and coastal defence)

## Appendix B Sector wise Direct Climate Change Impacts

<b>Maximum temperature extremes will rise</b>	Heat waves negatively impact crop yields Higher vulnerability to pests and disease outbreaks	Aquaculture (land base) impacted through higher water temperatures	Increase in fire-risk	Potential road damage (sealed roads)	Higher power demand for air-conditioning Power-generation disrupted by higher demand and higher temperatures (as these will lower the efficiency of the power plant and increase the resistance in the distribution network)	Heat stroke related diseases will increase	Heat waves might deter tourists coming to Vanuatu Impacts on outdoor activities
<b>Droughts will become more frequent and intense</b>	Prolonged periods of drought impacts irrigation requirements and water needed for cattle; shifts to different crops might be necessary	Increased demand because of lower agricultural production	Impacts might be strongly negative, leading to leaf-loss or killing trees Increased risk of forest fires	No major impacts	Impact on drinking water supply	Water-security issues (especially where dependent on rainwater collection) Food-security issues	Environmental stress might deter tourists
<b>Extreme high rainfall will become more frequent and intense</b>	Crops might be destroyed from heavy rainfall	Demand might increase because of impact on agriculture	No major impacts	Roads might get flooded and/or damaged	Potential increase in damage to infrastructure Higher drainage requirements Higher bridge/culvert design requirements Flooding of buildings Flooding of essential infrastructure (power, telecom, water-supply)	Safety and food-security impacted Water-security (interaction of septic and drinking water systems)	Frequent high rainfall events (or impacts thereof) might deter tourist
<b>Episodic high sea surface temperatures will become more frequent</b>	Demand for food might increase because of the impact on the fishery through deterioration of coral reef health	Potential impacts from coral reef deterioration	No major impacts	No major impacts	No major impacts	Food-security issues through impacted fisheries	Tourist coming for coral might be deterred because of the poor quality of the reefs

## Appendix C Key Findings & Recommendations

### Key Findings

- Climate projections for Vanuatu show growing risks that compound Vanuatu's existing vulnerability to climatic and geological hazards.
- Change change is already impacting on all economic sectors. "Social and economic development in Vanuatu will continue to be affected by climate change, underlining the need to mainstream disaster risk reduction and disaster management (DRR&DM) and climate change adaptation into national planning and budgetary processes<sup>63</sup>."
- Ni-Vanuatu livelihoods and social structures are inextricably linked to the natural environment.
- Renewable energy investment promises significant social and economic benefits for Ni-Vanuatu communities, including greater access to energy, reduced costs, and local economic development. However, the potential for clean and climate resilient development in Vanuatu will not be realized without greater support from the international community.
- Activity data for most of the sectors/categories for estimating GHG emissions is available in the country but is not consolidated and readily available.
- In Vanuatu, there is insufficient documentation of methods and data sources used for data collection, this in turn adversely impacts the reliability of the data.
- There is lack of country-specific emission factor in Vanuatu and hence IPCC default values are generally used in estimating the GHG emissions.
- It is also observed that there is lack of detail in the activity data as is case with other LDCs as well. For example in the energy sector there is substantial information available on fuel imports but limited information is available on end use consumption.
- There are no major industries in Vanuatu and emissions from the existing micro scale industries (such as food and beverage producing) is negligible, there is no or limited data available for estimating GHG emissions from IPPU sector.
- There is very limited large scale commercial farming activity in Vanuatu and hence limited use of fertilizers in the country, the data of fertilizer usage is not currently available. It can be included in the subsequent GHG inventory report under Third National Communication.
- There is a lack of support for GHG estimation activity initiatives resulting in small teams under different departments working with multiple responsibilities and limited resources. More resources (financial/human) are required to integrate GHG estimation with other sustainable and business as usual activities.
- Difficulties retaining capacity and expertise developed during the preparation of previous National , xCommunications are leading to drain of resources.

