REPUBLIC OF VANUATU

National Climate Change Adaptation Strategy

for Land-Based Resources

(2012 – 2022)

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Executive Summary

The environment of Vanuatu including its land based resources are extremely vulnerable to climate-related hazards, such as cyclones strong wind gusts, droughts, heats spells, floods and sea level rise/storm surges. Most of these hazards are precipitated by natural weather phenomena and therefore will be exacerbated by the current and future impacts of climate change. This vulnerability is a threat not only to the livelihoods of the people of Vanuatu but also to a healthy and prosperous nation.

This national climate change adaptation strategy (NCCAS) lays out an approach to identify and implement efficient and effective activities to manage the existing and anticipated consequences of climate change for the land-based resources sectors in Vanuatu, namely forestry, agriculture, water, livestock, and biodiversity/ natural ecosystems. These sectors play dominant and essential roles in the economy of Vanuatu and contribute to livelihoods and the general well-being of people and the country as a whole.

The NCCAS is aligned with and builds on existing strategies, policies and action plans. For example, it builds on Vanuatu's National Adaptation Programme of Action (NAPA), the Priorities and Action Agenda (PAA) or the Disaster Risk Reduction and Disaster Management National Action Plan (NAP) and sector specific documents like the National Biodiversity Conservation Strategy or the National Water Strategy.

It is not just a strategy for government, but actively involves civil society including churches, youth organizations and other NGOs working in the land based resources sector in an active process to cope with climate change in a coherent and strategic manner. For each sector it describes adaptation strategies that are usable, practical and implementable.

The NCCAS consists of two parts, with Part 1 – "Front End", a high level document that provides the national roadmap on climate change adaptation for the land based resources management, and Part 2, consisting of practical and sector specific adaptation measures and action plans that can be implemented at community level.

Contents of Part 1 – Front End

1) Introduction:
The essential background of the NCCAS including the aim of the strategy, information on the timeframe, how it has been developed and how it is linked with other policies and strategies, such as the NAPA.

2) Vision
The long-term vision of this strategy which might not necessarily be achieved during its current implementation period or by the NCCAS alone.

3) Objectives
The specific milestones which will be achieved by the NCCAS.

4) Guiding principles
The principles that have been used to set up this strategy and that are important elements for its implementation.

5) Summary of Vanuatu's climate and anticipated changes

The historic changes in the climate of Vanuatu, the observed and experienced impacts and vulnerabilities as well as the underlying drivers.

6) Recent and anticipated risks and vulnerabilities
The impacts and vulnerabilities under projected climate and socio- economic conditions. This chapter also explains the existing adaptive capacities to cope with these impacts and provides information on the adaptation gap, the amount of adaptation required to effectively cope with climate change and disasters.

7) An overview of adaptation options
The potential responses by sectors to reduce these current and future impacts and vulnerabilities (menu of options) and how they can be implemented.

8) A policy review
The review of existing regional and national policies, strategies and action plans including sector specific and crosscutting documents which contain relevant information and actions for adaptation.

9) An institutional review
A stocktake of existing institutional structures do address climate change and disaster management as well as recommendations how the current institutional set up can be improved to address the future challenges effectively and efficiently.

10) Action plans
The final set of sector specific actions, based on the menu of options (chapter 7) and summarized in an implementation schedule, including responsible agencies, stakeholders, timeframes as well as funding channels and indicators for monitoring.

11) Cross-cutting considerations
A summary of risks and opportunities that affect more than one sector as well as information on how to prevent mal-adaptation by a effective sector coordination on national, provincial and area/island level.

12) Recommendations
A description of measures, to support the effective implementation of adaptation actions within the timeframe of this strategy and beyond.

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Contents of Part 2 – Sector Adaptation Action Measures

Part 2 consists of sector specific action plans including a set of adaptation strategies that are

- based on the local needs
- detailed
- practical
- Vanuatu-specific
- based on custom & culture
- tried and tested by Vanuatu communities and individuals
- immediately implementable by departments, individuals, communities, NGOs, donors and others

This NCCAS will therefore be the guiding document and foundation for all upcoming climate change adaptation initiatives, programmes and projects implemented in Vanuatu. .

Acknowledgements

Many people contributed to the thinking process behind the preparation of the National Climate Change Adaptation Strategy. A large number of representatives of the following Ministries, Departments and services have provided valuable inputs and guidance, including of: the National Advisory Committee on Climate Change (NACCC); the Ministry of Agriculture, Quarantine, Forestry and Fisheries, including the Department of Forests, Department of Agriculture and Rural Development; the Department of Environmental Protection and Conservation; the Vanuatu Quarantine and Inspection Service; the Department of Geology, Mines and Water Resources; the Department of Lands; the Vanuatu Meteorological Service; the Office of the Prime Minister; the Ministry of Justice; the Department of Finance; and the Vanuatu Agriculture Development Bank.

The contributions provided by representatives from GIZ and SPC's Land Resources Division are also gratefully acknowledged.

In addition, the authors are grateful to the many people from around the Republic of Vanuatu who provided valuable information and ideas throughout the consultation process, particularly to all stakeholders who attended the regional workshops and consultations.

1. Introduction

This National Climate Change Adaptation Strategy (NCCAS) is designed to guide the implementation of efficient and effective activities to manage climate change impacts on the land-based resource sectors[1] in Vanuatu[2]. The NCCAS sets out a systematic, long-term approach for embedding climate change adaptation into core sectoral functional activities. Programmatic rather than project focused, the NCCAS addresses sector and national needs, and contains specific and practical actions. Sector specific action plans included in the NCCAS describe how commitments will be translated into concrete actions, how changing circumstances will be accommodated, and how risks and barriers will be addressed. The sector action plans detail substantive interventions to address adaptation needs, and specify the allocation of responsibilities and definitive implementation timelines.

In summary, for the land-based resources sectors the NCCAS considers:

- impacts/vulnerabilities that have been observed/experienced, and underlying drivers
- impacts and vulnerabilities under projected climate and socio-economic conditions
- appropriate responses to reduce vulnerabilities and how best to implement them

Importantly, the NCCAS is aligned with existing strategies, policies and action plans.[3] For example, it builds on Vanuatu's National Adaptation Programme of Action (NAPA). The latter focuses on "urgent and immediate" adaptation actions, is project based and has no action plan for implementation. In contrast, the NCCAS is programmatic and strategic as well as focused and practical, addresses both immediate and longer-term needs and includes action plans for implementation.

The strategy also highlights a pathway for the mobilization of resources, including country- and needs- driven financial and technical assistance. Accordingly, the NCCAS is intended to be a strategic, whole of country and living document.

Prepared by Vanuatu stakeholders using inclusive and participatory processes, the NCCAS is relevant to the target sectors as well as more widely to Government, civil society, the private sector and development partners. It is lays a foundation effective climate change coordination among all relevant stakeholders.

[1] forestry, agriculture, water, livestock, and biodiversity/ natural ecosystems.
[2] These sectors play dominant roles in the economy of Vanuatu and contribute to livelihoods and the general well-being of people and the country as a whole. Importantly, both experience and evidence reveal these sectors' high sensitivity to weather extremes as well as climate variability and change.

2. Vision

The following vision highlights the commitment of the people and Government of Vanuatu to being well prepared for a changing climate (in the context of other concurrent changes in the environment, economy, and society):

Vision:
The people and Government of Vanuatu are strongly committed to, and actively involved in, a nationwide ongoing collaborative process of adapting to climate change with the goal to build and sustain a healthy, resilient and prosperous nation.

Achieving this vision of the NCCAS will require meaningful changes to policies, regulations and institutions in order to provide incentives for behavioural changes by all actors at all levels (including government, non-governmental organisations, communities, families, the private sector, and individuals). Success will require actors to respond to the impacts of climate change that have already been observed, while taking pro-active steps to understand and prepare for future climatic changes and the likely impacts.

Objectives and guiding principles have been developed to support these efforts (see Sections 3 and 4). These principles have influenced both the design of the NCCAS and the actions to be undertaken as part of its implementation.

3. Goal and objectives

Adapting to climate change by the land-based resources sectors will require a pragmatic approach that progressively and continuously assesses needs and implements appropriate adaptation measures in cooperation with all relevant stakeholders. The process of implementing the NCCAS will provide the opportunity for all people of Vanuatu to gain a profound understanding of:

- the existing and expected climate changes in Vanuatu,
- the resultant impacts and risks to land-based activities and resources, and
- appropriate and practical actions to address and mitigate these risks.

The medium- to long-term goal of the NCCAS is to position Vanuatu to cope well with the current and anticipated impacts of climate change by reducing the vulnerability of and enhancing the adaptive capacities of our people and our environmental, social and economic resources and systems.

To achieve this goal, the NCCAS sets out to achieve the following objectives:

- Identify and analyze climate risks based on the most recent climate change projections for Vanuatu[4] and the region, and assess how the anticipated changes will impact on Vanuatu's land based resource sectors
- Provide a comprehensive list of Vanuatu specific, appropriate and prioritized adaptation strategies and actions at all levels (based on the analysis above and taking into account social, equity, institutional, policy, technical, environmental, economic, financial, gender and other relevant considerations)
- Recommend 'implementation pathways' that contribute to minimizing the adverse impacts of climate change on land-based resources and sectors, particularly those which address both the preparedness for and response capacity to climate change impacts and extreme events;
- Provide government and other decision makers with concise climate change policy recommendations (to the extent possible and including associated uncertainties) with reference to time-frames, locations and spatial scales that are of direct and immediate relevance; and support them with practical tools and guides to promote the best possible management of climate impacts on land-based resources;
- Encourage the continued development and application of targeted public outreach measures to increase knowledge and awareness among all people of Vanuatu about the risks posed by climate change, and provide guidance on how incorporate this knowledge into their planning and decision making;
- Achieve widespread recognition that adaptation to climate change is much broader than an exclusively environmental issue (a misunderstanding which often constitutes a significant institutional barrier to mainstreaming adaptation into sectoral policies) and treat adaptation as a development issue that is relevant and important to economy as a whole and the prosperity and

[4] These projections will include outputs from VanuaClim software, the Pacific Climate Change Science Programme and other analyses and be consistent with the 2011 Second National Communication

wellbeing of Vanuatu and its people. This shall be reflected in the recommendation that all ministries, including those responsible for planning and finance, take ownership of the issue;

- Link and coordinate Vanuatu efforts in climate change adaptation (CCA) and disaster risk reduction (DRR) and management (DRM), as policy frameworks and practical methodologies are synergistic. Both policy areas aim to achieve a reduction of vulnerability to the impacts of climate change and variability, and both depend on evaluating risks, vulnerabilities and remedial options. Foster strategic coordination, including an exchange of information, experience and tools, thus considerably contribute to improving the sustainability of development processes;
- Highlight ways to strengthen the governance and institutional arrangements of climate change in Vanuatu and clearly define responsibilities in order to enable effective and efficient implementation of adaptation strategies and actions; this includes identifying and addressing barriers to adaptation that may be inherent in existing policies, regulations and processes.

4. Guiding Principles

The following guiding principles underpin the design and implementation of the NCCAS including the selection of adaptation strategies, which shall be:

- **Relevant, appropriate and proportional**

  Threats and opportunities resulting from climate change will impact on different islands, sectors, activities and resources in different ways. Also, the capacity of different actors to adapt to climate change varies largely. It is therefore important that the adaptation measures included in the NCCAS take account of these variations and are tailored, where possible, to suit the specific geographic, sectoral, institutional, cultural and other relevant contexts in which they will be implemented. The strategy provides for flexibility in decision-making and implementation, so that measures are taken at the most appropriate level — local, regional/island or national. Adaptation measures should be cost-effective, commensurate with the climate-related risks and, where possible, also take advantage of the opportunities created by a changing climate.

- **Collaborative and coordinated**

  Recognizing that adaptation to climate change affects the society as a whole, and that no single sector or actor can effectively respond to climate impacts by working alone, the NCCAS shall foster dialogue and collaboration between actors at all decision-making levels, including national, regional and local governments, non-governmental and community organisations, academia, the private sector and individuals. All stakeholders need to be given the opportunity to inform the design of the NCCAS and be involved in its implementation in a structured and coordinated way. Adequate public outreach strategies, such as communication and education strategies, are essential to securing broad public support for the NCCAS.

- **Facilitated and guided by traditional knowledge**

  When designing and implementing adaptation measures particular attention should be paid to building on traditional knowledge and practices of land management, biodiversity conservation etc., which are often already (and have been for millennia) facilitating adaptation to climate variability and extremes. Communities that rely heavily on land based resources for their livelihoods experience the impacts of variations in weather and climate firsthand, and have built a vast repertoire of valuable knowledge that complements scientific approaches to understanding climate change. In particular, traditional knowledge on climate should be used where local scale expertise is needed, for instance as a source of climate history and baseline data; to provide insight into local scale impacts and adaptation options; and for long term, community-based monitoring.

- **Integrative and synergistic**

  For an adaptation strategy to be effective, it must take into account inter-dependencies among sectors and policies, recognizing that actions in one sector or field of activity may have repercussions on other sectors and the success of their interventions. Therefore, adaptation actions cannot be carried

out in isolation, but must be designed and implemented to take advantage of synergies and prevent adverse interactions of diverse policy objectives. Ideally, the adaptation measures highlighted in the NCCAS will complement or directly support existing sector policies and initiatives.

- **Evidence-based and adjustable**

  Actions identified in the NCCAS should be based on the best available traditional and scientific knowledge of climate change impacts, threats, vulnerabilities and adaptive measures. In this context, it is important to acknowledge that there will always remain some uncertainties with regards to the exact nature, intensity, temporal and geographic distribution of climate change impacts, however incomplete knowledge shall not be used as an excuse for inaction. The NCCAS is designed to allows for strategies and actions to be adjusted as knowledge evolves over time. Where opportunities exist to drive the development and expand the use of new information, technologies and technical skills, these should be exploited.

- **Measurable and flexible**

  It is critical that implementation of the NCCAS be monitored and continuously evaluated. Therefore, measurable adaptation goals, objectives and performance metrics must be identified that allow for outcome evaluation. However, due to the complex interrelationships between different sector strategies, actions and policies, it will likely be difficult to establish a clear, unambiguous and direct causal link between objectives, goals and resulting outcomes. Also, the quantitative data necessary to measure outcomes may not (yet) be readily available. In such instances, proxy indicators should be developed to provide approximate information regarding achievements made. Flexibility is key to building a robust and resilient process and so the NCCAS should allow for adjustments to be made on the basis of ongoing evaluation.

5. Vanuatu's Climate, and Anticipated Climate Changes

Vanuatu is extremely vulnerable to natural disasters. Those that are weather- and climate-related are likely to be exacerbated by global warming[5]. Changes over time reflect the influence of global warming.

According to the IPCC, The following messages have been endorsed by the workshop participants as a starting point for developing NACCC-approved CC messages in Vanuatu

1. Sea level in Vanuatu has risen, and will continue to rise, due to global warming and other factors. Vanuatu acknowledges the predictions of the Intergovernmental Panel on Climate Change (IPCC). According to the IPCC, Sea level is projected to rise between the present (1980–1999) and the end of this century (2090–2099) by 0.35 m (0.23 to 0.47 m).

2. **Temperature** (of the air land and sea) in Vanuatu has increased, and will continue to increase, due to global warming. Vanuatu acknowledges the predictions of the Intergovernmental Panel on Climate Change (IPCC). According to the IPCC, annual temperature is projected to rise between the present and the end of this century (2080 to 2099) by 1.8°C (1.4°C to 3.1°C).

3. **Rainfall** patterns in Vanuatu have changed, and will continue to change, due to climate change. Vanuatu acknowledges the predictions of the Intergovernmental Panel on Climate Change (IPCC). According to the IPCC, annual precipitation is projected to increase over the southern Pacific by close to 3% (–4 to +11%) Most of these increases are predicted to be in the first half of the year. However, changes in rainfall variability in the South Pacific will be strongly driven by changes in ENSO[6], although this is not well understood.

4. **Extreme Events** (cyclones, floods, droughts) in Vanuatu may become more frequent and more severe. Vanuatu acknowledges the predictions of the Intergovernmental Panel on Climate Change (IPCC). According to the IPCC, ENSO fluctuations have a strong impact on patterns of tropical cyclone occurrence in the southern Pacific, and this contributes to uncertainty with respect to tropical cyclone behaviour.

5. **Local ways of life** in Vanuatu will be negatively affected. Vanuatu acknowledges the predictions of the Intergovernmental Panel on Climate Change (IPCC). According to the IPCC, climate change in the Pacific may lead to

a. Accelerated coastal erosion, saline intrusion into freshwater lenses and increased flooding from the sea
b. Less rainfall coupled with accelerated sea-level rise compound the threat on water resources
c. Degradation in the health of coral reefs around islands

[5] 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.

[6] El Nino Southern Oscillation

d. Variable rainfall will cause soil degradation and loss of soil fertility which will negatively impact on agriculture and food security
e. If the intensity of tropical cyclones increases, a concomitant rise in significant damage to food crops and infrastructure is likely
f. decline in the total tuna stocks and a migration of the stock eastwards, both of which will lead to changes in the catch in different countries
g. impacts on infrastructure including closure of roads, airports and bridges due to flooding and landslides, and damage to port facilities (impacting other sectors and services including tourism, agriculture, the delivery of health care, clean water, food security and market supplies)
h. Reduced attractions for coastal tourism
    i. Sea-level rise and increased sea water temperatures are projected to accelerate beach erosion, cause degradation of natural coastal defences such as mangroves and coral reefs, and result in the loss of cultural heritage on coasts affected by inundation and flooding
i. declining human health
    i. rural and inland settlements and communities are more likely to be adversely affected by negative impacts on agriculture, given that they are often dependent upon crop production for many of their nutritional requirements
    j. more prevalent climate-sensitive diseases, including morbidity and mortality from extreme weather events, certain vector-borne diseases, and food- and water-borne diseases
    k. tropical cyclones, storm surges, flooding, and drought affect human health, by drowning, injuries, increased disease transmission, decreases in agricultural productivity, and an increased incidence of common mental disorders
    l. weather is conducive to the transmission of diseases such as malaria, dengue, filariasis, schistosomiasis, and food- and water-borne diseases
    m. increasing temperatures and decreasing water availability due to climate change may increase burdens of diarrhoeal and other infectious diseases
    n. Warmer sea surface temperatures during El Niño events have been associated with ciguatera outbreaks

Best estimates of long term, systematic changes in the average climate for Vanuatu indicate that by 2050 sea level is likely to have increased by 20 cm, maximum air temperatures by 0.2 ^{o}C, maximum water temperatures by 0.19 ^{o}C, extreme wind gusts by 6.8% and rainfall by 0.6%.

There is relatively high confidence in projections of maximum air temperature. Measurements at three sites in Vanuatu show maximum daily air temperatures of between 35 ^{o}C and 37 ^{o}C are currently approximately 150-year events. By 2050 these are likely to be approximately 50-year events. There are similar projections for extreme water temperatures. A maximum water temperature of 33.5 ^{o}C is currently a one in 200-year event at Port Vila. It will likely be a one in 50-year event by 2050.

Less certainty exists in projections for extreme wind gusts. However, a current one in 150-year event of a maximum daily wind gust of 40 kts is likely to be a one in 60-year event by 2050.

The observed annual rainfall shows an increase at some locations and a slight decrease at others. Currently a daily rainfall of at least 350 - 400 mm is a relatively rare event at the measurement sites in Vanuatu, with return periods of between 80 and 120 years. There is large uncertainty in the rainfall projections, with some models suggesting substantial increases in rainfall, other models suggesting only small increases, and even other models indicating a small decrease in rainfall into the future. An extreme daily rainfall of at least 350 mm at these sites will likely have return periods of between 60 and 80 years by 2050.

*Uncertainty in Climate Projections***.** All climate projections are subject to uncertainties, due in part to assumptions associated with modelling the changes and with estimating future emissions of greenhouse gases. Figures 6 and 7 show the level of uncertainty associated with projections of sea level and rainfall, respectively.

Best estimates of future sea-level rise and rainfall are based on an average of the estimates using a multi model and emission scenario ensemble. Figure 6 shows the best estimate of mean sea level out to 2100, as well as the band of extreme uncertainty. The latter is estimated using the highest and lowest estimates of sea-level rise for all model and emission scenario combinations.

