Choiseul Province Climate Change Vulnerability and Adaptation Assessment Report

SOLOMON ISLANDS

Securing the future of Lauru now

(Vanudui sinani kutea kuokuo ta tarakenakae dia zita bose ta vudu ni Lauru)

SPC Secretariat of the Pacific Community

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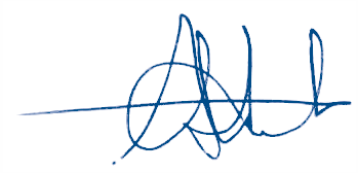
Foreword

Climate change poses serious challenges to the lives and development aspirations of the people of Lauru. As Premier of a province in a country that has contributed minimally to climate change, I join national and regional leaders in stressing our inherent vulnerability and limited capacity to adapt to climate change, and our need for external assistance to initiate a proper and dedicated climate change response in Choiseul Province. The province is aware of the significance of climate change and therefore factored it into its Medium Term Development Plan 2012–2014. My provincial government, on behalf of the people of Lauru, concurred with the national government that Choiseul be the pilot province for a new approach to adaptation, involving a number of partners, including the province, working in a collaborative partnership to increase the resilience of our people to the effects of climate change.

This vulnerability and adaptation assessment report is the first of its kind for Choiseul Province, and one of the first steps in rationalising what adaptation options should be piloted within the context of ridge-community-reef and ecosystem-based adaptation. I commend the assessment team and communities for accomplishing the task. The next important step is to plan and implement the adaptation demonstration pilots recommended in this report, bearing in mind the development aspirations of the communities and the province as a whole.
Thank you.



Hon. Jackson Kiloe
Premier, Choiseul Province

List of abbreviations

AC	adaptive capacity
AOA	agriculture opportunity area
CBD	Convention on Biological Diversity
CBRM	community-based resource management
CCA	climate change adaptation
CPG	Choiseul Provincial Government
DPs	development partners
EbA	ecosystem-based adaptation
ENSO	El Niño Southern Oscillation
FADs	fish aggregating devices
GIZ	German Agency for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit)
LLCTC	Lauru Land Conference of Tribal Community
MCP	man-made coastal protection
MEAs	multilateral environmental agreements
MECDM	Ministry of Environment, Climate Change, Disaster Management and Meteorology
MPAs	Members of Provincial Assembly
N/A	not applicable
NDS	national development strategy
NEMS	national environmental management strategies
NGOs	non-governmental organisations
ODA	overseas development assistance
RCR	ridge-community-reef
REDD+	reducing emissions from deforestation and degradation, plus the role of forest conservation, sustainable forest management, and carbon stock enhancement
SDA	Seventh Day Adventist
SIG	Solomon Islands Government
SLR	sea level rise
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
TNC	The Nature Conservancy
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
V&A	vulnerability and adaptation

Executive summary

Assessing people's vulnerability and adaptation to climate change is complex. There are a number of inter-related factors that affect people's vulnerability, sensitivity and capacity to adapt to the impacts of climate change. Therefore, understanding how communities interact with multiple social, cultural, political, economic and environmental factors is paramount to understanding how they are vulnerable and able to adapt to these impacts.

Consequently, this study focused on the community as the central point of measuring vulnerability to climate change in Choiseul province, and this report is primarily based on information gathered through a series of facilitated workshops, observations and recorded data in 27 communities throughout the province. The information is then strengthened through analysis of the literature, including scientific research and relevant government legislation that relates to issues raised in the Choiseul communities.

The context for climate change adaptation in Solomon Islands is established through an analysis of governance and relevant legislative frameworks at the national level. Subsequently, governance, economic development, social services, natural resources and climate of Choiseul Province are examined. The report then discusses the factors that affect people's resilience to the impacts of climate change at the community level. The national government, provincial government and the communities are all inextricably linked. Any adaptation approach must therefore focus on strengthening potentially beneficial links, such as the potential for community-based resource management, and also on identifying where action at the national level is increasing people's vulnerability to climate change.