<sup>63</sup>[http://www.nab.vu/sites/all/files/documents/14/11/2013%20-%2009%3A53/paa\\_2012\\_update.pdf](http://www.nab.vu/sites/all/files/documents/14/11/2013%20-%2009%3A53/paa_2012_update.pdf)

## Recommendations

- Continue to prioritize the mainstreaming of climate change adaptation in national development planning. This must include greater ability to access and manage international climate finance, including from the Green Climate Fund.
- Maintain a collaborative and coordinated approach to climate change adaptation and resilience building through strong and open partnerships with the non-government sector and community organizations.
- Develop appropriate templates to facilitate data collection for GHG estimation for various sectors. This is suggested to be done in coordination with all relevant stakeholders (departments, organizations etc.).
- Collaborate with Annex-1 countries to obtain high-quality satellite data and aerial imagery needed for forestry and land use sector.
- Train team working on compiling GHG inventory on using UNFCCC software and IPCC methodology requirements.
- Climate change unit could lead the efforts to mainstream GHG compilation initiative in the country and set guidelines for inventory improvement in terms of data availability, quality and detail.
- There is need for capacity-building activities in the country for preparing GHG inventory. These exercises need to focus on training and capacity building on data gathering, archiving and ascertaining quality of data. These initiatives must be highly targeted, focusing on specific and realistic outcomes with the ultimate goal of preparing a complete, transparent and accurate national GHG inventory.
- Government of Vanuatu lacks financial resources to support GHG and associated climate change studies. There is need for financial assistance to support GHG inventory development related activities.
- Develop/Procure specially designed electronic hardware and software for GHG inventory related work including a systematic research, monitoring and information collection system for GHG related data/information

## Appendix D National Energy Road Map (NERM) Implementation Recommendations

<b>Government Leadership and Commitment</b>		
<b>Develop enabling policies and legislation</b>	<ul style="list-style-type: none"> <li>Review possible legislative changes to facilitate investment in electricity generation (DoE, GoV)</li> <li>Review sustainable subsidy policy for the energy sector (DoE)</li> <li>Develop legal framework for public private partnerships (PPP) (GoV)</li> <li>Develop Independent Power Producer (IPP) framework (GoV)</li> </ul>	2013
<b>Empowering Key Energy Sector Institutions</b>		
<b>Department of Energy</b>	<ul style="list-style-type: none"> <li>Initiate skills development, awareness raising (DoE)</li> <li>Hire legal and financial expertise at DoE to advise in areas such as PPPs transactions (DoE)</li> </ul>	2013
<b>Implementing a Sector Wide Approach - Access Investments</b>		
<b>OBA subsidy</b>	<ul style="list-style-type: none"> <li>Approve final design (GPOBA)</li> <li>Enter into OBA grant, subsidy, and verification agreements (DoE, Ministry of Finance, UNELCO &amp; VUI, and Independent Verification Agent)</li> </ul>	2013-ongoing
<b>Grid extensions, Efate</b>	<ul style="list-style-type: none"> <li>Commission detailed costing studies (GoV)</li> <li>Establish financing arrangements (GoV)</li> </ul>	2015-2016
<b>Grid extensions, Santo</b>	<ul style="list-style-type: none"> <li>Commission costing studies (GoV)</li> <li>Establish financing arrangements (GoV)</li> </ul>	2015-2016
<b>LV Grid Infill</b>	<ul style="list-style-type: none"> <li>Establish financing arrangements (GoV)</li> </ul>	2013-ongoing
<b>SWER extensions</b>	<ul style="list-style-type: none"> <li>Establish financing arrangements (GoV)</li> </ul>	2013-ongoing
<b>RLSS</b>	<ul style="list-style-type: none"> <li>Product accreditation and vendor health checks (Contractor)</li> </ul>	2013-ongoing
<b>PIES</b>	<ul style="list-style-type: none"> <li>Complete management service agreements and competitive tenders for installation and maintenance contracts (Contractor)</li> </ul>	2013-ongoing
<b>Public Institutions Solar Panel Maintenance</b>	<ul style="list-style-type: none"> <li>Establish financing arrangements (GoV)</li> </ul>	2013-ongoing
<b>Implementing a Sector Wide Approach - Efficiency Improvements</b>		
<b>Geothermal Generation, Efate</b>	<ul style="list-style-type: none"> <li>Agreement on commercial structure and final exploration drilling (GoV)</li> </ul>	2013-2019
<b>Brenwe Hydro, Malekula</b>	<ul style="list-style-type: none"> <li>Final feasibility study and design (ADB)</li> </ul>	2018-2021
<b>Wampu Hydro, Santo</b>	<ul style="list-style-type: none"> <li>Final feasibility study and design (ADB)</li> </ul>	2019-2021
<b>Implementing a Sector-Wide Approach - Other Studies and Investments</b>		
<b>Renewable Energy After 2010</b>	<ul style="list-style-type: none"> <li>Feasibility study funded by Climate Investment Fund (US\$250,000)(SREP)</li> </ul>	2013-2020
<b>Increasing Energy Efficiency Information</b>	<ul style="list-style-type: none"> <li>Development of database (ADB)</li> </ul>	2013-ongoing