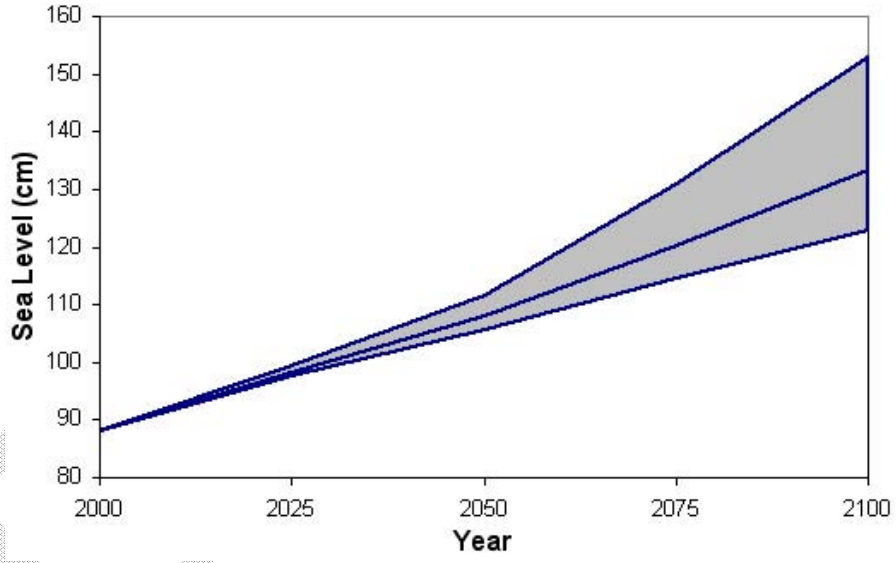


Figure 6 Best estimate of projected increase in mean sea level for Port Vila, along with the uncertainty envelope as given by the maximum and minimum estimates using all possible combinations of the available global climate models and emission scenarios.

Figure 7 shows the best estimate of mean daily rainfall out to 2100, as well as the band of extreme uncertainty. The latter is estimated using the highest and lowest estimates of rainfall projections for all model and emission scenario combinations.

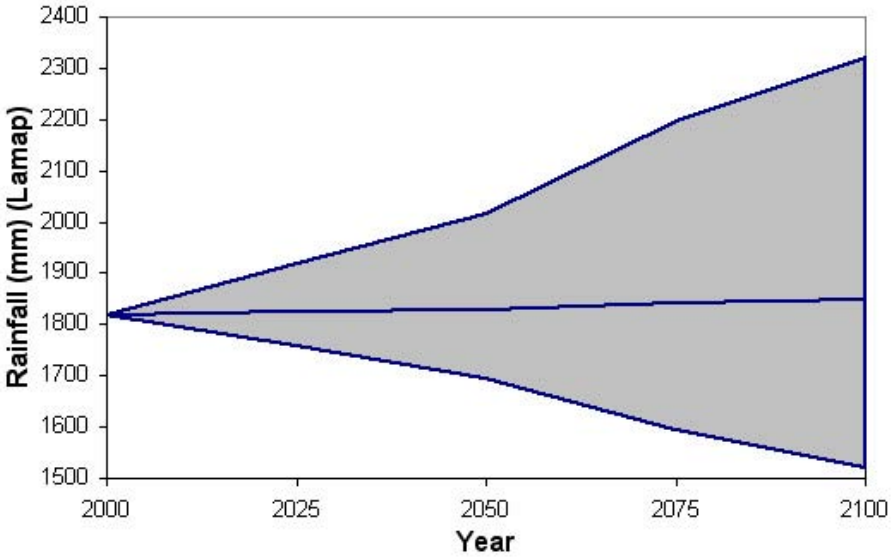


Figure 7 Best estimate of projected increase in mean annual rainfall for Lamap, along with the uncertainty envelope as given by the maximum and minimum estimates using all possible combinations of the available global climate models and emission scenarios.

6. Recent and Anticipated Risks and Vulnerabilities

6.1 Vulnerabilities

Vanuatu is already highly vulnerable to a range of natural disasters, many of which will be exacerbated by climate change. Most of the islands are mountainous and of volcanic origin and have a tropical or sub-tropical climate. Vanuatu was in 1996 classified as highly vulnerable to all natural hazards: tropical cyclone, storm surge, coastal flood, river flood, drought, earthquake, land-slide, tsunami and volcanic eruptions (UNFPA, 1996) and is ranked alongside Solomon Islands as the most disaster prone nation in the region. SOPACs Environmental Vulnerability Index classified Vanuatu in 2005 as vulnerable to natural hazards caused by disasters and climate change with an index of 285 (SOPAC, 2005).

The vulnerability of Vanuatu's society and economy in general, or specific sectors to the effects of climate change depends not only on the magnitude of current and future climatic stresses, but also on the sensitivity and capacity of affected sectors, groups and individuals to adapt to or cope with such stress. Box 1 provides a definition of sensitivity, adaptive capacity and vulnerability and gives practical examples how these terms are applied.

Sensitivity to climatic stress is higher for activities entailing climate-dependent natural resources, such as agriculture and coastal resources – often critical for the livelihoods of Vanuatu's population. The capacity to adapt and cope depends upon many factors, including wealth, technology, education, governance institutions, information, skills and access to resources, which are all generally scarce in ni-Vanuatu communities.

Poverty is therefore an important determinant of vulnerability to climate change; and precarious livelihoods will be further challenged through climate change. Lower-income groups are hit hardest because of greater sensitivity (e.g. those living in makeshift or traditional housing on unsafe and/or remote sites) and less capacity to cope and adapt (e.g. lack of assets and insurance). There are strong complementarities between reducing poverty and reducing vulnerability to climate change, e.g. higher education increase the adaptive capacity of households.

The concept of vulnerability therefore recognises that socio-economic systems play a crucial role in amplifying or moderating the impacts of climate change.

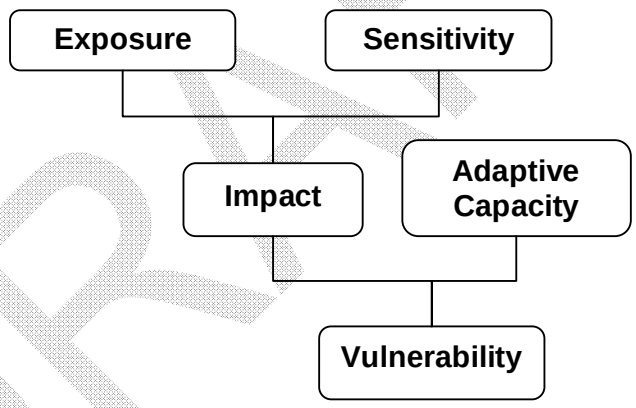
Box 1

CLIMATE CHANGE SENSITIVITY, ADAPTIVE CAPACITY AND VULNERABILITY

Sensitivity is the degree to which a system can be affected, negatively or positively, by changes in climate. This includes change in mean climate and the frequency and magnitude of extremes. The effect may be direct (for example a change in crop yield due to a change in temperature) or indirect (such as damage caused by increased frequency of coastal flooding due to sea-level rise). Sensitivity includes ***exposure*** which considers the nature and magnitude of climate change and whether a system would be affected by such change. For example, the lowlying coastal areas of Vanuatu are exposed to sea-level rise, whereas the mountainous inland, because of its elevation, is not. Sensitivity also considers the extent to which an exposed system can be affected by climate change. Some Vanuatu systems, like taro agriculture, are quite sensitive, while other systems, such as Tuscker beer manufacturing, are much less sensitive to climate change, although they can be affected by extreme events, reductions in water supplies, and power disruption.

Adaptive capacity is a system's ability to adjust to climate change (including climate variability and extremes), to moderate potential damage, to take advantage of opportunities or to cope with consequences. It is a function of the relative level of a society's economic resources, access to technology, access to information on climate variability and change, and skills to make use of the information, institutions (for example, the degree to which institutions can help to adapt), and equitable distribution of resources (societies with relatively more equitable resource distribution will be better able to adapt than societies with less equitable distribution). An ***adaptation gap*** is the amount of additional adaptation required to cope with climate change, including changes in climate variability. The level of adaptive capacity tends to be positively correlated with the level of development: more developed societies tend to have more adaptive capacity. However, possessing adaptive capacity is not a guarantee that it will be used effectively.

Vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate change, and the degree to which a system is exposed, along with its sensitivity and adaptive capacity. Vulnerability increases as the magnitude of climate change or sensitivity increases, and decreases as adaptive capacity increases.



Source: OECD, 2009 (adapted)

Climate change is also likely to differentially affect certain sectors and regions. For example, certain coastal and marine ecosystems, such as mangroves and coral reefs will be subject to multiple stresses. Climate change will affect many key resources that are critical for development in Vanuatu. These impacts will generally become more significant and more widespread with increasing climate change. For example, water resources especially in small islands will be affected by changes in rainfall and evapotranspiration. Low lying coastal systems will be affected by sea-level rise and more frequent extreme weather events.

Similar to the changes in climate as presented in chapter 5 of this strategy - the NAPA predicts the following scenarios for Vanuatu:

- Gradual increase in temperature which becomes more marked in the south
- Gradual decline in rainfall

- Significant increase in frequency of tropical cyclones including more frequent El Nino type conditions associated with prolonged dry seasons

When addressing adaptation to climate change and disasters, the first step is to identify the vulnerability of the systems of interest – the land based resources and the people who depend on them - and the climate risks to that system[7].

In addition to assessing current vulnerability and climate risks – as presented in chapter 5 - an assessment of future vulnerability and future climate risks needs to be carried out. In order to understand possible future vulnerability, a qualitative understanding of the drivers of vulnerability must be compiled. However the key is not so much to develop perfect information on a system of concern, but to ensure sufficient information to enable thoughtful consideration of adaptation options.

The following table is therefore summarizing the vulnerabilities for each sector and each province

Table:

[Include updated information on sector and local vulnerabilities based on SimCLIM projections or other sources once available]

6.2 Sensitivity and Adaptive Capacities

Sensitivity and adaptive capacity - especially at the local level - are influenced by many factors, e.g. income level, education, settlement patterns, infrastructure, ecosystem and human health, gender, political participation and individual behavior. Moreover, they shape the way in which people are able to reduce exposure to, cope with, and/or recover from negative impacts of climate change or, alternatively, take advantage of the opportunities afforded by climate change.

On the other side, individuals, households, communities and municipalities have longstanding experience in responding to climate variability and change (see chapter 7).

[77] The identification of current and future vulnerabilities and climate risks is step 1 in a generic four-step systematic approach developed by the OECD that decision makers can take to address adaptation to climate change on national, sectoral and local level. (OECD, 2009)

These coping strategies can be used to form the basis of successful adaptation strategies. However, some of these coping strategies could prove to be unsustainable over time as climate change progresses, leading to a greater risk of maladaptation (see box).

Box 3

DEFINITION OF MALADAPTATION

Maladaptation is defined as business-as-usual development which, by overlooking climate change impacts, inadvertently increases exposure and/or vulnerability to climate change. Maladaptation could also include actions undertaken to adapt to climate impacts that do not succeed in reducing vulnerability but increase it instead.

Example: Short-term adaptation strategies of the water sector in response to a decrease in rainfall could include over-exploitation of groundwater resources, which could actually exacerbate vulnerability over the longer term.

Source: OECD, 2009 (adapted)

Adaptation to climate change therefore requires a bottom-up thinking approach which is reflected in this NCCAS. Local knowledge on climate change and response options enlarges the overall management capacities, e.g. climate information from local observation may bring essential information far beyond meteorological observation. It also ensures that the final adaptation strategies reflect the needs of local people and communities thus triggering an locally "owned" development process which is especially important to ensure sustainability and to avoid conflicts.

Climate change is thus likely to impact on all sectors that are pertinent to the sustainable development of Vanuatu. For Ni-Vanuatu, the local population, their livelihood and social structure are closely linked to the natural environment and its resource base, and any negative changes in their availability to natural resources and possible decrease in the food security will have a direct bearing on the poverty levels and survival of the people.

6.3 Agriculture and Livestock Sector - Vulnerabilities, Sensitivity and Adaptive Capacities

[needs to be updated by the NACCC and local stakeholders]

The majority of the rural population of Vanuatu is engaged in agricultural production for subsistence with limited cash cropping. The main agricultural products are copra, kava, cocoa, coffee, taro, yams, fruits and vegetables. While large commercial farms and plantations are making a significant contribution to the cash economy of Vanuatu, approximately 80% of the population reside in rural areas and depend on small agricultural plots for their livelihood.

Vanuatu's environment is ideally suited to raising beef cattle. The production of beef, pork, poultry, sheep and goat for local consumption forms an essential part of the rural economy. (FAO, 2007)

The following table is summarizing the current impacts, sensitivities to climate climate change as well as the current adaptive capacity

Sector	**Agriculture – Crop Production**	
Impact	**Current Sensitivity to Climate Change**	**Current Adaptive Capacity**
- Droughts - Heat spells - Cyclones - Wind gusts - Floods - Sea level rise / salt water intrusion	-majority of ni-Vanuatu depend on agriculture (subsistence agriculture and limited cash cropping) - small farm sizes - little incentive to introduce modern equipment and methods - low productivity - commercial and subsistence agriculture are based on rain-fed agricultural production systems - most farmers are isolated with poorly maintained access roads - little additional information on cc-impacts on crops such as yams, taro and sweet potatoes - lack of food storage and preservation - lack of water storage facilities - xxx	- traditional multicropping methods - increasing the number of small farm plots (involvement of rural dwellers) - sustainable and affordable management practices for traditional crop production - xxx
Sector	**Agriculture – Livestock Production**	
Impact	**Current Sensitivity to Climate Change**	**Current Adaptive Capacity**
- Droughts - Heat spells - Cyclones - Wind gusts - Floods - Sea level rise / salt water intrusion	- Small farms - lack of shade trees - small farmers rely on streams for water supply - low nutritional value of pastures (for cattle) - overstocking of small scale livestock (poultry) - lack of veterinary services outside Efate and Espirito Santo - xxx	- veterinary services available on Efate and Espirito Santo - grazing of cattle under coconut plantations - xxx

6.4 Forestry Sector - Vulnerabilities, Sensitivity and Adaptive Capacities

[needs to be updated by the NACCC and local stakeholders]

Vanuatu possesses excellent soil and climate that are conducive to timber production. According to the National Forest Inventory of 1993, approx. 74 % of the land area (about 900 000 hectares) are covered with different forest types[8], or considered as other wooded land. Although about 890 000 hectares of this is still natural forests, the production forest occupies only 36 % of Vanuatu's land area

[8] Definitions, see Appendix 1 of Vanuatu's National Forest Policy

(Tate, 2008), and only about 20 % of it are of commercial use - mainly due to inaccessibility, low tree density, cultural reasons, or because it has already been heavily logged during the eighties and nineties (Forest Policy, 2010). In the year 2000, the forestry sector contributed VT295 million (approx. 0.9 %) to the GDP (Nat. Statistics Office, 2010 / Forest Policy, 2010). The importance of Vanuatu's forests can not be judged on economic benefits alone. Apart from providing job opportunities, income, and badly needed infrastructure, the development of the forest resources also stimulates activities within the whole economy. The concept of sustainable forest management in Vanuatu must be tempered by the fact that there is no government-owned forest land, and that it is an inalienable right of landowners under the Constitution to manage their land as they see fit. However, given the decreasing forested area and the threat of further damage through extreme climatic events, a sustainable forest industry for Vanuatu can only be achieved through a collaborative effort by the government, the landowners and the industry (FAO, 2007).

Mangroves are productive ecosystems that are important to the livelihoods of coastal communities. Many fish and other marine species breed and live in mangrove areas and yet, many such areas are being destroyed or converted to other uses. Mangrove forests also play an essential role in protecting the coast against storms and inundation. Mangrove areas are believed to be declining in Vanuatu, even in certain isolated areas where population densities remain low. Pollution from land-based activities is perceived as the most common threat to mangrove areas although land clearing is also a threat. Mangrove ecosystems will certainly be affected by climate change events. Sea level rise could affect growth and productivity while storms and associated heavy rain can cause pollution thereby affecting breeding and spawning grounds for many fish species that live in mangrove areas. (FAO, 2007)

The following table is summarizing the current impacts, sensitivities to climate climate change as well as the current adaptive capacity

Sector	**Forestry**	
Impact	**Current Sensitivity to Climate Change**	**Current Adaptive Capacity**
- Droughts - Heat spells - Cyclones - Wind gusts - Floods - Sea level rise / salt water intrusion	- lack of financial competitiveness with agricultural land (risk of forest conversion due to higher demand for agricultural land caused by climate change) - monocultures subject to wind gusts, pests and diseases - lack of financial resources for sustainable forest management (planting, pruning, thinning and harvesting) - xxx	- natural resistance of sustainably managed native forests - xxx

6.5 Water Sector - Vulnerabilities, Sensitivity and Adaptive Capacities

[needs to be updated by the NACCC and local stakeholders]

The larger mountainous islands of Vanuatu have good ground and surface water resources whilst the low lying islands have limited fresh ground water in shallow aquifers and rely heavily on rainwater. The mountainous terrain also creates challenges for traditional water carriers, the women and children, especially where sources are far from villages.

There is generally abundant rainfall (from <100mm per month in July to >400mm per month in January) although this varies from north to south of the country and high mountainous islands create rain shadows on their leeward side. In 2006 the Northern Islands received 20 to 30 percent more than average rain whilst the Southern Islands received 20 to 40 percent less rain than average.

Flooding and poor farming practices have resulted in erosion, threatening land stability and the health of rivers and marine life in or around river mouths. In general, the islands with active volcanoes have all suffered negative effects on water quality by contamination from a mixture of fluoride, hydrochloric acid, and sulphuric acid. This has created problems for rainwater collection systems and some surface water quality**.**

Inundation of water resources caused by land subsidence, sea level rise and water extraction is becoming more common. The opinion of the National Disaster Management Office is that "i*f a village doesn't have a problem with the quantity of drinkable water it has it will have a problem with the quality of drinking water it has. This is an issue for almost every person living in a rural area."* (National Water Strategy)

Port Vila water supply is provided by UNELCO, a private company under contract with the Government. The water supply for Luganville, Isangel and Lakatoro are managed by the PWD. Water quality is generally good with chlorine used for water treatment in Port Vila and Luganville. There are at least 6 known private water suppliers around Port Vila operating outside the UNELCO concession area. These suppliers are not regulated and no monitoring activity is known.

Outside these areas water supply is either taken from groundwater via open wells and bores, from surface water sources, or rainwater collection with storage in ferro-cement or polyethylene tanks. Demand for irrigated water is extremely low and limited to a few small horticultural sites (National Water Strategy).

The following table is summarizing the current impacts, sensitivities to climate climate change as well as the current adaptive capacity

Sector	**Water**	
Impact	**Current Sensitivity to Climate Change**	**Current Adaptive Capacity**
- Droughts - Heat spells - Cyclones - Wind gusts - Floods - Sea level rise / salt water intrusion	- lack of water storage and distribution infrastructure - lack of financial resources for infrastructure maintenance - lack of potable water caused by contamination - no water monitoring system in place - no water resource database of the quality, quantity and location of water resources in place	- existing rainwater harvesting systems in some communities - introduction of a IWRM concept (based on the National Water Strategy) - bottled water available in and around urban centers - xxx

	- competition of water use - no water reuse - xxx	

6.6 Environment & Biodiversity Sector - Vulnerabilities, Sensitivity and Adaptive Capacities

[needs to be updated by the NACCC and local stakeholders]

Although Vanuatu's biodiversity has been widely reported as less rich than its neighboring countries, New Caledonia and Solomon Islands, recent studies have suggested that Vanuatu's biodiversity was in fact richer than was previously estimated (Environment Unit, 1999). Vanuatu is in fact an important faunal crossroad in the Pacific. The three main streams by which it is believed wildlife colonized the SW Pacific (Papuan, Australian and Polynesian), meet here.

Of all the islands in Vanuatu, Espiritu Santo has the greatest species richness with 49 native species of land and freshwater birds found here. This represents 75% of Vanuatu's native land and freshwater birds and 85% of land and freshwater birds that breed in Vanuatu. Seven of the eleven species of bats found in Vanuatu are also present in the Santo region (Nari et al, 1996). Vanuatu's 200 nautical miles exclusive economic zone is extensive and encompasses mangrove, sea grass, lagoon, coral and pelagic habitats. Mangroves, sea grass and other coastal ecosystems provide protective buffers that shelter land and human settlements from the full impact of storm events but are under pressure from subsistence and commercial land use. (FAO, 2007)

The following table is summarizing the current impacts, sensitivities to climate climate change as well as the current adaptive capacity

Sector	**Environment / Biodiversity**	
Impact	**Current Sensitivity to Climate Change**	**Current Adaptive Capacity**
- Droughts - Heat spells - Cyclones - Wind gusts - Floods - Sea level rise / salt water intrusion	- lack of means and incentives to protect biodiversity - pollutants (insecticides, pesticides, herbicides) - changes on flowering patterns - extraction of coral, sand and gravel for construction purposes - destruction of breeding grounds for animals (birds, turtles, etc.) - xxx	- existing nature reserves - ecotourism as a driving force for environmental protection and biodiversity conservation - xxx

7. Overview of Adaptation Options

7.1 Identification of Adaptation Options

Based on the assessment of sector vulnerabilities a list of adaptation options was identified in a two-step participatory consultation process. These adaptation options may be justified by considering the risks of climate change, and even without considering these risks. In addition, in the interest of generating as full a catalogue as possible of adaptation options, these options were initially generated without regard to their feasibility, cost, or other limiting factors. These criteria have been included into the analysis in another step in which the adaptation measures have been evaluated (see chapter 10).