## Appendix E List of Climate Change Projects Registered with the National Advisory Board (as on June, 2014)<sup>64</sup>

Project	Brief Description	Funding
1. Increasing Resilience on Climate Change and Natural Hazards (IRCCNH) Project	Institutional strengthening; Technology investment and transfer; Training; Community capacity building. Implemented by DLA, NDMO, VARTC, Rural Water Supply, and Agriculture. (2013 – 2018).	USD \$ 11.1 million Funding Admin- World Bank Global Environment Facility (GEF), European Union (EU), Global Facility for Disaster Risk Reduction (GFDRR)
2. Managing Disaster Risk Reduction (MDRR)	Institutional strengthening; Technology investment and transfer; Training; Community capacity build. Implemented by NAB / PMU / VMGD. (2013-2015).	USD \$ 2,728,000 Funding Admin- World Bank Government of Japan- Policy and Human Resource Development Trust Fund (PHRD)
3. Global Climate Change Alliance – Vanuatu Project (GCCA-V)	Institutional strengthening; Mainstreaming; Data collection; Policy development. (2012 – 2014).	USD \$ 900,000 (approx.) Global Climate Change Alliance
4. Pacific Adaptation to Climate Change (PACC)	The PACC is a regional project developed as a 2nd Phase or follow-up to the CBDAMPIC project implemented in Vanuatu by the NACCC from 2002 to 2005. Focused on Epi island, Varsu Area Council with major focus on resilience of roadways. (2009 - 2014).	USD \$ 750,000 Funding Admin- SPREP UNDP / GEF SCCF
5. Pacific Risk Resilience Programme (PRRP)	Strengthening governance mechanisms for Disaster Risk Management (DRM) and Climate Change Adaptation (CCA). Based on Tanna, Tafea Outer islands, Santo and Emae. (2013-2016).	USD \$ 4 to 5 million (approx.) Funding Admin- UNDP UNDP/ GEF / AusAID
6. Coastal Community Adaptation Project (C-CAP)	Community based CCA, planning and implementation of plans based in Efate offshore islands and on Tanna Island. Implemented by DAI / USP. (2013-2018)	USD \$ 3 million (approx.) Funding Admin- DAI & USP US A.I.D. funding.

7. (V-CAP) Adaptation to Climate Change in the Coastal Zone in Vanuatu	Focus on community based climate change adaptation measures at 6 different sites with Infrastructure resilience, upland management and coastal resource management components. Early warning systems and policy support as well. Implemented by PMU, PWD, Environment, Agriculture, and Fisheries & Forestry. (2014-2019).	USD \$ 8 million (approx.) UNDP/ GEF
8. Enhanced Climate Change Resilience of Food Production Systems in PIC	Climate Change Adaptation & Food Security Project. Implemented by SPC. Based in Torba Province. (2012 – 2015).	USD \$ 4 million Funding Admin- Secretariat of the Pacific Community (SPC) US A.I.D. funding.
9. South Pentecost Community Ecosystems-Based Adaptation - Pacific Coral Triangle Program	Community-based Adaptation, Ecosystem regeneration, Governance. Implemented by Live & Learn. (2013 – 2015).	USD \$ 4 million Asian Development Bank
10. ArTEK Tanna: Naine Resilient Societies Centre (ATT-NRSC)	Youth & Community Training in Renewable Energy & Mitigation of Forest Degradation; Supporting Institutional Policy development around Community-level Resilience and Whole Systems Solutions to Climate Change. (2011 – 2014).	USD \$ - Unknown Funding Admin- VANGO (Vanuatu Association of NGO's)
11. Tourism Component - SPC-GIZ Coping with Climate Change in the Pacific Island Region	Tourism Component - SPC-GIZ Coping with Climate Change in the Pacific Island Region. Implemented by National Tourism Development Office. (2012-2014).	USD \$141,000 Funding Admin- SPC / GIZ
12. Sharing Perceptions of Adaptation, Resilience and Climate Knowledge (SPARCK)	Research, Community Awareness, Vulnerability Assessment, Educational Capacity Building. Implemented by UNESCO & Apidae Development Innovations. (2013 – 2014).	USD \$ 100,000 UNESCO Science Council