Adaptation options can be designed to provide net benefits regardless of climate change (these are known as “no regrets” or “low regrets” measures) or can, on the other hand, depend on projections of changes in climate to justify their benefits (known as “climate justified” measures).

“No regrets” or “low regrets” adaptations are justified under current (or historical) climate and are even more justified when climate change is taken into account. No regrets adaptations include removing or limiting maladaptation. Investments in development, particularly those that enhance the capacity of a society to adapt to climate change, are “no regrets” adaptations. The category also includes other measures, such as reduced pollution and destruction of natural habitats, water conservation and enhanced public health systems. Indeed, promoting development makes sense anyway and will reduce the vulnerability of future societies to climate change.

Examples of “No regrets” and “low regrets” adaptation measures from the annex

NCCAS Strategy # 38 Forestry – Plant local, endemic and long-cyclone resistant species

NCCAS Strategy # 4 Agriculture – Practice fruit drying

“Climate justified” adaptations consist of measures taken specifically to anticipate climate change. Often these are changes made to long-lived investments. For example, a sea wall being built or rehabilitated might be built somewhat higher to account for sealevel rise.

Examples of “climate justified” adaptation masures from the annex

NCCAS Strategy # 155 Forestry – Implement irrigation systems of commercial properties

NCCAS Strategy # 173 Livestock – Design bullock pastures so that streams and other water courses pass through them

"Climate justified" adaptations can be changes to infrastructure design, but can also include changing land use (such as limiting development in areas that would be vulnerable to climate change), enhancing emergency response procedures, enabling standards to be updated on the basis of changed conditions, and so on. Here, information on how climate may change may be needed to alter infrastructure design, land-use decisions, or other long-term decisions. In implementing such "climate justified" actions, however, adequate consideration needs to be placed not only on the projected climatic changes but also on the uncertainties associated with such projections. As noted in Section 5, all climate projections are subject to uncertainties. Even when uncertainties are large it is still important to make decisions to reduce unacceptably large climate-related risks. In such circumstances it is important to focus on *no regrets* initiatives. Such initiatives are towards the left of the continuum of climate change response initiatives (Figure 8).

Figure 8. Examples of responses to climate change, from development focussed (left) to climate change focussed (right), with examples for adaptation, mitigation and the two combined. Adapted from McGray et al. (2007) and OECD (2009).

7.2 Building on Existing Coping Strategies

Rural communities in Vanuatu have a long history of responding to climate variability and change, but with varying levels of success. These short-term coping strategies form the basis of successful long-term adaptation strategies. However, care needs to be taken as some of these traditional coping strategies could prove to be unsustainable over time as climate change progresses, leading to a greater risk of maladaptation. For example, short-term adaptation strategies in response to a decrease in rainfall could include over-exploitation of groundwater resources, which could actually exacerbate vulnerability over the longer term. Innovative approaches and new technologies and monitoring of the effectiveness of strategies in light of changing circumstances are needed to make sure that coping and adaptation strategies remain appropriate. Rural communities are therefore the key actors for implementing adaptation strategies, and hard-won lessons can be learned, communicated and fed into adaptation decision making at higher levels.

Box 4

EXAMPLES OF CURRENT COPING STRATEGIES IN VANUATU

[Include examples for traditional coping strategies in land based resource management]

7.3 Overview of Adaptation Options

The following box is summarizing some of the more than 500 adaptation measures which have been derived Vanuatu stakeholder consultation. The full list is included into Part 2 of this strategy.

Box 5

EXAMPLES OF ADDITIONAL ADAPTATION OPTIONS BASED ON THE NCCAS ANNEX

[Include examples for additional adaptation strategies from the annex]

7.4 Limits to Adaptation on Sectoral and Local Level

The NCCAS outlines climate change adaptation measures on sectoral and local level that are practical and applicable in the political, social and economic framework of

Vanuatu. However the implementation of adaptation actions on sectoral level is generally facing a number of key challenges that need to be dealt with:

Awareness: Awareness about climate risks is important to help sectors and communities deal with current climate variability and change. Lack of awareness on the part of government authorities, educators and trainers represents a significant impediment to integrating climate change considerations at local decision-making levels.

Information:

- **Sector Level:** Unlike the national level where assessments of climate change impacts and vulnerabilities are generally available, there is a general lack of detailed information on climate change impacts, vulnerabilities, and adaptation priorities at the sectoral level. Furthermore, there is also a need for assessments on how climate change impacts might interplay with other drivers of change within the context of specific sectors. For example, in the case of the agricultural sector, the implications of climate change might need to be viewed not in isolation from but in conjunction with other pressures such as demographic trends, scenarios of water availability, and trends in trade and commodity prices – all of which might influence sectoral policies. Such integrated information would often be key to both partner governments and donors to facilitate more meaningful integration of adaptation at the sectoral level. Chapter 9 provides additional information on how two or more sectors might deal with this challenge.
- **Local Level**: Perhaps the most challenging information gap on local level is the availability of climate change projections at a scale that is relevant to rural communities. Efforts to downscale global and regional climate models proceed, but their utility at the community level is still limited. General trends can provide a starting point for considering changing risks, but may not be enough to encourage behavioural change. The absence of climate change projections however is no justification for doing nothing but should be taken into consideration in the long term.

Priorities:

- **Sector Level:** Adaptation to climate change is still not high enough on the agenda of some sectoral ministries and donor agencies in Vanuatu and beyond. Even in cases where consideration of climate variability is part of established practice (as in water resource management), the established regulations and procedures frequently rely upon historical climate as a baseline and do not adequately reflect how the baseline itself might change as a result of the changing climate.
- **Local Level:** Climate change adaptation is competing with other development priorities such as HIV/AIDS, conflict and access to primary education. In rural communities, because managing climate risk may be viewed as a “way of life”, local authorities may be reluctant to allocate too many resources to it. Instead, they may want to focus on more immediate threats to development such as infectious diseases, illiteracy, and food insecurity. The key to making sure climate risk management and climate change considerations do not remain ignored is to make the links between these development priorities and climate risk. For example, climate risk management may have an important role to play in reducing disease transmission and food insecurity.

Capacities

- **Sector Level:** There is a general lack of capacity in terms of analysing the implications of climate change in many sectors. There is also limited access to centralised sources of climate expertise such as the Meteorological Services. Consequently, decision makers may not have adequate information on the specific implications of climate change on their specific sectors.
- **Local Level:** Local governments and organisations are almost always underresourced and over-committed. Budgets are typically stretched, whether local government revenue is raised locally or allocated by central government. Technical knowledge in the area of climate risk is correspondingly limited, as hydro meteorological knowledge is typically housed in a small department of a ministry, often removed from local communities. These inadequacies reflect local governments lacking the resources to meet their responsibilities – and often with very limited capacities to invest (as almost all local revenues go to recurrent expenditures or debt repayment).

Institutional structures: Complicated and unresolved institutional questions or conflicts may present a barrier to the implementation of adaptation actions on sector and local level. For example, poorly defined or insecure land tenure may impede a revision of local land-use plans and prevent people from adopting certain resilience-building strategies, since there may be no guaranteed returns on risk reduction investments on the land if land is suddenly taken away. Chapter 9 provides a detailed stocktaking of the current institutional set up and potential measures to strengthen these institutions.

8. Vanuatu Policies & Plans Relevant to Climate Change

The NCCAS aims to support the implementation of existing national and regional strategies and policies, particularly where these define goals and actions that are relevant to climate change adaptation. Aligning the NCCAS with these policies will contribute to increased resilience and adaptive capacity, locally, nationally and regionally. In addition, the NCCAS will focus on areas in which specific adaptation policies, strategies and plans are as yet lacking.

The following national and regional policies and plans have been identified as relevant in the context of the NCCAS and influence climate change adaptation in Vanuatu:

Relevant national policies and strategies:

- *Priorities and Action Agenda (PAA) 2006-15*
- *PAA 2006-2010 Supplementary for Mainstreaming Disaster Risk Reduction and Disaster Management*
- *Disaster Risk Reduction and Disaster Management National Action Plan 2006-16*
- *Planning Long, Acting Short: The Government's Policy Priorities for 2009-2012*
- *National Adaptation Program for Action (NAPA)*
- *Land Sector Framework 2009-18*
- *National Biodiversity Conservation Strategy*
- *Physical Planning Act of 1986*
- *Environmental Management and Conservation Act No. 12 of 2002*
- *Foreshore Development Act 1976*
- *The Vanuatu and the Secretariat of the Pacific Community Joint Country Strategy 2011-2015*

Policies under development:

- *National Forest Policy*
- *Vanuatu Overarching Productive Sector Policy*
- *Climate Change Policy and Implementation Strategy*

Relevant regional strategies:

- *United Nations Framework Convention on Climate Change*
- *United Nations Convention on Biodiversity*
- *Pacific Island Framework for Action on Climate Change 2006-2015 (PIFACC)*
- *Regional Framework for Action for Disaster Risk Reduction and Disaster Management 2005 -2015* (status/document?)
- *The Pacific Plan for Strengthening Regional Cooperation and Integration*

- *Pacific Leader's Call to Action Climate Change (Annex A to the 2009 Forum Leader's Communique)*
- *Alliance of Small Island States (AOSIS) Declaration on Climate Change 2009*
- *Pacific Island Adaptation Initiative (2003-2015)*

These policies and initiatives differ in terms of focus, i.e. some are sector-specific policies (e.g. National Forest Policy), while others relate to all sectors within the national economy (e.g. Priorities and Action Agenda). They also vary in terms of their nature and purpose and, as a result, take climate change and its impacts into account to varying degrees — they range from initiatives with broader environmental or sustainability objectives, to climate change initiatives relevant to both mitigation and adaptation, to specific initiatives aimed at improving adaptation, adaptive capacity and disaster risk management.

Regardless of the depth of climate change integration into these policies and strategies, all contain goals and measures that are relevant to, or may contribute to supporting, the adaptation process in Vanuatu. The table below provides an overview of adaptation relevant directives, priorities and measures contained in the aforementioned policy documents.

Table 1: Overview of national policies, strategies and legislation and their relevance for adaptation in the land-based sectors

Policy/strategy/ legislation	Relevant land-based sectors/resources	Examples of priorities/ actions relevant to climate change adaptation	Analysis: Link with NCCAS and contribution to adaptation; synergies and gaps	Legal and implementation status of the policy/strategy/ legislation
Priorities and Action Agenda 2006-15 (PAA)	Agriculture	(p. 27) Increased productivity through: • Better research on traditional food crops • More effective extension services • Dissemination of improved planting material • Improving access to credit • Increased ni-Vanuatu participation in agri-business	Successful adaptation is a precondition for achieving the goals of the PAA, which is to raise the welfare of the people of Vanuatu, inter alia, through higher and sustainable economic growth. Equally, various priorities defined in the PAA contribute to adaptation in the land-based sectors. Both the NCCAS and the PAA, if implemented effectively and efficiently, can support each other for the benefit of the entire nation.	*This section will be completed by local stakeholders; progress in implementation is an important piece of information for the gap analysis in column four, which can only be undertaken once this information has been received*
	Forestry	(p. 28) • Improve/increase sustainable management • Expansion of agro-forestry • Greater utilization of other timber species		
	Livestock	(p. 27) Improved livestock production through: • Improved extension services to livestock • Better access for smallholder farmers to credit • A program of breeding improvement		
PAA Supplementary for Mainstreaming Disaster Risk Reduction and Disaster Management	All land-based sectors	All policy objectives outlined in Section 4. In particular: • recognise disaster risk management as a development issue and mainstream all-hazards risk management into all sectors and decision-making processes at all levels of government, including national planning and budgetary processes • recognise disaster risk management as a whole-of-country responsibility and actively engage communities, NGOs and the private sector in disaster risk reduction and disaster management efforts • recognise that disaster risk management is	The DRR/DRM NAP and PAA DRR/DRM Supplement were prepared in tandem and jointly define actions to reduce disaster risks in Vanuatu. They call for institutional strengthening through fostering integration of disaster risk reduction in all economic sectors and high-level coordinating responsibility for DRR and DRM (rather than leaving	

		about supporting communities to reduce and manage risks, and empower communities by providing appropriate and timely information; building their capacity to use this information to make informed decisions; and promoting community-based disaster risk management through participatory planning and public-private sector partnerships In addition, the PAA DRR/DRM Supplement calls for revising the PAA to mainstream DRM (see Annex 1); adaptation-relevant actions include: (p. 19) Meteorological services to provide timely and accurate meteorological information to facilitate integration of climate change into national development plans. Objectives: • provide early warning systems • build local capacity • incorporate climate change and other risk management issues into national development plans, sector plans, etc.	responsibility with the small, potentially under-funded National Disaster Management Office). Implementation of relevant actions will contribute to improved resilience of people, institutions and resources and enhanced adaptive capacity. The NCCAS acknowledges a close relationship between DRR/DRM and adaptation, and strengthen the DRR/DRM agenda by identifying relevant actions.	
Disaster Risk Reduction and Disaster Management National Action Plan (NAP)	All land-based sectors	The NAP summarises key strategies and programs contained in various ministerial, sectoral and provincial corporate plans; provision of particular interest to land-based resources include: • (p. 14) Strengthen the Vanuatu Meteorological Service to increase its ability to provide accurate forecasts and forewarning, particularly in light of increased frequency and intensity of extreme weather events • (p. 17) Develop village water supply systems and watershed management, including the provision of training to village dwellers to maintain their own water systems		
Planning Long, Acting Short: The	Land	The following strategies are of particular relevance to climate change adaptation (p. 4):	If properly implemented, Planning Long, Acting Short	

Government's Policy Priorities for 2009-12		• Implement key recommendations of the national land summit especially sustainable utilization of land by Ni-Vanuatu • Strengthen Land Laws Act to increase transparency in land lease decisions • Strengthen the capacity of the MLNR to formulate and implement land policies and laws • Promote sustainable environment	can create important synergies for adaptation in the land-based resources area; however, the short time-frame of the strategy presents limits to what is achievable and the effectiveness in contributing to adaptation over the longer term. Therefore, it would be useful if synergistic actions were included in any follow-up policy from 2012.	
	Productive sector, including agriculture, livestock, forestry	(p. 6) • Improved productive sector institutional capacities • Improve farmers' access to markets and information • Improve access to credit facilities through existing commercial and micro credit schemes • Institutional strengthening of DARD, Forestry Extension Services, livestock services		
National Adaptation Program for Action (NAPA)	Agriculture & food security, water, agriculture, forestry, land use planning	Adaptation strategies defined across these sectors and activities, e.g. rainwater harvesting, sustainable livestock farming and management, sustainable forestry management, early warning systems	The NAPA focuses on urgent and immediate needs and includes a list of ranked adaptation activities and projects based on individual preferences and information existing at the time. The NCCAS, on the other hand, focuses on the medium to long term and defines priorities for land-based resources based on the most recent data and climate change impact information. Where adaptation measures defined in the NAPA are in line with updated action priorities, their	

			implementation is fully supported by and included within the NCCAS.	
Land Sector Framework 2009-2018	Land resources management, including agriculture, forestry	All strategies and activities outlined in the Framework are directly or indirectly relevant to adaption, in particular the following (p. 7): • Strengthen land management • Support sustainable development practices • Increase support for community awareness and engagement	While not explicitly mentioning climate change, some strategies defined in the LSF will directly contribute to enhanced adaptation. However, it would be critical for LSF measures (that cut across all important sectors of the economy) to take climate change into account.	
National Water Strategy 2008-2018	Water, agriculture, livestock, forestry	The strategy is generally relevant for adaptation as it calls for a sustainable and equitable access to safe water and sanitation for the people of Vanuatu to support improved public health and promote social and economic development. At a high level, it acknowledges that climate-related changes have the potential to exacerbate the situation caused by the growing demand for water, thus potentially further limiting the availability of potable water.	All seven objectives of the strategy have the potential to contribute to climate change adaptation if they take the impacts of climate change into account in their implementation. Currently, climate change is not explicitly mentioned in the objectives.	
National Biodiversity Conservation Strategy	Biodiversity, water and other land-based resources	All objectives of the Strategy are potentially relevant for adaptation by making an indirect contribution: • Biodiversity protection and conservation • Enable sustainable management of biodiversity • Research, assessment and monitoring of biodiversity • Capacity building for environmental management • Environmental education, awareness and information sharing	The Strategy was adopted in 1999 and there is a potential that some of the priorities specified are outdated. Climate change is not explicitly mentioned in the Strategy. An update of the strategy might be warranted that takes climate change and its impacts into account.	

Physical Planning Act of 1986	Potentially agriculture, livestock, forestry, water	The Physical Planning Act primarily regulates the built environment sector and therefore is relevant to land-based sectors such as agriculture, livestock, forestry and water and their related production and processing infrastructure.	Climate change impacts and adaptation are not explicitly taken into account in the Act. To facilitate a built environment more resilient to both future changes in weather and extreme weather events arising from climate change, it would be necessary to identify and implement changes in regulations such as the Physical Planning Act.	
Environmental Management and Conservation Act No. 12 of 2002. Amendment in 2011.	All land-based resources and sectors	Through setting of environmental standards, making provision for a national environmental registry, and requiring environmental impact assessments (EIA) for all projects in Vanuatu, the Environment Act is potentially of adaptation relevance to all land-based sectors.	The Act and its tools and provisions, such as the EIA and the environmental registry, were considerably strengthened through incorporation of climate change aspects and impacts in a 2011 amendment.	
Vanuatu and the Secretariat of the Pacific Community Joint Country Strategy 2011-2015	Agriculture, livestock, forestry, environment	All key result areas defined for relevant land-based sectors indirectly contribute to adaptation. Some key result areas make a direct contribution by explicitly addressing adaptation. These include: Agriculture, key result areas 4, 5, 7, pp. 17 & 18: • Climate change adaptation strategies developed and integrated into national priorities and strategies • New crop varieties introduced and produced, and improved and resilient climate-ready planting materials disseminated • Appropriate databases and information management systems developed to capture	The Vanuatu-SPC JCS aims to support the implementation of the PAA and the Planning Long, Acting Short Action Agenda. As such it contributes indirectly to adaptation by supporting the goals and objectives in defined in both policy documents that are of relevance to adaptation (see above). In addition, the JCS defines some actions that are directly relevant to the	

		agriculture information […] (including climate change, food security and poverty alleviation) Forestry, key result areas 3 and 9, p. 18: • See orchards of priority commercial, endemic and climate-resilient species established • New climate-mainstreamed National Forest Policy developed and implemented	NCCAS.	
National Forest Policy	Forestry	Objectives and actions that directly address adaptation include those that: • contribute to adaptation, e.g. biodiversity conservation (see section 4H&L), watershed management and soil conservation (see section 4D) • directly address climate change adaptation (see section 4J) • will be improved by taking adaptation into account, e.g. actions relating to extension (4Z), land use and land use planning (4F)	The Vanuatu National Forest Policy has recently been revised and updated. This opportunity was used to fully integrate climate change into four thematic areas. As such, once adopted by the Government, the National Forest Policy is one of the most progressive policies in the country and makes an important contribution to the implementation of forestry-related actions defined in the NCCAS.	
Vanuatu Overarching Productive Sector Policy	Agriculture, livestock, forestry	*To be finalised in 2011, currently only the 'Report on Consultations during 12-30 July 2010' is available*	The Productive Sector Policy will be an important policy affecting, in particular, the agriculture, livestock and forestry sectors, and will need to take climate change into account in order to be effective and efficient. This has also been raised in the consultations and the consultation report emphasizes: "The competing demands on the environment	

			and differentiated impacts of climate change must be assessed and taken into consideration when formulating strategies to address the development challenges the productive sector faces."	
Draft CC Policy and Implementation Strategy	All land-based resources and sectors	*This Policy exists only in draft form and is unlikely to be adopted and implemented in its current form.*		

Since the NCCAS is designed to support and contribute to Vanuatu's medium- to long-term development goals, it aims to support implementation of the goals and priorities of existing policies wherever possible, rather than identifying and implementing new ones. This is an important way to maximise synergies and avoid duplication, thus avoiding or reducing confusion of actors and inefficient use of existing institutional and financial resources.

Importantly, when developing strategies and actions under the NCCAS care has been taken to ensure that they are in line with the latest scientific findings. This is particularly important in cases where the current policies are likely to be outdated in terms of climate risks, and how best to manage them. A possible example is the National Biodiversity Conservation Strategy, which dates back to 1999.

On the other hand, most of the above mentioned policies are reasonably up to date. After recent revision some of them now take climate change into account explicitly. This is the case with the National Forestry Policy. Other sectors, however, represent current policy gaps, which may be partly filled by the NCCAS. For the important sector of agriculture, for example, no sector policy currently exists.

9. Vanuatu Climate Change Institutional Arrangements

9.1 Institutional capacity: A stocktake

According to the Draft National Capacity Self-Assessment Project Report on the UNFCCC (2006, p. 51), 'Vanuatu is one of the Pacific Island Countries and LDC that have done enormously well in this aspect of capacity building for implementation of adaptation measures'. In the five years since this assessment, Vanuatu has made significant further progress and is among the leaders in the Pacific region in developing and implementing climate change adaptation and disaster risk reduction and management measures.