12. Sharing Perceptions of Adaptation, Resilience and Climate Knowledge (SPARCK)	Research, Community Awareness, Vulnerability Assessment, Educational Capacity Building. Implemented by UNESCO & Apidae Development Innovations. (2013 – 2014).	USD \$ 100,000 UNESCO Science Council
13. Using mobile phones to improve climate change project monitoring and evaluation in the Pacific	Research, Pilot, Implemented by University of Melbourne. (2013).	USD \$ 23,279 University of Melbourne
14. A2C2 Climate Change Awareness project	Research, Media Production, Community Awareness, Educational Capacity Building, Mentoring. Implemented by Apidae Development Innovations. 6 secondary schools around Port Vila. Starts July 2014 (6 months).	USD \$134,776 over four countries in the Pacific  AusAID
15. Natural Solutions to Climate Change in Pacific Islands Region: Implementing Ecosystem-based Adaptation	Education and awareness of ecosystem approaches. Support of ridge to reef and integrated coastal zone management planning. Implemented by Secretariat of the Pacific Regional Environment Programme in collaboration with the SPC-GIZ coping with climate change in the Pacific Island Regional Program (CCCPIR). Port Vila and surrounding areas plus one site in Tafea Province. (2014 – 2019).	USD \$ 2.9 million International Climate Initiative (German Government)
16. Strengthening Vanuatu's International Climate Change Negotiating Capacity (COP19)	Capacity building. Implemented by PMU. (2013 – 2014).	USD \$ 106,346 Oxfam, GIZ

17. Climate Zone National Competition 2013	Youth and student engagement in climate change, written and oral quiz. Implemented by Ministry of Education.	USD \$ 27,375 SPC-GIZ, USP GCCA and others
18. AECOM Pacific Australia Climate Change Science and Adaptation Planning (PACCSAP) Program	Infrastructure - Economic analysis of climate change adaptation options to protect low-lying settlements and critical infrastructure. (2014).	USD \$ 93,176 Australian Aid - Pacific Australia Climate Change Science and Adaptation Planning (PACCSAP) Program
19. Climate Resilient Road Standards Project (PWD-SMEC)	Integrating CCA practices and resiliency into design and delivery of services from Public Works Department. Not officially endorsed by NAB yet.	N/A
20. Nambawan Vanuatu REDD+ Project	REDD+ Implementation. Implemented by Vanuatu Carbon Syndicate Company (to be registered). Not officially endorsed by NAB yet.	USD \$ 500,000
21. Building Safety & Resilience in the Pacific	Multi-sectoral. Not officially endorsed by NAB yet.	N/A
22. WISE REDD+ Project	Education support for Government Program. Not officially endorsed by NAB yet. Implemented by Conservation International and Live & Learn Vanuatu. (2013-2016).	USD \$ 200,000 United States of America Department of State
23. Integrated Sustainable Land and Coastal Management	Strengthening coastal and land based resource management practices at several project sites. Not officially endorsed by NAB yet, design team yet to initiate work. To be implemented by NAB / PMU, Agriculture, Fisheries, Environment, Forestry, Quarantine.	USD \$ 4.6 million UNDP GEF







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