A number of reforms and initiatives have contributed to improved governmental and institutional capacity in Vanuatu. An important step has been, for example, Vanuatu's Comprehensive Reform Program (CRP), which was launched in 1997 as a response to 'fiscal fragility, political instability, economic stagnation, inefficient public administration and poor social service delivery in the mid to late 1990s' (Hay, 2009, p. 22). Among other goals, the CRP aimed to renew governance institutions, and develop a redefined role for the public sector and improved public sector efficiency (Proposal for GEF funding for National Capacity Needs Self-Assessment for Global Environmental Management (NCSA), 2004, p. 8).

Ten years on from the launch of the CRP, further reforms have been brought underway through the implementation of the Governance for Growth (GFG) program. This program addresses barriers and impediments to achieving improved economic and social outcomes inherent in current governance and institutional arrangements.

A number of new policies and plans, developed and implemented as a result of these reforms, demonstrate the progress Vanuatu is making in addressing institutional issues that will also improve the capacity to implement climate change adaptation measures. Such initiatives include:

- The Priorities and Action Agenda (PAA) 2005-2016, the Government's medium-term strategy for development;
- Planning Long, Acting Short: Action Agenda for 2009-2012, which uses the priority areas in the PAA as a starting point to address specific priorities;
- The Disaster Risk Management Framework, including an arrangements flowchart, which was adopted by the government in early 2007 as the basis for developing new legislation, a new disaster management plan and new government organizational arrangements;
- The new Land Reform Policy, which will lead to a five-year action plan that includes land-use zoning maps and vulnerable area mapping, addressing both disaster risk reduction and climate change adaptation.

While there has been significant progress, there is much more that can, and should be, done to foster progress towards a more resilient nation that is less vulnerable to the impacts of climate change. Political, legal, research, social and other institutions will need to be further strengthened.

In the context of implementing appropriate DRR/DRM and climate change adaptation measures, a recent report notes: 'Success in all of the areas identified by the government will require it to overcome the policy inertia that presently exists and to substantially improve policy implementation' (Hay, 2009, p. 23).

Other reports emphasize the general lack of coordination between Government departments, limited monitoring and enforcement of relevant regulations, as well as other limitations, including those outlined in Box 1, as a barrier to effective action.

Box 1

OVERVIEW OF KEY ENVIRONMENTAL CAPACITY ISSUES IN THE GOVERNMENT SECTOR

Most Government Departments recognise capacity limitations at the individual or staff level, and emphasise a need to expand on training both to equip staff to better complete their existing responsibilities and to up-skill individuals to better fill the nation's needs for technical and managerial staff.

Second to this is recognition of inadequate institutional capacity with which to address environmental responsibilities: this includes inadequate work facilities; inadequate budget allocations; inadequate access to technical equipment; inadequate ability to maintain equipment in place; and inadequate information and data management. The Department of Meteorology finds it difficult to keep the increasingly complex technical base necessary to effectively interface with weather monitoring systems deployed in Australia and Fiji. Many agencies have raised issues over sharing and management of information.

Both these priority capacity building needs reflect inadequate resourcing of the environmental sector. This is due in part to the structural economic problems faced by the country and also to government priority being directed toward provision of social services such as education and health, expanding opportunities for income generation and providing an enabling environment for private sector led growth. In comparison the NBSAP Enabling Add-on has led to significant recognition of structural capacity needs, and has been active to build the foundations for an institutional platform that will be better able to support in-country environmental management over the long term.

Note: Despite assessing the broader environmental capacity, these issues are generally also applicable in the context of climate change adaptation. While these capacity limitations will have been addressed and mitigated to some extent since the writing of the GEF proposal, they may nevertheless be considered in implementing the NCCAS.

Source: Proposal for GEF funding for National Capacity Needs Self-Assessment for Global Environmental Management (NCSA), 2004.

For an overview of findings of the CCA/DRR Institutional and Policy Analyses for Vanuatu, as of May 2009, see Appendix 1.

9.2 The way forward: Strengthening institutions and governance for adaptation

Any review of institutional arrangements in Vanuatu with a view to strengthening them in support of adaptation to climate change must consider the administrative structure in the country. While the Government of Vanuatu formally makes decisions and operates at national, provincial and municipal levels, there is also a parallel traditional customary structure, which effectively operates at national, island, area and village level. It is important to strengthen adaptive capacity within both administrative structures. However this section primarily describes options for institutional strengthening at the formal government level.

a. Options for governance of climate change adaptation issues at national level

It must be noted that the establishment of the NACCC, which occurred as early as the late 1980s, positioned the country well to deal with climate change. Having an institution with the mandate to advise and act on climate change is a prerequisite for successful management of climate related issues and risks.

However, it appears that to strengthen the country's capacity to deal with current and future impacts of climate change, some changes to governance structures and responsibilities will be necessary. Options discussed by stakeholders include:

- Maintain the current structure and location of the NACCC but strengthen the body's capacity and expertise in the area of climate change adaptation and equip it with the financial and human resources necessary to provide decision-makers with robust and relevant information on climate change impacts, vulnerability and adaptation options, and oversee the implementation of the NCCAS;
- Restructure and/or relocate the NACCC, for example:
    - Restructure the NACCC and allow for the formation of Technical or Thematic Working Groups (TWGs) overseen by the NACCC. These TWGs could be formed following the example of the working groups under the Land Sector Framework and include representatives of relevant ministries, municipal councils etc. An 'Integrated Farming Working Group' was mentioned as an example, which would include representatives from agriculture, environment, livestock and forestry. These working groups would be responsible for providing advice on and coordinating the adaptation work of the different sectors. Working groups should be appointed by the responsible Minister, be given clear Terms of Reference, be integrated into Public Service Commission job descriptions, be provided an appropriate budget and its performance should be linked to and measured by key performance indicators (KPIs);
    - Relocate the NACCC to be included in the formal structures of either the Ministry of Environment or the Vanuatu Meteorological Service;
    - Amalgamate the NACCC and the National Disaster Management Taskforce, which is responsible for implementing DRR/DRM measures of the NAP (National Action Plan), to exploit synergies between adaptation and DRM policies and measures; and obtain endorsement for this new body by the Council of Ministers.
- Expand the portfolios of existing Ministries to include responsibility for climate change (adaptation), for example:
    - Make climate change adaptation, including coordination of relevant activities and guidance of all sectors, a responsibility of the Prime Minister's Office (Policy and Planning); placing responsibility for adaptation with an 'influential ministry' should be done in acknowledgement of the cross-sectoral nature and significance of adaptation;
    - Include climate change responsibility in the portfolio of the Department of Economic and Sector Planning;
    - Development of KPIs by the Directors General (DGs); the KPIs would reflect the achievement in terms of climate change adaptation in their sectors. Incentives shall be put in place for the different sectors to work together to achieve the KPIs. Stakeholders further suggested that the Public Service Commission (PSC) reviews the DG and staff job descriptions (or, alternatively, puts DGs under contract) and reviews their performance regularly.
- Form a new Ministry or Department responsible for climate change:

- Form a new 'Department of Climate Change', which could sit, for instance, within either the Ministry of Lands or the Ministry of Public Utilities. (Some stakeholders warned, however, that forming a separate ministry for climate change could be counterproductive if it just adds another layer of bureaucracy without leading to much improvement in the take up of climate change issues by the different sectors.)
- Form a Ministry of Natural Sciences, which would be responsible for climate change, water, energy and other relevant topics.

While the large number of options suggested by stakeholders reflects the divergent visions of Vanuatu's climate change institutional environment, there are also significant commonalities. All stakeholders agree that the new institutional arrangement should reflect that climate change is a development issue, not just an environmental issue. As a result, responsibility for climate change should be established at a high level in government with decision-making power.

Further actions to strengthen governance arrangements and institutions may include, but are not limited to, the following:

- Mainstreaming of adaptation: It is recommended that the process of mainstreaming climate change adaptation into sectoral policies, strategies, plans and programmes be continued, and that the necessary resources be made available. In this context, stakeholders have suggested that the PAA be reviewed with a view to improving the 'visibility' of climate change and DRR/DRM, and that the review result in practical actions towards these goals.
- Modify adaptation funding arrangements: In the first instance, the Ministry of Finance and Economic Management, and other bodies with budgetary decision-making power, should become involved in, and share responsibility for, adequately responding to climate change and support the effective and efficient implementation of the NCCAS. Then, in order to make the implementation of adaptation more effective and efficient, stakeholders suggested that the Finance Department screen all sectoral budgets, business plans and proposal to ensure climate change adaptation has been taken into account and, where that is the case, distribute funding according to the needs (recommended to follow OECD climate lens guidelines for budget processes, see Box 2).
- Due to the cross-sectoral nature of adaptation, it is also important to strengthen cooperation between different sectors and to reduce competition for funds. Stakeholders mentioned joint programming as particularly effective in implementing activities through shared responsibility and effective allocation of resources.

Box 2

APPLYING A CLIMATE LENS TO PROPOSED SECTORAL PLANS AND RESOURCE ALLOCATION

A climate lens should be applied to the proposed sectoral plans to assess climate risks and/or opportunities and potential responses. An important measure may be to revise existing guidelines and criteria used to assess plans proposed by sectoral ministries, with a view to adding climate change concerns. The application of a climate lens to proposed sectoral plans should lead to better

("climate-proofed") plans or proposals and suggest modifications if required.

The resource allocation stage corresponds to the translation of operational action into budgets. National budgets and, in some countries, Medium Term Expenditure Frameworks (MTEFs[9]) constitute the main instruments at this level. The national budget is spread across the different sectors and thus determines the budget envelope that each sector has to implement in its sector-level development plans. […]

The national budget is the main instrument for operationalising a government's policy. […] The specific interventions that are required at the resource allocation stage within the national policy cycle would consist of:

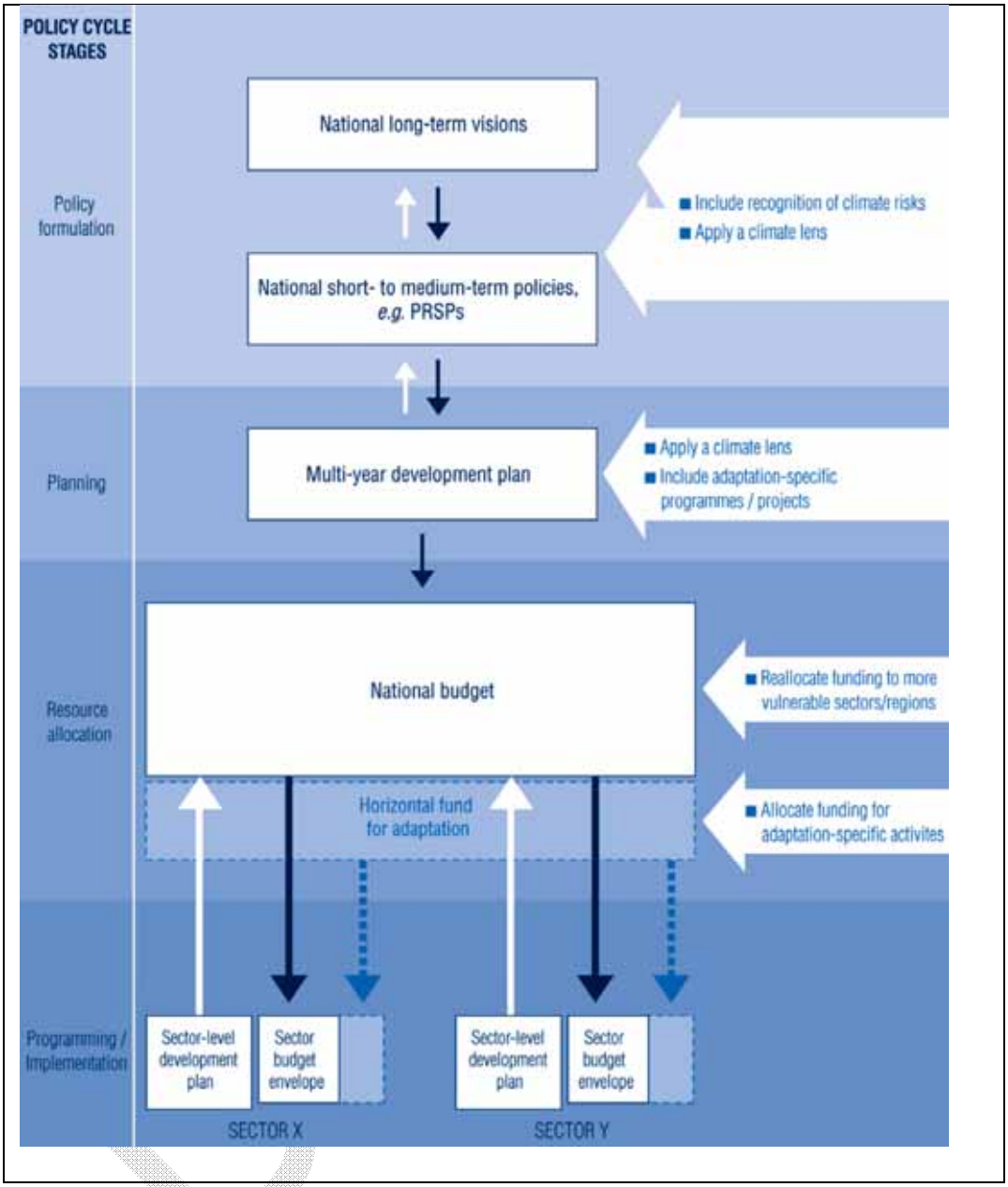
Reallocating funding to more vulnerable sectors or regions or increase the budget for these regions: The climate lens should reveal key sectors and regions that will be vulnerable to climate change and which may require further funding to "climate-proof" their policies/programs and also develop specific adaptation responses/measures/programs/projects. The results from this climate lens can therefore serve to reorient to a certain extent some of the funding to more vulnerable sectors or regions, or lead to an increase in budget for some sectors and regions.

Funding for adaptation specific plans or activities: Funding adaptation may entail: (i) funding nation-wide plans specifically aimed at enabling adaptation (e.g. investment in new agricultural technologies such as more drought-resistant varieties); (ii) establishing a horizontal fund for adaptation which sectoral ministries could tap on to meet the additional costs of integrating indentified climate risks in their planned activities or investments.

The MTEF process can be used to incorporate adaptation priorities into resource allocation processes. The MTEF may need to be reviewed to determine if climate change adaptation priorities have been appropriately integrated into medium-term spending plans.

The following figure provides an overview of the main interventions for climate change adaptation at the national policy cycle.

9 Medium-term expenditure frameworks are a budget programming tool for planning actions and programming spending over a three to five year period, thereby translating policies into budgets.



Source: OECD (2009).

- Strengthening of other important ministries and services: For example, adaptive capacity within the Ministry of Land and Natural Resources will need to be strengthened in order to ensure that land policies, laws and management practices take climate change risks and impacts into account. In addition, the Vanuatu Meteorological Service (VMS) should be strengthened through an increase in human and financial resources (see also Box 3).

Box 3

CAPACITY BUILDING ISSUES FOR IMPLEMENTING THE UNFCCC: RESEARCH AND SYSTEMATIC OBSERVATION

Systematic observations including meteorological, hydrological and climatological services have been very, very good in Vanuatu especially at the VMS. As an important component in the overall monitoring of climate and weather conditions, the VMS has data dating back more than five (5) decades. What has been lacking is the analytical aspect of these variables i.e. temperatures, humidity, rainfall etc against research hypothesis. Research as a tool for decision making has never been given the recognition and resources although most government departments have research sections and even the formation of a national scientific research council (NSRC) has not improved the status of research capacity and capability in the country.

[…] research using the relevant systematic observation meteorological, hydrological and climatological data must be promoted to:

- Better understand the effects of the present climate, (climate variability) on human health, agricultural production, marine resources in order to better understand and predict the implications of climate change;
- Develop situational analysis of real potential impacts on Vanuatu's vulnerable populations (vulnerability);
- Facilitate early detection of future socio-economic effects (health, food production, food security, economic loss etc) of climate change; and
- Facilitate the formulation of relevant socio-economic development policy (Evidence-based policy and evidence- based decision making) in the context of global warming and global environmental change (adaptation and mitigation strategies).

Source: Republic of Vanuatu (2006).

b. Develop new and make better use of existing policies, laws, regulations and processes

Apart from strengthening Ministries and other government bodies, it will also be important to establish new policies, laws and processes or strengthen existing ones in order to facilitate adaptation, such as:

- Develop and implement a national climate change policy: According to stakeholders, it is important to update and adopt the existing climate change policy, or develop a new national policy for climate change. Such a policy could follow the example of the Land Sector Framework as a mulit-sectoral overarching policy and set broad goals and objectives and a road map for action[10]. Implementation would occur in the different sectors and be included in the respective sector plans.
- Strengthen the EIA process: Strengthening the Environmental Impact Assessment (EIA) instrument to become a 'two-way process' could contribute to improved adaptation. Apart from explicitly addressing climate change risks through this process by identifying those activities that will potentially exacerbate the risks posed by climate change or lead to mal-adaptation, good practice would also mean an EIA is used to determine the impact of climate change on the proposed initiative. Stakeholders have further recommended that EIAs be made a requirement before granting major loans for a development activity (preferably as voluntary best practice by the bank).
- Use regulations to facilitate adaptation by private actors: Enhanced adaptive capacity may also occur through increasing the understanding of how laws

[10] Malaysia's Vision 2020 or PNG's or Samoa's visions could also be used as a model in implementing the policy.

and legal institutions, including regulatory instruments, support or impede adaptation planning and practice. Where barriers exist, institutional reforms could be undertaken in order to reduce or remove existing obstacles and facilitate adaptation, particularly by private actors. In this context, it is recommended to also assess the potential for, and limits to, market-based adaptation measures. This may include a review of the role of the financial sector, particularly insurers and banks, in enabling climate change adaptation.

- Awareness raising and education: All ministries in Vanuatu and their staff should be made aware of the implications of climate change on the resources they are directly responsible for and other resources more widely; this includes training on the use of the new climate change information and database systems[11]. In addition, a public awareness campaign should be designed to inform the general public about existing and expected climate changes and impacts, as well as practical examples of successful adaptation measures. This campaign should be based around strong leaders and advocates and use existing education and awareness raising channels[12]
- An initiative to "green the banks", by requesting local financial institutions to agree that when they loan monies, they will encourage people to ensure their development minimizes greenhouse gas emissions (e.g. fund solar), reduces climate risk (e.g. setback from hazard areas) and enables adaptation.
- Undertake continuous monitoring and evaluation of the progress made in reducing vulnerability and increasing resilience in general, and achievement of the NCCAS objectives in particular. In this context, it will be important to revise and enhance data collection, management and sharing arrangements in order to allow for progress to be measured and strategies to be revised where they are not achieving the desired outcomes.

[11] Such as those that are currently under development by the Lands Department, the Vanuatu Meteorological Service and SPC-GIZ.
[12] Such as the Wan Smolbag's Vanua-Tai monitors approach or the Vanuatu Cultural Center's fieldworker programme

10. Action Plans **(5pp)**

[This will be prepared after the annexes are completed]

- overview of sector action plans (details in annexes)
- communication and uptake (details in annexes)
- funding (details in annexes)
- monitoring, evaluation and reporting (details in annexes)

12. Recommendations

[These will be inserted for the final draft of the NCCAS]

13. References

Hay, J.E. (2009, p. 23), *Institutional and Policy Analysis of Disaster Risk Reduction and Climate Change Adaptation in Pacific Island Countries*, Final Report Prepared for the United Nations International System for Disaster Reduction and the United Nations Development Programme, JEH+ Ltd, Rarotonga.

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Appendix 1: Summary of Findings of the CCA/DRR Institutional and Policy Analyses for Vanuatu

Level of mainstreaming of DRR in development planning processes	
National	**Local**
Disaster risk management is integrated in the PAA; a key priority and strategy is to prepare a Port Vila development plan which mainstreams climate change and disaster risk reduction measures; the National Disaster Act (2000) focuses primarily on preparedness and response arrangements for disasters; while the Act includes a definition of prevention, it is not specific about requirements and powers for addressing prevention measures.	A key priority and strategy in the PAA is developing and implementing risk reduction programs in communities; Vanuatu is the only Pacific island country recipient of the USD 65.69 million Millennium Challenge Corporation funds which focus on overcoming transport infrastructure constraints to poverty reduction and economic growth, specifically for rural areas.
Level of mainstreaming of CAA in development planning processes	
National	**Local**
Vanuatu's NAPA was adopted by Government in 2007; this determines eligibility to apply for funding for implementation under the LDC Fund, which is managed by the Global Environmental Facility; Vanuatu has also prepared a discussion paper, Climate Change Policy and Implementation Strategy; its purpose is provide a summary on climate change development in Vanuatu including future areas that the government and other stakeholders need to address, to determine the issues that had been identified over the years in particular from the First National Communication that may form the basis for a climate change policy, and to develop a preliminary climate change policy framework for consultation purposes; the discussion paper proposes a policy framework that highlights the commitment of government, through the Environment and Meteorology Departments and other government ministries, civil society and the private sector to mainstreaming climate change issues in all its environmental, social, economic, planning structures and processes for sustainable development at the national and community level.	The policy framework also highlights a commitment to proactively identify vulnerable communities, areas and assets at risk and develop adaptation options that are appropriate, cost effective and culturally sensitive in order to increase resilience; there is also a commitment to ensure effective provincial participation in the climate change process, with existing systems being used as the basis for local authority participation.
Policies and plans for DRR and how they have been translated into programmes	
National	**Local**
A number of ministries and agencies participate in disaster risk management, including Vanuatu's Meteorological Department which is responsible for day to day weather forecasting, cyclone and tsunami warnings and advisories, and long term seasonal forecasting; the Agriculture Department s involved in disaster response; the Department of Internal Affairs which coordinates responses between provincial authorities; the National Advisory Committee of Climate Change (NACC) assists in raising awareness on disaster risk reduction through its climate change core team; the Ministry of Lands and Natural Resources incorporates risk reduction into to land, water and energy planning; a National Water Strategy Plan has been prepared proposing risk assessments and vulnerability mapping; this work has commenced, but there is very little capacity to undertake it; he biggest impediment to the development of risk and vulnerability assessments and maps is a lack of climatic, hydrological and geophysical data.	Both the NAP and its Implementation Plan include provisions for extending disaster risk management to the provinces; however, lack of funding prevents implementation of the NAP. Provinces are, in theory, also mandated to prepare their own Disaster Plans which should be approved by the NDMO Director, reviewed annually, and updated as needed; but lack of action on the central NAP has prevented the creation of provincial action plans; provincial authorities are responsible for coordinating responses under the guidance of the NDMO and NDC; each village should have a disaster management committee which coordinates response at the local level, works in consultation with the provincial level and is responsible for local level damage and loss assessments; most volunteer organisations or agencies that assist civil society organisations and/or rural communities to implement DRR are involved on a voluntary basis, with this as their secondary activity; their primary focus is on service delivery and technical assistance type of work right across all the provinces of Vanuatu; the situation is improving as a result of the recent expansion of the international & local NGOs like the Red Cross and CARE who engaging communities in participatory methods of problem identification, risk analysis and action planning in Vanuatu; their objective is for communities to be empowered to organise themselves for, and manage, disasters and to build risk reduction measures into their daily development activities;
Policies and plans for CCA and how they have been translated into programmes	
National	**Local**
Vanuatu's NAPA identifies four priority sector areas:	The main output of the Vanuatu Climate Change Adaptation

agriculture and food security, sustainable tourism development, community based marine resource management and sustainable forestry management; the EU announced mid 2008 that the Vanuatu NAPA qualified for funding under its Global Climate Change Alliance, with co-Financing by the World Bank totalling VT 800 million; the project, "Enhancing coastal and marine ecosystems resilience to climate change impacts through strengthened coastal governance and conservation measures" is being executed by SPREP; a GIZ project focusing on land based resource management as a means of building resilience to climate change is being executed by the South Pacific Commission and is funded by GIZ to a total of Euro 1.4 million.	Project is a rainwater harvesting project on the island of Aniwa in the southern province of Tafea; the Vanuatu component of the PACC project will focus on climate proofing coastal infrastructure with Epi island as the pilot site.
Institutional arrangements for DRR	
National	
Disaster risk management is housed in the Ministry of Internal Affairs, which supports the National Task Force (NTF) for Disaster Risk Reduction and Disaster Management; the NTF comprises representatives of departments with a role in disaster risk management and is co- chaired by the Director of the Meteorological Service and the NDMO; the NTF takes a proactive as well as reactive approach – thus it does not meet solely in response to a disaster events; the National Disaster Committee (NDC), established by the National Disaster Act, is tasked with developing the country's disaster risk reduction policy and strategy; it is made up of representatives of relevant government agencies and three NGO representatives; the National Disaster Management Office is its secretariat; the NDMO is tasked with implementing the strategies and policies of the NDC; however, the NDMO has no powers to require other agencies to act on any identified prevention measures; the NDC coordinates response and recovery activities including coordination with donors.	
Institutional arrangements for CCA	
National	
Climate change activities are coordinated by the NACCC; the NACCC is formally recognized by the Vanuatu's Council of Ministers to implement a Multilateral Environmental Agreement for the government; NACCC is made up of department heads, including the NDMO Director, and chaired by the Director of Forestry; the Director of the Meteorological Services is co-chair of the National Task Force for Disaster Risk Reduction and Disaster Risk Management; the Climate Change Unit in the Department of Meteorological Services functions as the Secretariat of the NACCC; there is a plan for the NACCC to establish a National Group of Experts to do research on environmental change issues, particularly on climate change, affecting the country and periodically report to the NACCC on its findings.	
Level of integration of DRR/CCA policies and institutions, incl. drivers and barriers	
National	
The NTF for DRR and DM is co-chaired by the Director of the Meteorological Service (who has overall responsibility for the governments climate change activities) and the NDMO Director; a key priority and strategy in the PAA is to prepare a Port Vila development plan which mainstreams climate change and disaster risk reduction measures; lack of understanding of climate change and variability issues and DRR in the higher echelons of governance is still a major constraint leading to a lack of coordinated approach to addressing climate related risks; financial and human constraints are a major concern to line departments such as both Meteorology and Environment that are dealing with climate related issues and at present have depended largely on donor assistance to fund on-going activities at the national and community level.	

Source: Hay, J.E. (2009), *Institutional and Policy Analysis of Disaster Risk Reduction and Climate Change Adaptation in Pacific Island Countries*, Final Report Prepared for the United Nations International System for Disaster Reduction and the United Nations Development Programme, JEH+ Ltd, Rarotonga.

Strategy No	Major Impact	Sector	Sector Impact	Adaptation Strategy Specific	Notes, Examples, Recommendations, Advice
1	Cyclone	Agriculture	Crops are killed	After a cyclone, pile tubers and fresh foods in a hole, the foods will begin to rot, but moisture will eventually drain out and the dried foods can be eaten	practiced in Big Bay Santo
2	Cyclone	Agriculture	Crops are killed	After a cyclone, bring Fiji taro to bush kitchen, keep in a dry place, and constantly rotate so that is does not constantly lay on one side	can last for months
3	Cyclone	Agriculture	Crops are killed	dry	Yams can last for many months. (e.g. Uripiv island)
4	Cyclone	Agriculture	Crops are killed	Practice fruit drying	-
5	Cyclone	Agriculture	Crops are killed	Practice preserve/jam making	-
6	Cyclone	Agriculture	Crops are killed	Dry nangai and natapoa for long term usage	Big Bay Santo
7	Cyclone	Agriculture	Crops are killed	Dry breadfruit for long term use	Banks and Torres
8	Cyclone	Agriculture	Crops are killed	Produce flour for long term use	Manioc- Paunangisu
9	Cyclone	Agriculture	Crops are killed	Collect wild tubers for consumption after cyclones	Examples of bush tubers from Santo, Erromango and Tanna
10	Cyclone	Agriculture	Salt Spray will damage crops	Utilize Salt Resistant Crops	-
11	Cyclone	Agriculture	Salt Spray will damage crops	Protect gardens by building physical ocean barriers etc.	not especially effective with sea level rise projections
12	Cyclone	Agriculture	Wind physically damages crops	Plant gardens within forest wind breaks, or plant windbreaks to protect sensitive crops (glyricidia)	the coastal strip should not be used for anything but recreation/gathering etc. No gardening, residence building or clearing to protect against storm surge etc
13	Cyclone	Agriculture	Wind physically damages crops	Avoidance of agricultural activities in the immediate coastal strip	-
14	Cyclone	Agriculture	Wind physically damages crops	Plant leafy crops in gardens that are well sheltered from winds (e.g. valleys etc)	-
15	Cyclone	Agriculture	Wind physically damages crops	Plant root crops in exposed areas	-
16	Cyclone	Agriculture	Wind physically damages crops	Cut the leaves of bananas prior to a cyclone to prevent uprooting	-
17	Cyclone	Agriculture	Wind physically damages crops	Cut the stems of manioc prior to a cyclone to prevent uprooting	-
18	Cyclone	Agriculture	Wind physically damages crops	Introduce Dwarf Varieties of manioc that will be less susceptible to wind damage	-
19	Cyclone	Agriculture	Wind physically damages crops	Remove yam stakes during pre cyclone preparations	-
20	Cyclone	Agriculture	Wind physically damages crops	Utilize early harvest varieties of yam (6 months) that can be harvested before cyclone season	-
21	Cyclone	Environment	Direct damage to ecosystems or flora and fauna	Physically remove any creeping vines or invasives that threaten to colonize a damaged forest	In Vathe Santo they use environmentally benign chemicals (not affect other plants via spraying, but use injection) – 5 different trials completed: Weed Master best; and hand cutting works to slow growth but will require ongoing maintenance)
22	Cyclone	Environment	Direct damage to ecosystems or flora and fauna	Pick up fallen/injured birds and animals and look after them until they are able to be released again	-
23	Cyclone	Environment	Direct damage to ecosystems or flora and fauna	Provide wild animals with fallen fruits	e.g. fruit bats and flying foxes will be searching for available foods.
24	Cyclone	Forestry	Change in wood properties and timber quality (twisting, compacting etc)	Employ and train stakeholders on wood technologies to correct timber defects	-
25	Cyclone	Forestry	Change in wood properties and timber quality (twisting, compacting etc)	Find markets for deformed products	clocks, carvings, furniture etc.

Strategy No	Major Impact	Sector	Sector Impact	Adaptation Strategy Specific	Notes, Examples, Recommendations, Advice
26	Cyclone	Forestry	Change in wood properties and timber quality (twisting, compacting etc)	Develop guidelines and training on the utilization of durable and lesser known species for construction	-
27	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Practice pollarding/topping to enhance for wind resistance in key species	This technique works well with young natapoa
28	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Prune and thin planted forests before a cyclone	-
29	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Prop young trees with braces to enhance wind resistance	-
30	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Establish green belts/wind breaks around and within planted forests	Casaurina sp work well as windbreaks
31	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Practice proactive management of forests (remove old, dead, diseased species that may cause damage during cyclones	-
32	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Selectively harvest large, cyclone-vulnerable trees and allow small trees to remain.	-
33	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Establish seed orchards in cyclone-resistant and secured locations	-
34	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Take out insurance on planted forests and forestry equipment	-
35	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Identify and plant dwarf fruit trees	-
36	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Identify and encourage plantation establishment in areas less affected by cyclones	-
37	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Discourage introduction of foreign tree species with low wind tolerance	-
38	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Plant local, endemic, long-cyclone resistant species	E.g. whitewood
39	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Establish permanent sample plots to investigate the impacts of cyclones of certain forests and tree species	-
40	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Practice enrichment planting in cyclone/storm affected forests	-
41	Cyclone	Forestry	Damage to planted forests (wind damage, breakage, toppling)	Develop plans and products that utilize (re use) cyclone-damaged trees and branches	-
42	Cyclone	Livestock	Animals are Killed	Freeze Excess meat where possible	-
43	Cyclone	Livestock	Animals are Killed	Preserve Meat using traditional bamboo cooking methods	Bullock meat can be preserved by slightly cooking (removing blood), and then baking inside a bamboo tube (the softest/weakest kind of bamboo). The tube must be hung in a dry place, and continuously re-heated. The preserved bullock meat can last for several weeks up to a month.
44	Cyclone	Livestock	Animals are Killed	Preserve Meat using salting methods	Bullock meat can be preserved by salting. Heavily salted and dry meat is packaged into an airtight container and can last for up to a month.

Strategy No	Major Impact	Sector	Sector Impact	Adaptation Strategy Specific	Notes, Examples, Recommendations, Advice
45	Cyclone	Livestock	Animals are Killed	Preserve Fish using multiple canning methods	Can be preserved in sterilized jars using chili, oil, curry, ginger and onion for up to a month
46	Cyclone	Livestock	Animals are Killed	Preserve Fish using smoking and drying methods	Fish can be smoked which may last up to 3 days
47	Cyclone	Livestock	Animals are Killed	Preserve Fish using traditional breadfruit leaf baking methods	Freshwater fish may be baked in tightly wrapped breadfruit or laplap leaves and last for up to a week
48	Cyclone	Livestock	Physical Damage to Animals	Ensure that farmers have at least one area that can be used as a 'cyclone pasture' (open with no nearby trees)	During cyclones, airborne and falling branches and trees pose a major threat to animals
49	Cyclone	Livestock	Physical Damage to Animals	Farmer should have or make arrangements to have access to multiple pastures/grazing sites that will each be appropriate for a different climate situations	not overly affected by exposure to strong winds, thus there is no need to bring the animals inside shelters or other structures.
50	Cyclone	Livestock	Physical Damage to Animals	Follow storm warnings/advisories to move herd to safe locations (out of wind)	For example, on Pentecost- farmers bring their herds down from exposed hillsides into the sheltered valleys below).
51	Cyclone	Livestock	Physical Damage to Animals	Avoid fastening animals with ropes to fixed objects during cyclones	-
52	Cyclone	Livestock	Physical Damage to Animals	Keep smaller animals inside a strong enclosure during cyclones	-
53	Cyclone	Livestock	Physical Damage to Animals	Allow larger animals to roam free to find adequate shelter during a cyclone	-
54	Cyclone	Livestock	Physical Damage to Animals	Keep animals out of/ remove animals from known swampy or low lying coastal areas in preparation for a cyclone	-
55	Cyclone	Livestock	Physical Damage to Infrastructure	Thoroughly inspect all bullock fencing before a cyclone to cut out any living branches on posts (i.e. purao fences)	strong winds will catch the branches and then begin to root out the fence posts.
56	Cyclone	Livestock	Physical Damage to Infrastructure	Avoid corrosive fencing materials (i.e. barb wire)	An example of major pasture and fence damage by salt can be seen at VLD
57	Cyclone	Livestock	Physical Damage to Infrastructure	Allow glycine to grow over barbed wire fences to provide a physical barrier to salt exposure	-
58	Cyclone	Livestock	Salt Spray will damage pastures	Plant less susceptible grasses like Glycine, Signal, Guinea and Koronea grasses which may be affected by salt for 2-3 weeks after the storm, but then will recover.	If the pasture fences are located very near the sea (and less than 50-100meters), there is a high chance that salt-spray will impact (corrode) the barb wire and the kill the pasture grass during major storms and winds
59	Cyclone	Livestock	Salt Spray will damage pastures	Plant wind breaks near pastures that are coastal, already salt tolerant species	The Department has tried several windbreak species (purao, pine, cylindrica) but nothing yet has been able to quell the impacts of salt spray.
60	Cyclone	Water	Overflowing creeks/rivers damage some piping infrastructure	Raise/elevate river creek crossings highly	-
61	Cyclone	Water	Overflowing creeks/rivers damage some piping infrastructure	Bury/lower river/creek crossings well underground	-
62	Cyclone	Water	Overflowing creeks/rivers damage some piping infrastructure	If possible, have water pipes cross rivers/creeks at less vulnerable points up or down stream	even if not a direct piping course
63	Cyclone	Water	Overflowing creeks/rivers damage some piping infrastructure	Use local knowledge of cyclone vulnerable areas when laying water pipes/infrastructure	In Futuna regarding land slide problems, serious damage to water infrastructure could have been avoided if engineers had followed local guidance
64	Cyclone	Water	Sediments and Debris contaminate water supply	Use spring boxes around sources , to ensure nothing gets into the source itself	-

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65	Cyclone	Water	Sediments and Debris contaminate water supply	Close down inlets to water into tanks before a storm, reopen after event	-
66	Cyclone	Water	Sediments and Debris contaminate water supply	Ensure there is enough water storage for use during and after the storm events	-
67	Cyclone	Water	Sediments and Debris contaminate water supply	Practice regular water monitoring	An accurate system must advise when to drink from a possibly contaminated water source or when to wait. Need a PH logger inside the water sources as an indicator
68	Cyclone	Water	Sediments and Debris contaminate water supply	Ensure the manhole in ferro cement tanks is fitted perfectly to avoid ash fall or other contaminants entering the tanks	On Tanna the tank hole covers do not fit, and debris is able to wash into the tank
69	Cyclone	Water	Sediments and Debris contaminate water supply	Do not glue in the downpipe of the tank, must be able to pull out as needed before storms	-
70	Cyclone	Water	Sediments and Debris contaminate water supply	Rain water tanks should use a T joint (first flush system) so that all contaminants are flushed away before water is collected	-
71	Cyclone	Water	Sediments and Debris contaminate water supply	Close off water sources before a cyclone events to prevent flooding, contamination, especially to crop irrigation areas	-
72	Cyclone	Water	Sediments and Debris contaminate water supply	Use sediment filtration boxes to purify water	On Pentecost- Ranwati school- built 3 sediment filtration boxes, successful, not too expensive 100,000vt for the whole system) built with plywood and cement
73	Cyclone	Water	Sediments and Debris contaminate water supply	Use slow sand filters for the best filtration of contaminated water	slow sand filters may be effective, however need a very large filter for a good flow of water (community size)
74	Cyclone	Water	Sediments and Debris contaminate water supply	Design the simplement water filtration systems for Vanuatu sustainability	systems will require training and maintenance, which is already a problem here for simpler in Vanuatu systems
75	Cyclone	Water	Sediments and Debris contaminate water supply	Boil water to kill microorganisms and may also reduce this bad 'tank' taste	Rainwater tanks may provide water that is not as tasty as those used to drinking from fresh springs etc
76	Cyclone	Water	Sediments and Debris contaminate water supply	Do not rely on a single source of water; have several backups	may be expensive unfeasible for communities/household to have both piped supply AND rainwater tanks
77	Cyclone	Water	Sediments and Debris contaminate water supply	Undertake monitoring of water sources after cyclone, to target assistance	-
78	Cyclone	Water	Sediments and Debris contaminate water supply	Encourage self sufficiency and self help and local disaster response	-
79	Cyclone	Water	Sediments and Debris contaminate water supply	Mainstreaming hazard assessment and risk management into the current plans and policies	water safety planning and IWRM
80	Cyclone	Water	Water sources are destroyed directly	User change technical designs of sources to be cyclone proofed	New designs are now available, changed in 2000, better for high wind, including suggested materials to build tanks etc
81	Cyclone	Water	Water sources are destroyed directly	Ensure that tank catchment roofs are securely fastened before a storm	Often water tank withstands the winds, but catchment roofing is lost
82	Cyclone	Water	Water sources are destroyed directly	Small dams & spring boxes may be used so the source itself is not buried	-
83	Cyclone	Water	Water sources are destroyed directly	Adjust the design of the intake box	G&M may be beginning a trial on Malo, but no national design has been validated yet
84	Cyclone	Water	Water sources are destroyed directly	Promote underground tanks that are not susceptible to winds	-
85	Cyclone	Water	Water sources are destroyed directly	Use strong ferro cement tanks that will not move in wind	may be vulnerable to tree and debris damage

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86	Cyclone	Water	Water sources are destroyed directly	Do not use light plastic polytanks in cyclone exposed areas	polytanks
87	Cyclone	Water	Water sources are destroyed directly	Keep water source areas cleared, cut old branches and remove possible debris to protect infrastructure	-
88	Cyclone	Water	Water sources are destroyed directly	Build sea walls/other barriers around exposed coastal spring sources	Matantas- storm surge permanently damaged coastal source
89	Drought	Agriculture	Crops are exposed to excessive sunlight	Intercrop with valuable trees	With too much sun, crops/fruits are not yet mature but the crop leaves/fruits dry and dies
90	Drought	Agriculture	sunlight	Intercrop taro with trees that will provide some sunlight penetration	Note: taro requires good sunlight to thrive
91	Drought	Agriculture	sunlight	Intercrop kumala with banana to provide shade	Intercrop kumala with banana to provide shade
92	Drought	Agriculture	Crops are exposed to excessive sunlight	Intercrop trees with banana to provide shade	impacts of excessive heat and sunlight on bananas include: The fruit is very small when it ripens, Offshoot suckers do not bear fruit as much as the mother stalk, the inside of the ripe-looking banana is rotten, the stalk of the banana becomes dry and the stem looses turgor and falls down, root rot kills the banana
93	Drought	Agriculture	sunlight	Practice alley cropping with nutrient providing trees like glyricidia	Appropriate for most crops inc: Taro , manioc, kumala
94	Drought	Agriculture	sunlight	Plant taro under green net (60-80% sunlight) shade cloth	likely very expensive
95	Drought	Agriculture	Crops are exposed to excessive sunlight	Use live staking of yam leaves, so that the live supports will provide shade to the yam plant	-
96	Drought	Agriculture	sunlight	Grow sensitive crops in protected nurseries	-
97	Drought	Agriculture	Crops do not have sufficient water	Use mulching around crops to trap moisture	Appropriate for most crops inc: Taro , manioc
98	Drought	Agriculture	Crops do not have sufficient water	Use compost around crops to trap moisture	-
99	Drought	Agriculture	Crops do not have sufficient water	Rotate crops inside disused livestock pastures to take advantage of manure fertilizers	-
100	Drought	Agriculture	Crops do not have sufficient water	Place manure on and around the stems of crops	
101	Drought	Agriculture	Crops do not have sufficient water	Utilize mucuna and other crops to cover and replenish soils	Appropriate for most crops inc: Taro , manioc
102	Drought	Agriculture	Crops do not have sufficient water	Use cover crops for at least 3 years on degraded soil before planting dry land taro	Cover crops should be used for at least 3 years on degraded soil before planting dry land taro
103	Drought	Agriculture	Crops do not have sufficient water	Practice minimum tillage of soils before planting, which will hold soil moisture and nutrients	-
104	Drought	Agriculture	Crops do not have sufficient water	Plant heat and sun tolerant varieties of Taro like navia and taro with small leaves, and leaves pointed down away from the sun.	-
105	Drought	Agriculture	Crops do not have sufficient water	Select for manioc varieties with smaller leaves and those that grow shorter	may be available at VRTC
106	Drought	Agriculture	Crops do not have sufficient water	Select for manioc varieties that are drought resilient	W. Coast Manioc or some used in custom, which are drought resistant , although these can be quite strong to grate and tougher to eat when cooked.
107	Drought	Agriculture	Crops do not have sufficient water	Select for yam varieties that produce minisetts (small tubers that do not easily rot or dry out)	-
108	Drought	Agriculture	Crops do not have sufficient water	Encourage the domestication of wild yam varieties that are climate resistant	-
109	Drought	Agriculture	Crops do not have sufficient water	Utilize drought resistant varieties of island cabbage (e.g. red vein cabbage, not white).	-

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110	Drought	Agriculture	Crops do not have sufficient water	Encourage more planting of Vietnam/Chinese Banana as a hardy and drought resilient variety	-
111	Drought	Agriculture	Crops do not have sufficient water	Select drought and sun resistant vegetables (e.g. beans, white bun/Chinese cabbage, lettuce, tomatoes, pumpkin, capsicum, cucumber, spring onions)	-
112	Drought	Agriculture	Crops do not have sufficient water	Use grafting techniques resilient varieties	-
113	Drought	Agriculture	Crops do not have sufficient water	Practice targeted irrigation around the roots of the crop	may be cost intensive. Appropriate for most crops inc: Taro , manioc
114	Drought	Agriculture	Crops do not have sufficient water	Irrigate individual high value plants, with bucket or other means	-
115	Drought	Agriculture	Crops do not have sufficient water	Irrigate individual high value plants, with bucket or other means	-
116	Drought	Agriculture	Crops do not have sufficient water	Be conscious of the timing for planting of Taro before drought plant 5-6 month Taro that will be ready for harvest and immune to the dry season.	especially el Niño event forecasts
117	Drought	Agriculture	Crops do not have sufficient water	Follow and act on Meteo climate advisories: el Niño la Niña	-
118	Drought	Agriculture	Crops do not have sufficient water	Plant yams before the onset of a major drought event	Yam is usually resistant to water shortage but must be already in ground when drought begins
119	Drought	Agriculture	Crops do not have sufficient water	Plant island cabbage every 2 months to ensure that seasonality will not affect all plants at all stages of cabbage growth	-
120	Drought	Agriculture	Crops do not have sufficient water	Relocate garden site to more moist/shaded area	The fruit is not yet mature but the banana dries and dies as if were time for harvest
121	Drought	Agriculture	Crops do not have sufficient water	Allow several years of garden fallow before replanting in the same area	-
122	Drought	Agriculture	Crops do not have sufficient water	Use permaculture in order to continuously protect soils from excessive drying and overheating	-
123	Drought	Agriculture	Crops do not have sufficient water	Do not burn gardens as cleaning methods, rather weed and leave grass as a mulch to hold soil moisture and nutrients	-
124	Drought	Agriculture	Crops do not have sufficient water	Avoid Garden clearing or maintenance to allow moisture retention	-
125	Drought	Agriculture	Crops do not have sufficient water	Use multiple farming systems (mulching, alley cropping, mix planting etc)	-
126	Drought	Agriculture	Crops do not have sufficient water	Plant water sensitive/needy plants around water giving plants like nangalat and banana	-
127	Drought	Agriculture	Crops do not have sufficient water	Remove all but two young banana shoots away from the mother tree and replant in a different area (to relieve water stress during dry seasons)	-
128	Drought	Agriculture	Crops experience die off	Preserve Taro suckers in household nurseries	-
129	Drought	Agriculture	Crops experience die off	Collect taro seeds and sow to encourage new varieties, maintain biodiversity, and find climate resistant strains.	-
130	Drought	Agriculture	Crops experience die off	Practice Tissue Culture in research stations to preserve genetic diversity and climate resilient varieties	-
131	Drought	Agriculture	Crops experience die off	Bury planting materials to preserve them during dry and hot times	-
132	Drought	Agriculture	Crops experience die off	Utilize store bought/chemicals fertilizers to enhance productivity	-
133	Drought	Agriculture	Crops experience die off	Utilize custom fertilizers and manures to enhance productivity	-
134	Drought	Agriculture	Crops experience die off	Utilize all parts of vegetables (e.g. pumpkin fruit and leaf tops, sutsut fruit and shoots)	-
135	Drought	Agriculture	Crops experience die off	Utilize traditional vegetable crops (ferns or vines)	-

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136	Drought	Agriculture	Crops experience die off	Take stock of and re-promote traditional foods	Tubers in Erromango, Tanna and Santo that are collected when other tubers die
137	Drought	Environment	Water in streams and pools becomes stagnant	Introduce freshwater namarai to stagnant pools	Namarai- dig holes in the mud, die when dry. _ the namarai help the flow of water with their digging (aeration). Can be a solution for dead water. Say namarai can pull water
138	Drought	Environment	Water in streams and pools becomes stagnant	Physically move animals from drying streams to others that are running	use buckets to relocate snails, slugs, naura, freshwater fish
139	Drought	Environment	Water in streams and pools becomes stagnant	Channel water from consistent source for sensitive animals in drying pools	Freshwater Fish eggs may dry out when rivers are dry
140	Drought	Environment	Water in streams and pools becomes stagnant	Clean water sources of debris/obstruction to allow flow of water to drying aquatic habitats	-
141	Drought	Environment	Water in streams and pools becomes stagnant	Build water storage areas (dams etc) for vulnerable species	-
142	Drought	Environment	Water in streams and pools becomes stagnant	Establish protected areas/tabus to control other threats to drought stressed animals and plants	often protected areas are too small to adequately protect these flora and fauna
143	Drought	Forestry	Change in timing of fruiting seasons	Utilize green houses for enhanced/controlled fruit production	Fruit trees may be improved in dry conditions (sweetness and abundance)
144	Drought	Forestry	Change in timing of fruiting seasons	species	-
145	Drought	Forestry	Food web, flora association, and symbiotic species disruptions	Undertake ecosystem enrichment planting	-
146	Drought	Forestry	Food web, flora association, and symbiotic species disruptions	Identify and focus on sensitive/vulnerable ecosystems for management	-
147	Drought	Forestry	Reduction in germination rates	Undertake artificial germination of important species (nursery)	-
148	Drought	Forestry	Reduction in germination rates	Collect and store wildings for replanting	-
149	Drought	Forestry	Tree Death	practice species site selection	e.g. sandalwood on dry sides of islands
150	Drought	Forestry	Water-catchments and watersheds dry up	Provide awareness on the importance of water catchment areas for water quality	-
151	Drought	Forestry	Water-catchments and watersheds dry up	Establish protected areas over sensitive water catchments	often communities seek benefits from CA with unrealistic tourism aspirations (E.g. Vathe CA Santo)
152	Drought	Forestry	Water-catchments and watersheds dry up	Reforest and rehabilitate forests within sensitive watershed and catchment areas	-
153	Drought	Forestry	Water-catchments and watersheds dry up	Place and enforce buffer zones around streams and water sources	-
154	Drought	Forestry	Wilting of tree leaves/stems, loss of productivity	Establish site specific water guidelines for each species to ensure planting in right location	-
155	Drought	Forestry	Wilting of tree leaves/stems, loss of productivity	Implement irrigation systems on commercial properties	-
156	Drought	Forestry	Wilting of tree leaves/stems, loss of productivity	Irrigate individual high value individual trees, with bucket or other means	-
157	Drought	Forestry	Wilting of tree leaves/stems, loss of productivity	Introduce desalination/distillation for irrigation in dry coastal communities	-

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158	Drought	Forestry	Wilting of tree leaves/stems, loss of productivity	Develop and expand water storage facilities/infrastructure (water tanks and reservoirs)	-
159	Drought	Forestry	Wilting of tree leaves/stems, loss of productivity	Identify and relocate vulnerable species to wetter locations.	see matrix for forest species
160	Drought	Livestock	Animals are exposed to excessive sunlight	Plant shade trees around and within bullock and pig pastures/enclosures	Plant leguminous trees. Kasis and Glyricidia double as food for cows, Purao is good for shade. Napanga may provide shade but there exists a worry that cyclones will break branches which could affect on animals. Rain tree is an excellent shade tree- but is invasive (Buffalo grass can be grown underneath). Coconuts may provide some shade.
161	Drought	Livestock	Animals are exposed to excessive sunlight	Keep forested/shade/reserve areas within the farm, so that during drought times, animals can be moved into these cooler naturally moist areas	-
162	Drought	Livestock	Animals are exposed to excessive sunlight	Bullock may be grazed in the open, but for resting should be brought into forests	-
163	Drought	Livestock	Animals are exposed to excessive sunlight	Build special houses for pigs to have an appropriate balance of exposure and shelter	Michelle Furet has built a house for night time, during the day, they run in a paddock (fenced) glycine pasture. Pele Island GIZ project site
164	Drought	Livestock	Animals are exposed to excessive sunlight	Select shady sites for pig enclosures	Lawrence- use the nambanga roots as good shade areas for pigs
165	Drought	Livestock	Animals are exposed to excessive sunlight	Provide shade over the chicken fence, either with normal housing roof material or trees.	The shade trees used should also be edible (manioc) .
166	Drought	Livestock	Animals do not have sufficient drinking water/food	Provide bullock with bore hole wells within pastures	may be very cost intensive
167	Drought	Livestock	Animals do not have sufficient drinking water/food	Provide dishes of water, cement pools inside pig fence	Pigs don't need as much water as bullock
168	Drought	Livestock	Animals do not have sufficient drinking water/food	Provide bullock with water dumps within pastures (Dig trenches to hold water)	E.g. in Elgres, a trench was dug and lined with plastic sheeting, but soon afterwards the bullock entered the trench and broke the plastic
169	Drought	Livestock	Animals do not have sufficient drinking water/food	Proactively move animals (bullock, pigs, goats etc) close to rivers, streams and water sources during drought times.	-
170	Drought	Livestock	Animals do not have sufficient drinking water/food	Build cement water catchment pools within the bullock enclosure	-
171	Drought	Livestock	Animals do not have sufficient drinking water/food	Provide water to chickens in dishes inside of the fence	-
172	Drought	Livestock	Animals do not have sufficient drinking water/food	Practice compositing inside the chicken fence, to keep soil moisture and also attract food insects	-
173	Drought	Livestock	Animals do not have sufficient drinking water/food	Design bullock pastures so that streams and other water courses pass through them	this may cause environmental concerns downstream and with water quality
174	Drought	Livestock	Animals do not have sufficient drinking water/food	Design bullock pastures with appropriate mix of grasses: 70% grass, 30% legume	This ratio depend on stocking rate and water content of grass used

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175	Drought	Livestock	Animals do not have sufficient drinking water/food	Utilize gravity feed water systems to bring water into the pasture	-
176	Drought	Livestock	Animals do not have sufficient drinking water/food	Use Bamboo 'pipes' to get water running into farms	Malekula as an example
177	Drought	Livestock	Animals do not have sufficient drinking water/food	Use living fences to feed and provide moisture-filled leaves for bullocks during dry times.	E.g. at Klem Hill (kaltuk, has trialed in his farm), the farmer planted Purao trees along the fence and didn't cut back the leaves. During a prolonged dry spell the bullock ate the leaves to get water. When the Steers from the 'dry' pasture were taken to the abattoir, they were almost same weight as bullock from other farms that had had access to regular water supply. Used on Santo w/ a climbing big leaf heavily variegated vine and also the Big Leaf Meremia vine.
178	Drought	Livestock	Animals do not have sufficient drinking water/food	Feed chickens with moisture rich Navarra & other fresh foods and fruits (pawpaw, mango nakavika)	-
179	Drought	Livestock	Animals do not have sufficient drinking water/food	Feed pigs with moisture rich foods like banana stem, taro , Navarra, pineapple, watermelon, climbing vines, Meremia big leaf.	Some farmers plant pineapples for pig only
180	Drought	Livestock	Animals do not have sufficient drinking water/food	Select drought resistant bullock feed varieties	elephant grass, nail grass and siratro.
181	Drought	Livestock	Animals do not have sufficient drinking water/food	Let chickens out of fence during the day to find water, but for sleeping come back inside.	-
182	Drought	Livestock	Animals do not have sufficient drinking water/food	Allow chickens to drink dew on plants outside of the fence.	-
183	Drought	Livestock	Animals do not have sufficient drinking water/food	Let pigs go into the coconut plantations and cut Navarra for them there	Let pigs go into the coconut plantations and cut Navarra for them there
184	Drought	Livestock	Animals do not have sufficient drinking water/food	Fence of plantations especially for use by pigs	On Tongoa, some landowners fence off plantations specially for pigs. also Tati Larent.
185	Drought	Livestock	Animals do not have sufficient drinking water/food	If domesticating wild pig varieties, ensure they have access to water rest areas	Wild pigs choose rainy wet spots for sleeping etc, and roam widely during drought.
186	Drought	Livestock	Animals do not have sufficient drinking water/food	Limit the water consumption of pigs to train them for leaner times	If pigs get used to having water always, during dry times they will face more issues.
187	Drought	Livestock	Animals do not have sufficient drinking water/food	During extreme drought farmer should consider reducing his stock (selling animals).	The best time to sell is at a change of seasons (wet-dry).
188	Drought	Livestock	Animals do not have sufficient drinking water/food	During dry times, the bullocks should be mating, and during the wet productive growing seasons, the animals should be calving.	-
189	Drought	Livestock	Animals suffer shortage of water and decreased productivity	Utilize drought resilient varieties of bullock	Charolais (white)- can moderately tolerate drought. , Brahman- is very good for drought (as are the local cross-breeds with Brahman)
190	Drought	Livestock	Animals suffer shortage of water and decreased productivity	Utilize drought resilient Rasta chickens	Rasta fowls may be resilient (more ventilation)
191	Drought	Livestock	Animals suffer shortage of water and decreased productivity	Utilize drought resilient African chickens	Santo farmers suggest that African and Yellow Leg are also somewhat drought resistant.

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192	Drought	Livestock	Animals suffer shortage of water and decreased productivity	Utilize fast breeding African chickens	The African fowls breed faster than the local one, can out breed and out compete, chicks have a higher survival rate than other varieties. More meat, better. But important not to lose other varieties
193	Drought	Livestock	Animals suffer shortage of water and decreased productivity	Utilize chickens for meat during drought times rather than other animals	In general chickens seem to fare better than other animals. During drought chickens are more productive, during rain, the pikinini will dies.
194	Drought	Livestock	Animals suffer shortage of water and decreased productivity	Utilize slim, lean wild chickens for drought times	Domesticated chickens have a larger size and require more water while wild chickens are very thin.
195	Drought	Livestock	Animals suffer shortage of water and decreased productivity	Domesticate wild chickens for meat but ensure robust fencing	Wild fowl is strong- but easily wanders out of the fence to the bush.
196	Drought	Livestock	Animals suffer shortage of water and decreased productivity	Utilize drought resilient varieties of pig	Wild and Local breed are best
197	Drought	Water	Shortage of drinking water	year	-
198	Drought	Water	Shortage of drinking water	Identify nationally vulnerable areas to water shortage and target these first	e.g. el Niño affects middle bush the most etc
199	Drought	Water	Shortage of drinking water	Develop national databases of water systems and supplies as a tool for decision making	already developed for tafea malampa sanma
200	Drought	Water	Shortage of drinking water	Undertake surveys of alternative water sources	-
201	Drought	Water	Shortage of drinking water	Undertake watershed mapping for land use management and forest maintenance	-
202	Drought	Water	Shortage of drinking water	Do not rely on a single source of water, use and develop multiple systems	ex at Eton, during drought the use an engine pump for ground water, possible to combine bore hole and gravity feed systems.
203	Drought	Water	Shortage of drinking water	Fill standby/reservoir tanks during wet times for use during dry times	-
204	Drought	Water	Shortage of drinking water	Use different sources systems at different types of the year	ground water to rainwater tanks according to weather pattern
205	Drought	Water	Shortage of drinking water	Physically transport water to vulnerable communities	-
206	Drought	Water	Shortage of drinking water	Relocate households to less vulnerable areas, villages, islands	People of Aneityum have had to move to Tanna for 4-5 months during drought periods
207	Drought	Water	Shortage of drinking water	Provide drought early warnings to communities	Currently Meteo gives 3 months outlook for el Niño- dry periods
208	Drought	Water	Shortage of drinking water	Improve the working relationship between Meteo and Hydrology Departments	Currently Met and Hydrology have shared rain gauges, but need to improve cooperation. In other countries the two departments are joined
209	Drought	Water	Shortage of drinking water	Improve Dept of Geology and Mines operational budget	Hydrology budget is now very low, need more operational support (with only 100,000vt./month-cant be proactive).
210	Drought	Water	Shortage of drinking water	Water authorities must put in place water conservation or saving measures & awareness	-
211	Drought	Water	Shortage of drinking water	Increase tank size	-
212	Drought	Water	Shortage of drinking water	Increase roof catchment area	-

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213	Drought	Water	Shortage of drinking water	Improve design standard to weather drought periods	Standard design of water tanks, 5L pp per day, designed for average dry season. Not for extremes. Meant for drinking and cooking only. Standard 50m2 roof, 5000L tank
214	Drought	Water	Shortage of drinking water	Need to change water storage and use behaviors and past history – through awareness	Note: most people have built tanks already for a long time, but during droughts, these old tanks designs may not be enough
215	Drought	Water	Shortage of drinking water	Develop standard tank designs for different parts of the country (north south etc)	-
216	Drought	Water	Shortage of drinking water	Develop water recommendations according to local contexts	Aniwa, no open water etc, recommend individual household tanks rather than communal ones vs. Mataso- insignificant source, hand pumps, and some tanks, but population there is declining so think about growth projections too.
217	Drought	Water	Shortage of drinking water	Ensure that direct sunlight does not penetrate water to prevent algal	-
218	Drought	Water	Shortage of drinking water	Monitor, and clean sources that have become contaminated during droughts before use again	-
219	Fire	Agriculture	Fire burns crops	Create firebreaks between bush and garden areas	-
220	Fire	Agriculture	Fire burns crops	Remove unnecessary weeds, dead trees, dry branches and dry organic litter from gardens	-
221	Fire	Agriculture	Fire burns crops	Relocate gardens away from fire prone areas	-
222	Fire	Agriculture	Fire burns crops	Burn flammable grasses around gardens in the wet season to prevent excessive fuel buildup	-
223	Fire	Environment	Death of wild animals	Throw moist plants (green) on the fire to slow and stop	if not a strong fire!
224	Fire	Environment	Death of wild animals	Revive cultural burning of grasslands	may have been a cultural practice on many islands
225	Fire	Environment	Death of wild animals	Ensure that grassland burning is not undertaken in biodiversity rich areas	coconut crabs, snakes and other ground dwelling organisms especially vulnerable
226	Fire	Forestry	Increase incidence and severity of forest fires	Utilize firebreaks and windbreaks to prevent to spread of forest fires	-
227	Fire	Forestry	Increase incidence and severity of forest fires	Discourage burning activities around forested areas during drought seasons	-
228	Fire	Forestry	Increase incidence and severity of forest fires	Practice mix cropping/planting approach to prevent spread of fire	-
229	Fire	Forestry	Increase incidence and severity of forest fires	Prescribe burning in sensitive forest areas to reduce dangerous biomass fuel buildup	-
230	Fire	Forestry	Increase incidence and severity of forest fires	Regularly weed, clean and maintain woodlots	-
231	Fire	Forestry	Increase incidence and severity of forest fires	Ensure that fire fighting equipment is accessible and available	-
232	Fire	Forestry	Increase incidence and severity of forest fires	Train forestry stakeholders on fire management and fire fighting	-
233	Fire	Forestry	Increase incidence and severity of forest fires	Plant fire resilient species (bamboo and wild thatching cane)	-

Strategy No	Major Impact	Sector	Sector Impact	Adaptation Strategy Specific	Notes, Examples, Recommendations, Advice
234	Fire	Forestry	Increase incidence and severity of forest fires	Provide awareness to forestry stakeholders and communities on the risks of forest fires	-
235	Fire	Livestock	Animals are directly affected	Do not allow chickens to roam free and lay eggs in the bush during dry season	Adult chickens may be able to avoid fires, but eggs will be affected, especially those of wild fowl
236	Fire	Livestock	Infrastructure and Pastures are burned	Use less fire prone grasses including Buffalo Grass	Guinea grass lights very easily.
237	Fire	Livestock	Infrastructure and Pastures are burned	Use steel or iron for fence posts	-
238	Fire	Livestock	Infrastructure and Pastures are burned	Use living Fence posts which do not rapidly light	-
239	Fire	Livestock	Infrastructure and Pastures are burned	Encourage some overgrazing during the dry season to prevent buildup of biomass and fuel	Grazing should reach ankle level, but not higher
240	Fire	Livestock	Infrastructure and Pastures are burned	Ensure that there is an appropriate number of stock in the pasture to remove potential fire fuel	If the numbers of bullock are few but much food remains, then a potential problem exists with fuel buildup
241	Flooding	Agriculture	Crops are infested/infected by pests and disease	Use pesticides against taro beetle and other insects	-
242	Flooding	Agriculture	Crops are infested/infected by pests and disease	Encourage existing Cultural practices that prevent pests & diseases	e.g. in Torba, before planting, a special bush rope can be buried around the garden 1 month before planting taro. The smell and scent of the rope discourages beetles from invading taro plants
243	Flooding	Agriculture	Crops are infested/infected by pests and disease	Utilize and strengthen regional networks that have experience with locally appropriate pest and disease controls	-
244	Flooding	Agriculture	Crops are infested/infected by pests and disease	Prune excess kumala leaves to control rat damage	-
245	Flooding	Agriculture	Crops are infested/infected by pests and disease	Intercrop multiple plants to control the spread of species-specific pests and diseases	-
246	Flooding	Agriculture	Crops are infested/infected by pests and disease	Treat banana nematode infestations by allowing infested roots to aerate and dry before replanting	-
247	Flooding	Agriculture	Crops are infested/infected by pests and disease	Control rat damage on tuber roots by mixing coconut with leaf of glyricidia (which acts as a rat poison)	-
248	Flooding	Agriculture	Crops are infested/infected by pests and disease	Mix concoctions of plants to create natural pesticides	Tamanu infusion water, chili infusion water, derris root infusion water, glyricidia leaf infusion. Avoid the use of synthetic chemicals for pests, but utilize traditional knowledge listed above
249	Flooding	Agriculture	Crops are infested/infected by pests and disease	Prune excess leaves of kumala and other crops to control rat damage	-
250	Flooding	Agriculture	Crops are infested/infected by pests and disease	Harvest island cabbages regularly to reduce the number of insects that accumulate around plants	Island cabbage seems to be especially vulnerable to insect damage after a storm event (may be due to loss of normal food plants)
251	Flooding	Agriculture	Crops are infested/infected by pests and disease	Remove diseased or pest-affected branches or plants	-
252	Flooding	Agriculture	Crops are infested/infected by pests and disease	To prevent whitefly infestation, select island cabbage plants that are not as leafy	-

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253	Flooding	Agriculture	Crops are infested/infected by pests and disease	Ensure that imported planting materials (from other islands/locations) are pest and disease free	-
254	Flooding	Agriculture	Crops are infested/infected by pests and disease	Use fire ashes to prevent insect damage on island cabbage: A. Sprinkle ashes on affected leaves, the leaves will die and the new shoots will be insect free B. Mix ashes with soil before planting island cabbage, acts as an infestation prevention C. Surround the cabbage stems by a ring of ashes	-
255	Flooding	Agriculture	Crops are infested/infected by pests and disease	Cover fruit bunches (bananas, guava etc) with plastic bags to prevent insect attacks	Insects often attack the fruits before they are mature
256	Flooding	Agriculture	Crops are infested/infected by pests and disease	Physically remove or kill caterpillars or other pests that are found within the garden	-
257	Flooding	Agriculture	Crops are infested/infected by pests and disease	Plant around times of the year that insects are less likely to outbreak or damage crops	-
258	Flooding	Agriculture	Crops are infested/infected by pests and disease	Weed grass and maintain gardens to remove plants that could harbor pests and diseases	-
259	Flooding	Agriculture	Crops are infested/infected by pests and disease	Use grafting techniques resilient varieties	practiced on Malekula with disease resistant cacao
260	Flooding	Agriculture	Crops are killed	Bury harvested cassava to preserve it before consumption	-
261	Flooding	Agriculture	Crops are killed	Make and Use Manioc Flour for use during wet times	-
262	Flooding	Agriculture	Crops are killed	Store harvested tubers in a cool dry place to prevent rotting before consumption	-
263	Flooding	Agriculture	Crops are killed	Collect and sow seeds to encourage genetic diversity and obtain possible climate resistant traits	-
264	Flooding	Agriculture	Crops are killed	Practice tissue culture in the laboratory	-
265	Flooding	Agriculture	Crops are killed	Plant several varieties of a single crop in order to continuously select the best and healthiest planting materials	-
266	Flooding	Agriculture	Crops are killed	Use physical barriers around gardens to prevent wind-dispersing pest intrusions	laplap leaves serve as an effective barrier
267	Flooding	Agriculture	Crops are killed	Prune kumala leaves to encourage growth of tuber	-
268	Flooding	Agriculture	Crops are killed	Prop tilting banana stems with Y stakes to prevent toppling	Topping is especially problematic when heavy rains occur after a period of drought
269	Flooding	Agriculture	Crops become waterlogged and rot in ground	Dig drainage canals in gardens to prevent pooling and flooding in gardens	-
270	Flooding	Agriculture	Crops become waterlogged and rot in ground	Practice Mix Cropping of water-sensitive crops with species that utilize lots of water and can help control water logged soils	use species with long Tap roots e.g.. Papaya or those that can quickly drink large amounts of water banana
271	Flooding	Agriculture	Crops become waterlogged and rot in ground	Alley crop water-sensitive species in-between with water-intensive species	-
272	Flooding	Agriculture	Crops become waterlogged and rot in ground	Use plastic polybags to plant vegetables that are off the ground and cannot be flooded	-
273	Flooding	Agriculture	Crops become waterlogged and rot in ground	Build mounds in gardens and plant with vulnerable root crops to keep them above flood waters	-

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274	Flooding	Agriculture	Crops become waterlogged and rot in ground	Plant crops in raised beds to prevent flooding or excess moisture	-
275	Flooding	Agriculture	Crops become waterlogged and rot in ground	Select well drained garden sites, including porous soils that do not hold water	-
276	Flooding	Agriculture	Crops become waterlogged and rot in ground	Plant along ridges or on gently sloping areas	-
277	Flooding	Agriculture	Crops become waterlogged and rot in ground	Avoid planting on flood plains or areas close to streams, creeks and rivers	Runoff, floods and landslides can easily uproot bananas
278	Flooding	Agriculture	Crops become waterlogged and rot in ground	Plant water tolerant root crops like water taro and soft mud taro	-
279	Flooding	Agriculture	Crops become waterlogged and rot in ground	Find water tolerant varieties with help from regional and national research institutions	-
280	Flooding	Agriculture	Crops become waterlogged and rot in ground	Plant bananas in water-prone areas as they grow well with a high level of moisture; good productivity	Roots can rot with excessive moisture
281	Flooding	Agriculture	Crops become waterlogged and rot in ground	Grow wet tolerant vegetable species (e.g. Susut and cucumber and eggplant)	-
282	Flooding	Agriculture	Crops become waterlogged and rot in ground	Protect crops and germinants from excessive Rainfallin greenhouses	-
283	Flooding	Agriculture	Crops become waterlogged and rot in ground	Change planting timing according to seasonal climate forecasts, especially la Niña events	-
284	Flooding	Agriculture	Crops become waterlogged and rot in ground	Harvest yams early (at the first sign of leaves turning yellow) so that they will not have a chance to rot in the groups.	-
285	Flooding	Agriculture	Top Soil is eroded	Use contour planting to prevent soil erosion during floods or storms	-
286	Flooding	Agriculture	Top Soil is eroded	Practice minimal tillage agriculture	-
287	Flooding	Agriculture	Top Soil is eroded	Utilize vetiver grasses to hold and prevent topsoil loss from gardens	-
288	Flooding	Agriculture	Top Soil is eroded	Utilize animal manure to counteract soil nutrient leeching in rainy times	-
289	Flooding	Environment	Floods wash away sensitive flora and fauna	Establish conserved buffer and creek rehabilitation zones	as in Lingarek Malekula creekside reforestation
290	Flooding	Environment	Floods wash away sensitive flora and fauna	Divert flood prone waterways away from sensitive biodiversity breeding areas	fast flowing water can wash away ground nesting birds (namalao etc)
291	Flooding	Environment	Floods wash away sensitive flora and fauna	Remove the invasive vines that are killing trees and covering the canopy that inhibits water removal/evaporation	-
292	Flooding	Environment	Floods wash away sensitive flora and fauna	Plant trees and flora that have good root systems to control, slow flood damage	Oak trees as not suitable as river erosion control species, are easily washed away
293	Flooding	Environment	Loss of endemic species	Identify and assist regeneration of water intolerant flora and fauna species	Sheflera & Capoxilon palm (gene pool tanna and south Santo) Dysolim sp. (young) dead due to excessive moisture
294	Flooding	Forestry	Change in flowering & fruiting seasons	Introduce and encourage wet tolerant species for seasonally waterlogged or low-lying areas.	-
295	Flooding	Forestry	Change in flowering & fruiting seasons	Undertake vegetative propagation to encourage rapid fruiting	use of cuttings enables fruit bearing trees to mature and bear faster
296	Flooding	Forestry	Change in flowering & fruiting seasons	Utilize hormones to induce fruiting and flowering out of season	-

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297	Flooding	Forestry	Change in flowering & fruiting seasons	Store seeds for use during low fruiting periods.	-
298	Flooding	Forestry	Change in flowering & fruiting seasons	Assess the fruiting calendars of different species in different climatic areas	-
299	Flooding	Forestry	Change in flowering & fruiting seasons	Protect of trees from rainfall/elements in green houses	-
300	Flooding	Forestry	Change in flowering & fruiting seasons	Practice anthropogenic fertilization (by hand) in cases where Rainfallinhibits natural pollination and fertilization	-
301	Flooding	Forestry	Change in flowering & fruiting seasons	Identify, select and plant varieties that fruit/flower at different times throughout the year.	-
302	Flooding	Forestry	Change in flowering & fruiting seasons	Develop and breed new rain-tolerate tree varieties	-
303	Flooding	Forestry	Change in flowering & fruiting seasons	Undertake grafting to ensure fruiting under controlled conditions	-
304	Flooding	Forestry	Increase soil erosion, landslides and nutrient loss	Discourage clearing of vegetation on steep slopes	-
305	Flooding	Forestry	Logging operations are compromised: erosion in logging area,	Use downed braches as a soil erosion/runoff break (sloped areas)	-
306	Flooding	Forestry	Logging operations are compromised: erosion in logging area,	Gravel/pave roads in logging areas	-
307	Flooding	Forestry	Logging operations are compromised: erosion in logging area,	Maintain proper crossings (streams and rivers)	-
308	Flooding	Forestry	Logging operations are compromised: erosion in logging area,	Introduce sediment catchment devices (leaves/branches or other sediment traps)	-
309	Flooding	Forestry	Logging operations are compromised: erosion in logging area,	Practice good log stacking and log piling to maintain production quality during wet times	-
310	Flooding	Forestry	Logging operations are compromised: erosion in logging area,	Use cable logging rather than bulldozers	-
311	Flooding	Forestry	Logging operations are compromised: erosion in logging area,	Shift forestry operations to dry areas/islands during prolong rainy periods.	-
312	Flooding	Forestry	Logging operations are compromised: erosion in logging area,	Appropriately zone and spatially plan logging activities within concession areas	consider where to log based on distance to mill and environmental features of terrain and climate/weather patterns
313	Flooding	Forestry	Logging operations are compromised: erosion in logging area,	Follow and plan operations according to Meteo forecasts and outlooks	-
314	Flooding	Forestry	Logging operations are compromised: erosion in logging area,	Reduce working hours/tasks during rain times	-
315	Flooding	Forestry	Logging operations are compromised: erosion in logging area,	Plan for the extra available labor during rain times, to do other jobs and functions	-
316	Flooding	Forestry	Logging operations are compromised: erosion in logging area,	Expand the use of protective gear and clothing	-
317	Flooding	Forestry	Logging operations are compromised: erosion in logging area,	Introduce forestry workplace condition standards	-

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318	Flooding	Forestry	erosion in logging area, muddy conditions, degraded roads and infrastructure, moisture & rust in equipment, machine idleness and breakdowns, wasted salaries/lost income, forgone timber harvests (economic), safety and health of workers.	Abide by the harvesting strategies outlined in the coupe harvesting plans, permits and logging agreements signed with DoF	-
319	Flooding	Forestry	Reduce forest and tree biodiversity	Practice ex situ conservation	-
320	Flooding	Forestry	Reduce forest and tree biodiversity	Relocate endemic and species of cultural importance to dyer/non-waterlog areas.	-
321	Flooding	Forestry	Reduce forest and tree biodiversity	Practice site-species matching for reforestation/rehabilitation	-
322	Flooding	Livestock	Animal feed is unavailable or productivity is reduced	Plant pasture grass species that can withstand flood conditions (para and elephant)	Para grass- on the Teouma plain and also in Tagabe copes well with flood conditions). Elephant grass is good for flood
323	Flooding	Livestock	Animal feed is unavailable or productivity is reduced	Plant pasture grass species that can tolerate water (papolo and beans)	Bullock feed varieties that are resistant to excessive moisture: papolo grass, beans etc
324	Flooding	Livestock	Animal feed is unavailable or productivity is reduced	Plant fodder tree species in pastures that tolerate water	Kasis and Glyricidia) can also be used during flood times
325	Flooding	Livestock	Animal feed is unavailable or productivity is reduced	Move bullock to less flood prone areas including hill side grazing areas, and plateaus	may have negative environmental affects
326	Flooding	Livestock	Animal feed is unavailable or productivity is reduced	Make advance arrangements where bullock could be moved in case of flooding in the primary pastures	-
327	Flooding	Livestock	Animal movement in flooded areas leads to enhanced erosion of topsoil	Remove bullock immediately from erosion-prone flooded areas	A major concern with flooding is that when the ground if wet/soft, and bullock are moving around, they are inadvertently digging the soil, which can be washed away. Further flooding combined with bullock activity can seriously erode an area of topsoil
328	Flooding	Livestock	Animal movement in flooded areas leads to enhanced erosion of topsoil	Keep bullock pastures in grass at all times to hold top soils in place during floods	-
329	Flooding	Livestock	Animal movement in flooded areas leads to enhanced erosion of topsoil	Control the pooling of water in pasture eroded depressions to combat mosquito breeding	-
330	Flooding	Livestock	Animal movement in flooded areas leads to enhanced erosion of topsoil	Do not select aggressive Brahman bullock in flood prone areas, as they dig	Brahman have a bad temperament- digs much and contributes to erosion, especially the bulls
331	Flooding	Livestock	Animal movement in flooded areas leads to enhanced erosion of topsoil	Do not select aggressive African fowl in flood prone areas, as they dig	African fowls are more aggressive, especially during feeding, and dig and forage more which may contribute to erosion
332	Flooding	Livestock	Animals develop sickness	To combat foot rot on the hooves of bullock, place stones within the paddock to trim the hooves	-
333	Flooding	Livestock	Animals develop sickness	To combat foot rot on the hooves of bullock, wash the animals in the sea	, but saltwater treatments take considerable time.

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334	Flooding	Livestock	Animals develop sickness	To treat intestinal complications when Bullock drink standing contaminated flood waters, utilize antibiotics and vaccinations	antibiotics are expensive
335	Flooding	Livestock	Animals develop sickness	To treat intestinal complications when Bullock drink standing contaminated flood waters, move bullock out of flooded pastures to other more suitable areas	-
336	Flooding	Livestock	Animals develop sickness	To treat water-related scratches on bullock skin, wash with sea water	-
337	Flooding	Livestock	Animals develop sickness	Vaccinate pigs to prevent worm buildup/burden	effective vaccination (Tanna, Epi Malakula) sent by livestock. The farmers appreciate it. Not too expensive for medication. (1 bottle 100ml- all of Vanuatu) 1ml 30 kilo live weight.
338	Flooding	Livestock	Animals develop sickness	Prevent spread of horseflies by ensuring new animals are fly free when brought in	Horse flies- (come out with high temps)- Disturbs the feeding regime of the bullock, can loose weight
339	Flooding	Livestock	Animals develop sickness	Prevent spread of horseflies by not mixing bullock and horses	-
340	Flooding	Livestock	Animals develop sickness	Prevent animal pests using store bought chemicals	NEftate farmer- tried to use mortein, but didn't work
341	Flooding	Livestock	Animals develop sickness	To prevent worm infection don't over graze grasses or overstock pastures	When the grazing is allowed to proceed all the way to the ground, bullock, Overstocking can lead to easy transmission
342	Flooding	Livestock	Animals develop sickness	To prevent worm infection, utilize improved pastures with higher growth rates	This will decrease the chances of worm infections from ground level grazing etc.
343	Flooding	Livestock	Animals develop sickness	To prevent horse rust put blanket or mat or other cover over horses (or put the animal under a shelter)	horses- skin rust- due moisture rainfall
344	Flooding	Livestock	Animals develop sickness	To treat bottle jaw on bullock (lump), undertake an Operation to remove puss	-
345	Flooding	Livestock	Animals develop sickness	To treat bottle jaw on bullock (lump), improve diet	due to worms, moisture related
346	Flooding	Livestock	Animals develop sickness	bathing)	caused by worms
347	Flooding	Livestock	Animals develop sickness	of the fowls to one that is more pristine without a build-up of worm eggs/larvae.	-
348	Flooding	Livestock	Animals develop sickness	To treat swollen eyes of chickens, use an infusion of lemon, panadol, chili or seawater	-
349	Flooding	Livestock	Animals develop sickness	To prevent the spread of mites on chickens, don't mix different size and age groups	adult chickens tend to have, and can pass mites to younger chickens
350	Flooding	Livestock	Animals develop sickness	To prevent the impacts of louse on chickens, allow them to be covered in dust and have access to dusty situations	-
351	Flooding	Livestock	Animals develop sickness	to control infections, ensure animals are eating appropriate foods	-
352	Flooding	Livestock	Animals develop sickness	To control the spread of disease from sick chickens to others in the pens, remove or quarantine sick animals	Disease travels quickly. Ma pass in the air, food etc
353	Flooding	Livestock	Animals develop sickness	Use customary legume leaves to treat disease in chickens	One legume used on Santo, leaves crushed and fed to chickens
354	Flooding	Livestock	Animals develop sickness	Promote bullock as animal of choice in flooded pastures	Bullock can be quite tolerant of flood conditions in Vanuatu (e.g. at the Tagabe farm- officers observed that Charolais could still move around and were coping well)

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355	Flooding	Livestock	Animals develop sickness	Undertake research on mositure tolerant chicken varieties	Rasta fowl may or may not be appropriate for rainy times, though there may be an adaptive characteristic with its feather type . Not enough research on precip impacts on chickens
356	Flooding	Livestock	Animals develop sickness	Ensure small chickens (chicks) have access to elevated, fully dry areas for feeding and laying	eggs, small chicks will be most affected
357	Flooding	Livestock	Animals develop sickness	Plant water absorbing trees around chicken coops	Bamboo works well and also provides an egg laying site and shade
358	Flooding	Livestock	Animals develop sickness	Lift the floors of chicken coops, raise enclosure away from ground level to prevent storm floods	also serves to reduce predation, and adds ventilation
359	Flooding	Livestock	Animals develop sickness	Ensure that pig enclosures have some permanently dry space	enclosures to have a house/roof
360	Flooding	Livestock	Animals develop sickness	Build roofing over animal coops and enclosures	cooling
361	Flooding	Livestock	Animals develop sickness	Pig enclosures sites should be selected for well draining porous soil types	Pigs can easily drown I flooded enclosures, especially piglets
362	Flooding	Livestock	Animals develop sickness	Do not place pig enclosures in known water channels/runoff areas	-
363	Flooding	Livestock	Animals develop sickness	Dig water runoff/drainage channels through flood prone pig enclosures	-
364	Flooding	Livestock	Animals develop sickness	Regularly move the location of pig enclosures so that excessive mud doesn't accumulate in their pens	-
365	Flooding	Water	Air pollution (including volcanic ash) is washed into tanks	Tanks should be conically shaped to avoid catching volcanic ash	aid post in Taniapa is an ash catchment, ash is constantly washed into tanks
366	Flooding	Water	Air pollution (including volcanic ash) is washed into tanks	Utilize cement water tanks in areas with volcanic ash to neutralize water pH	Cement tanks actually neutralize some drops in water pH
367	Flooding	Water	Damage to infrastructure (roads, water tanks/storage facilities- wooden tanks etc	Ensure proper drainage: outflow needs direction away from infrastructures and towards a safer place	-
368	Flooding	Water	Damage to infrastructure (roads, water tanks/storage facilities- wooden tanks etc	Check that hand pumps are properly sealed (at top of bore hole) to prevent contamination and back leakage	-
369	Flooding	Water	Damage to infrastructure (roads, water tanks/storage facilities- wooden tanks etc	Fully check the performance of new systems 3 months – 1 yr after construction	may be constrained by budget
370	Flooding	Water	Damage to infrastructure (roads, water tanks/storage facilities- wooden tanks etc	Build homes with cement around the base so as to prevent inundation	as in Maskellynes islands
371	Flooding	Water	Damage to infrastructure (roads, water tanks/storage facilities- wooden tanks etc	Build homes that are raised above ground level to prevent household inundation during floods	as in W. C. Santo
372	Flooding	Water	Damage to infrastructure (roads, water tanks/storage facilities- wooden tanks etc	Build walls and sea walls to prevent storm surge related flooding	e.g. Uripiv, built walls with stone, but filled cracks with Pandanus/coconut leaves to further cut the power of flowing water

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373	Flooding	Water	Damage to infrastructure (roads, water tanks/storage facilities- wooden tanks etc	Develop health guidelines on consumption and contamination by air pollution and ash	No acidity guidelines yet in Vanuatu
374	Flooding	Water	Decrease in Timber quality (moulding, insufficient drying)	Construct proper timber drying facilities to ensure timber is properly dried during rainy periods	-
375	Flooding	Water	Decrease in Timber quality (moulding, insufficient drying)	Apply chemical treatments for mould	-
376	Flooding	Water	Impacts on Forest Eco-tourism: (declines in tourist numbers, tour activities cancelled, mosquito pests, flu and sickness, infrastructure damage, transport options limited)	Plan and promote forest eco-tourism activities for dryer areas during prolonged rainy periods	-
377	Flooding	Water	Impacts on Forest Eco-tourism: (declines in tourist numbers, tour activities cancelled, mosquito pests, flu and sickness, infrastructure damage, transport options limited)	Design forest tourism activities that are rain-proof (indoor activities- greenhouses and indoor botanical gardens)	-
378	Flooding	Water	Impacts on Forest Eco-tourism: (declines in tourist numbers, tour activities cancelled, mosquito pests, flu and sickness, infrastructure damage, transport options limited)	Make personal pesticides available to tourists in mosquito-prevalent areas	-
379	Flooding	Water	Impacts on Forest Eco-tourism: (declines in tourist numbers, tour activities cancelled, mosquito pests, flu and sickness, infrastructure damage, transport options limited)	Construct tourism facilities (bungalows) with durable non-weathering timber species (not likely to rot)	-
380	Flooding	Water	Impacts on Forest Eco-tourism: (declines in tourist numbers, tour activities cancelled, mosquito pests, flu and sickness, infrastructure damage, transport options limited)	Advise tourism operators on differing weathering properties of various forest products	-
381	Flooding	Water	Increase soil erosion, landslides and nutrient loss	Discourage burning of grasslands or marginal vegetation that holds soil	-
382	Flooding	Water	Increase soil erosion, landslides and nutrient loss	Practice contour cropping/terracing	-
383	Flooding	Water	Increase soil erosion, landslides and nutrient loss	Encourage rehabilitation of bare land and areas subject to soil erosion.	Vetiver grass on Aneityum
384	Flooding	Water	Increase soil erosion, landslides and nutrient loss	Utilize site capture crops to quickly revegetate bare slopes	e.g. whitewood, namamao, pioneer species

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385	Flooding	Water	Increase soil erosion, landslides and nutrient loss	Utilize cover crops to hold soil	e.g. mucuna
386	Flooding	Water	Increase soil erosion, landslides and nutrient loss	Utilize barrier crops to trap and prevent sediments from eroding	Vetiver grass on Aneityum
387	Flooding	Water	Increase soil erosion, landslides and nutrient loss	Plant stabilizing trees on vulnerable slopes to control landslides	Narara is used on W. C. Santo to prevent land slides (custom)
388	Flooding	Water	Increase soil erosion, landslides and nutrient loss	Utilize Nitrogen fixing crops	e.g. glyricidia, kasis
389	Flooding	Water	Increased growth of weeds and invasive species	Apply local and imported herbicides (and chemical injections)	-
390	Flooding	Water	Increased growth of weeds and invasive species	Physically remove invasive species	-
391	Flooding	Water	Increased growth of weeds and invasive species	Introduce biological control of invasives	new rust being imported by Quarantine to control Mile-A-Minute vine
392	Flooding	Water	Increased growth of weeds and invasive species	Practice regular maintenance, cleaning and weeding of forest plots	-
393	Flooding	Water	Outbreaks of timber and forest pests and diseases	Identify and relocate vulnerable species that have high risk of pest and disease attack to dryer areas	-
394	Flooding	Water	Outbreaks of timber and forest pests and diseases	Practice mixed species cropping systems to prevent rapid spread of disease	-
395	Flooding	Water	Outbreaks of timber and forest pests and diseases	Apply local and imported pesticides and Insecticides	Custom plant used in Matantas Santo to surround citrus trees and treat incidences of 'ring worm'
396	Flooding	Water	Outbreaks of timber and forest pests and diseases	Introduce biological control measures	-
397	Flooding	Water	Outbreaks of timber and forest pests and diseases	Physically remove diseased or dying trees/plants	-
398	Flooding	Water	Outbreaks of timber and forest pests and diseases	Conduct research on specific tree pests and diseases	-
399	Flooding	Water	Outbreaks of timber and forest pests and diseases	Accurately identify pest and disease agents	-
400	Flooding	Water	Toilets over flow and contaminate water resources	Do not utilize sensitive Bush and VIP toilets in flood prone areas	Bush toilets and VIPs pits are vulnerable, although even with significant Rainfallevents, the rain filtrates quickly
401	Flooding	Water	Toilets over flow and contaminate water resources	Do not drink ground water near bush and VIP toilets after flood conditions	Problem occurs when flooding occurs, and standing water exists for a long time (Tanna)
402	Flooding	Water	Toilets over flow and contaminate water resources	Do not use bush and VIP toilets in areas with undrainable clay soils	Holen (Efate)- the rain goes in the pits, and overflows into the yards- very much depends on the soil type and layering
403	Flooding	Water	Toilets over flow and contaminate water resources	Do not swim or bathe in rivers immediately following a flood event	Tagabe to Blacksands, are on the river bank- can see human waste floating past after rain events
404	Flooding	Water	Toilets over flow and contaminate water resources	Suggest other types of toilet designs	composting toilets are a good alternative

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405	Flooding	Water	Toilets over flow and contaminate water resources	Septic tanks could be placed above ground to avoid flood contamination	-
406	Flooding	Water	Toilets over flow and contaminate water resources	Develop and follow construction standards for water supply and sanitation, use of toilets in certain areas	Already written, currently being reviewed by Hydrology
407	Flooding	Water	Toilets over flow and contaminate water resources	Consider toilet location in terms of nearby water sources, and also in terms of soil type, nearness to sensitive areas (coral reefs etc)	for example Maskellynes – has very strong soil, so should not use pit toilets
408	Flooding	Water	Underground wells are contaminated	clean wells immediately after major rains	-
409	Flooding	Water	Underground wells are contaminated	raise the walls of wells so that rain events do not bring debris into them directly	-
410	Flooding	Water	Waterlogged and anaerobic soils	Introduce forest plot or area drainage systems	-
411	Flooding	Water	Waterlogged and anaerobic soils	Plant water tolerant tree species in flood prone areas like coconut, bamboo, purao	-
412	Flooding	Water	Waterlogged and anaerobic soils	Plan or Relocate forestry operations to typically 'dry soil' areas	-
413	Heat Stress	Agriculture	Crops are exposed to excessive temperatures	Use Open and deep hole planting of Taro, dig a deep hole, place taro inside, do not bury so as to allow air cooling of the growing taro.	-
414	Heat Stress	Agriculture	Crops are exposed to excessive temperatures	Use low tight staking of yam vines that will not allow excessive drying out	-
415	Heat Stress	Agriculture	Crops are exposed to excessive temperatures	Bury harvested cassava to preserve it before consumption	-
416	Heat Stress	Agriculture	Crops are exposed to excessive temperatures	Learn how to make Manioc Flour (Modern & traditional methods) so that harvested tubers can be preserved for extended periods.	-
417	Heat Stress	Agriculture	Crops are exposed to excessive temperatures	Dig the yam, but leave it in an open hole in well drained dry ground. Cover the hole with coconut leaves.	can last for months
418	Heat Stress	Agriculture	Crops are exposed to excessive temperatures	Re Bury harvested taro in well drained/sandy soil.	can last for months
419	Heat Stress	Agriculture	Crops are exposed to excessive temperatures	Practice alley cropping, to provide shade to vulnerable crops	Glyricidia works well, and provides nutrients , Can tie branches together to provide more shade inside alleys
420	Heat Stress	Agriculture	Crops are exposed to excessive temperatures	Practice temporary alley cropping with taro to avoid harsh sunight	Taro has been planted inside alleys, and then removed after hot season finishes
421	Heat Stress	Agriculture	Crops are exposed to excessive temperatures	Practice fallow improvement, individual	-
422	Heat Stress	Environment	Endemic, rare or endangered species may be lost	Protect all species of endemic freshwater fish	-
423	Heat Stress	Environment	Endemic, rare or endangered species may be lost	Develop databases of all Vanuatu biodiversity, including vulnerable habitats and food sources	E.g. freshwater fish database and butterfly database already begun
424	Heat Stress	Environment	Endemic, rare or endangered species may be lost	Identify and protect all species of heat-sensitive gecko	-
425	Heat Stress	Environment	Endemic, rare or endangered species may be lost	identify and replant host tree of sensitive epiphyte, orchids and lizards	E.g. in Penaru CA Santo- lives of an endemic lizards are symbiotically linked to an epiphytic plant (fern like)- lives inside the cavity

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426	Heat Stress	Environment	Endemic, rare or endangered species may be lost	Identify and protect all species of heat-sensitive insects	some of these may be important agricultural pollinators (native bees)
427	Heat Stress	Environment	Endemic, rare or endangered species may be lost	Identify and protect all species of heat-sensitive high elevation birds	high elevation birds are especially vulnerable (Santo Mountain Starling and endemic pigeon Ducula bakeri)
428	Heat Stress	Environment	Endemic, rare or endangered species may be lost	Identify and protect all species of heat-sensitive ground nesting birds	ground incubating birds are especially vulnerable (Namalao)
429	Heat Stress	Environment	Endemic, rare or endangered species may be lost	Place coconut fronds or other protection over sea turtle nests on the beach to cool them down	Temperatureaffects the number of males and females of sea turtles that hatch from the nest
430	Heat Stress	Environment	Endemic, rare or endangered species may be lost	Ensure that in times of extreme temperatures, flying foxes are protected if they attempt to find food near villages in gardens	Fruit bats will likely suffer with changing/delayed fruiting seasons, also affected by increasing night time temperatures (will affect their nocturnal feeding patterns
431	Heat Stress	Environment	Endemic, rare or endangered species may be lost	Control and minimize the conversion of high montane forests through proper Land Use planning and Sustainable Ag Methods-	-
432	Heat Stress	Environment	Endemic, rare or endangered species may be lost	Vanuatu's international CC negotiators must be aware of and highlight to others the potential to lose very critical ecosystems and species	-
433	Heat Stress	Environment	Endemic, rare or endangered species may be lost	Restrict fishing activities on coral reefs that are already stressed from bleaching	-
434	Heat Stress	Forestry	Forest seeds burnt and do not have a chance to germinate	Germinate vulnerable seeds in controlled conditions (nurseries)	-
435	Heat Stress	Forestry	Heat Stresson humans	Reconstruction and relocation of homes/communities to areas that are sheltered by forests	-
436	Heat Stress	Forestry	Heat Stresson humans	Plant green spaces for outdoor congregating and relaxing	-
437	Heat Stress	Forestry	Heat Stresson humans	Encourage the maintenance of trees when constructing houses	build around trees, incorporate them into construction designs
438	Heat Stress	Forestry	Trees wither and experience sun burn	Develop planting guidelines for each species to ensure planting in appropriate locations	-
439	Heat Stress	Forestry	Trees wither and experience sun burn	Identify and relocate important species to cooler locations.	-
440	Heat Stress	Forestry	Trees wither and experience sun burn	Plant new trees inside existing forests to exploit cooler temperatures	-
441	Heat Stress	Forestry	Trees wither and experience sun burn	Intercrop high canopy species in mixed planting with lower canopy species	-
442	Heat Stress	Forestry	Trees wither and experience sun burn	Encourage shading of germinants by mother trees	especially sandalwood seed trees.
443	Heat Stress	Forestry	Trees wither and experience sun burn	Utilize shade cloths/nurseries to protect vulnerable seedlings and juvenile trees from excessive heat	-
444	Heat Stress	Forestry	Trees wither and experience sun burn	Investigate and promote Temperaturetolerant tree species	-
445	Heat Stress	Livestock	Animals are sluggish and unproductive	Goat is especially heat tolerant	-
446	Heat Stress	Livestock	Animals develop sunlight-related problems	Use antibiotics to treat the Charolais Bullock eyelid sores problem due to sunlight overexposure	-
447	Heat Stress	Livestock	Animals develop sunlight-related problems	Avoid sunlight vulnerable varieties of bullock like Charolais	Strong sunlight causes chicken's eyes to swell up (especially in black legged fowls)
448	Heat Stress	Livestock	Animals develop sunlight-related problems	Encourage sunlight tolerant varieties of bullock like Brahman mixes	Crossbreed w/ Brahman and other bullock varieties are good with extreme temperatures

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449	Heat Stress	Livestock	Animals develop sunlight-related problems	Ensure that Charolais variety is placed in the shade during the hottest and sunniest parts of the day.	Place in shade trees for middle day times, while morning and afternoon time are best for feeding in open pastures. Nights can be spent in the open pasture. The farmer has to actually move the bullock to different areas of the farms.
450	Heat Stress	Livestock	Animals develop sunlight-related problems	Cross Charolais with Brahman to develop tolerance to high light intensity.	Charolais, when cross bred with Brahman, can become tolerant to high light intensity.
451	Heat Stress	Livestock	Animals develop sunlight-related problems	Place bullock in shade trees for middle day times, while morning and afternoon time are best for feeding in open pastures	Charolais and Brahman are not as resilient as others with strong sunlight or high temperatures.
452	Heat Stress	Livestock	enclosures	Ventilate chicken enclosures (e.g. with bamboo floors)	-
453	Heat Stress	Livestock	enclosures	Provide Mulching or leaves inside chicken enclosures for temp cooling	-
454	Heat Stress	Livestock	enclosures	Ensure there is dust available that chickens can kick up for temp regulation	only for larger animals, not chicks
455	Heat Stress	Livestock	enclosures	Keep an area of small bush inside enclosures under which they can hide	-
456	Heat Stress	Livestock	enclosures	Cover fences, to provide shade and respite from sun	Malekula farmers build small shelters over their pig fences
457	Heat Stress	Water	Water in storage reservoirs is hot	White wash (paint) the tanks for sunlight reflection to keep water cool	-
458	Heat Stress	Water	Water in storage reservoirs is hot	Build underground tanks that are not exposed to the sun	drawback of underground tanks is that it is hard to spot a leak
459	Heat Stress	Water	Water in storage reservoirs is hot	Plant ivy and other vines around and on tanks to keep water cold	-
460	Heat Stress	Water	Water in storage reservoirs is hot	Place tanks under shelters	in Torres tanks under the house, but when sun is low, still heats tank
461	Heat Stress	Water	Water in storage reservoirs is hot	Ferro cement tanks best resist high temperatures	may crack but can be resealed
462	Heat Stress	Water	Water in storage reservoirs is hot	Avoid poly tanks that may melt and become deformed in high temps	poly tanks melt and become deformed in high temps
463	Heat Stress	Water	Water in storage reservoirs is hot	Avoid fiberglass tanks that may experience inner lining peeling, and dust may have health implications	fiberglass tanks may experience inner lining peeling, and dust may have health implications
464	Sea Level Rise	Agriculture	Crops are exposed to high levels of salinity in soils	Relocate Gardens away from the coast	-
465	Sea Level Rise	Agriculture	Crops are exposed to high levels of salinity in soils	Introduce buffer zones between gardens and low-lying coastal areas	-
466	Sea Level Rise	Agriculture	Crops are exposed to high levels of salinity in soils	Find and encourage salt tolerant crops	-
467	Sea Level Rise	Environment	Loss of coastal habitat, flora and fauna	Relocate sea turtle nests to higher, safer parts of the beach	Wan Smolbag Vanua Tai monitors have been trained on how to do this
468	Sea Level Rise	Environment	Loss of coastal habitat, flora and fauna	Replant coastal species following their natural zonations	water tolerant mangroves inland to dry land mangroves and other trees
469	Sea Level Rise	Environment	Loss of coastal habitat, flora and fauna	Regulate and limit the extraction of sand, coral and gravel for development purposes	-
470	Rise	Environment	Loss of coastal habitat, flora and fauna	Establish protected areas on the coastal strip	-
471	Rise	Environment	Loss of coastal habitat, flora and fauna	Ensure the adequate EIAs are completed on all coastal developments	-
472	Sea Level Rise	Forestry	Erosion of coastal forest areas	Plant coastal, endemic and site adapted species on beaches and vulnerable coasts trees to control erosion	-
473	Rise	Forestry	Erosion of coastal forest areas	Plant/protect wetland species including mangroves to reduce erosion	-

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474	Sea Level Rise	Forestry	Erosion of coastal forest areas	Encourage and assist communities to establish forested buffer zones between the coast and the village	-
475	Sea Level Rise	Forestry	Erosion of coastal forest areas	Research the potential for desalination and irrigation of coastal woodlots/plantations	-
476	Sea Level Rise	Forestry	Erosion of coastal forest areas	Relocate species of importance to higher grounds to avoid loss through sea water inundation	-
477	Rise	Forestry	Erosion of coastal forest areas	Adopt coastal management or land use plans	-
478	Rise	Forestry	Erosion of coastal forest areas	Find and encourage salt tolerant trees	-
479	Sea Level Rise	Livestock	Livestock are exposed to high salinity feeds and environments	Train bullock to use salt blocks	are already bring used by some livestock owners
480	Sea Level Rise	Livestock	Livestock are exposed to high salinity feeds and environments	Allow animals to roam freely on the coast	(Ambrym, Epi, Tanna- cows already drink the pools near the coast)
481	Sea Level Rise	Livestock	Livestock are exposed to high salinity feeds and environments	Allow cows and bullocks to swim in the sea	In Torres – Red bullock and local bullock- regularly walk on the reef, swim in the sea
482	Sea Level Rise	Livestock	Livestock are exposed to high salinity feeds and environments	Allow chickens to walk on the reef flat to find food	Emae- fowls walk on the reef looking for food
483	Sea Level Rise	Livestock	Livestock are exposed to high salinity feeds and environments	Allow pigs to scavange on the coast	In Lamap- pigs scavenge in the mangroves for food
484	Sea Level Rise	Livestock	Livestock are exposed to high salinity feeds and environments	Allow pigs to swim in the sea	on Tongoa- white pigs commonly swim in the sea
485	Sea Level Rise	Livestock	Livestock are exposed to high salinity feeds and environments	To treat chicken pox, wash chickens in salt water	wild chicks sent to Pentecost caught chicken pox, and were treated with sea water face wash
486	Sea Level Rise	Livestock	Livestock are exposed to high salinity feeds and environments	Allow chickens use minerals from the reef and beach to strengthen their eggs	-
487	Sea Level Rise	Livestock	Livestock are exposed to high salinity feeds and environments	Relocate vulnerable pastures/enclosures away from the coast	-
488	Sea Level Rise	Water	Sea water contaminates ground water	Use proper surveys and an altimeter to select site	If not done well, as in Maskellynes, a major shift in water usage to rain water will be required
489	Rise	Water	Sea water contaminates ground water	Conduct a series of tests on water quality prior to installing a system	often not completed in Vanuatu due to lack of funds
490	Sea Level Rise	Water	Sea water contaminates ground water	Ensure proper site selection for bore water	E.g. Gaua- ground water best source, but 6/10 were no good, salty because checks not performed
491	Rise	Water	Sea water contaminates ground water	Seal bore hole when drilling	-
492	Rise	Water	Sea water contaminates ground water	Review government internal processes and guidelines for selecting bore	Now reviewed in the National Water Strategy
493	Sea Level Rise	Water	Sea water contaminates ground water	Build capacity of govt and local communities on desalination options	Expensive because of fuel. The brine product needs proper disposal. Skills for management and maintenance is often beyond island capacity
494	Sea Level Rise	Water	Sea water contaminates ground water	Use desalination in emergency situations	Desalination may be useful for emergencies, (i.e. Mataso, while setting ups tanks, a small desalinator could be sent in temporarily
495	Rise	Water	Sea water contaminates ground water	Trial small scale inexpensive desalination technology	VANREPA may have trialed a low cost design

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496	Sea Level Rise	Water	Sea water contaminates ground water	Desalinate sea water	An NGO trialed desalination on Rah island, but was unsuccessful