Peoples' livelihoods depend currently on their interaction with terrestrial and marine resources. The continued ability to utilise natural resources and ecosystem services, in addition to properly planned development interventions, are essential to peoples' resilience and ability to adapt to climate change. This report discusses the impacts of climate change and non-climate change factors on natural resources and development, and a summary of peoples' interactions and utilisation of natural resources and key ecosystem services is provided in order to demonstrate their value to the people of Choiseul. Given the close connectivity of livelihoods and natural resources, ecosystem-based adaptation (EbA) approaches are deemed an appropriate adaptation response in Choiseul Province. Furthermore, given the close connectivity between terrestrial, coastal and marine ecosystems and communities, a ridge-community-reef (RCR) approach to resource management and development is described as an appropriate adaptation framework. Since communities are also the resource owners, an RCR approach must focus on the community as the central point of adaptation actions.

Based on the findings of this assessment, a suite of adaptation options are recommended, addressing land, coastal, community and sea-based vulnerabilities. It is clear that, in order to develop an effective adaptation response, a multi-sectoral and multi-partner approach is required to adequately address the complexity of factors contributing to the people of Choiseul's vulnerability and capacity to adapt to the effects of climate change.

1 Introduction

As in many other countries, Solomon Island's response to climate change is best described as piecemeal and uncoordinated because of the multiple agencies, including national government agencies, development partners (DPs), regional organisations, non-governmental organisations (NGOs) and individuals working in isolation or having only limited connectivity with each other's programmes. The limited coordination traverses not only the policy arena, but also that of resource mobilisation and implementation.

To help improve coordination and alignment of support, as well as optimise the selection and impact of planned climate change interventions, permanent secretaries in the Solomon Islands Government (SIG) proposed to adopt an integrated and holistic approach to climate change adaptation at the provincial level. The programme foresees an integrated, holistic and programmatic ridge-community-reef (RCR) approach, where government agencies, DPs and NGOs work together in a multi sectoral 'programme' in one province to strengthen the resilience of the local population to climate change.

Box 1. Ridge-community-reef concept

Links between terrestrial, freshwater and marine ecosystems are particularly tight on many Pacific Islands, with relatively small catchment areas from mountains to coastal and marine ecosystems. For example, forest cover, particularly riparian vegetation, is critically important in maintaining downstream water quality through bank stabilisation, sediment trapping and nutrient cycling. In recognition of these links and the considerable issues associated with land-based activities in coastal watersheds, many management agencies have tried to initiate integrated catchment management. However, to effectively do this, multiple sectors (e.g. agriculture, forestry and fisheries) and multiple jurisdictions must work in a coordinated fashion, as each area is affected by the others' actions. In local settings, communities are at the centre of the sectors and ecosystems. Their livelihoods depend on them and their decisions and actions have direct impacts on all sectors and ecosystems. The ridge-community-reef approach captures the context of Solomon Islands and Choiseul Province. Given this close connectivity, climate change adaptation in Choiseul requires a look at entire catchment areas — from the land to communities, to coastal and marine environments — and must bring in multiple community interests, sectors and agencies to effectively plan and implement adaptation.

Box 2. EbA

The concept of ecosystem-based adaptation (EbA) is embedded within the Convention for Biological Diversity (CBD) and is defined as: 'Adaptation that integrates the use of biodiversity and ecosystem services into an overall strategy to help people adapt to the adverse impacts of climate change'. Hence the primary beneficiaries of EbA are people rather than local ecosystems. There is growing consensus that using natural capital is an important part of climate change adaptation, particularly in developing countries where there is reliance on ecosystem services.

By closely coordinating and bundling resources and activities in a targeted geographic area, it is envisaged that the chances of programme success will be enhanced. This coordinated approach will not only increase the likelihood of achieving desired impacts on the ground, but will also promote optimal use of human and financial resources, minimise duplication and overlap, build on the strengths of multiple organisations, and reduce the coordination burden on the Choiseul Provincial Government, the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM), the Ministry of Development, Planning and Aid Coordination and other relevant line ministries.

In response to the SIG request, the German Agency for International Cooperation (GIZ) and the Secretariat of the Pacific Community (SPC) through the SPC/GIZ Regional Programme on Coping with Climate Change in the Pacific Island Region, the United States Agency for International Development (USAID) and the Secretariat of the Pacific Regional Environment Programme (SPREP) took on board the province-based approach to climate change adaptation (CCA) and underpinned it with ridge-community-reef (RCR) and ecosystem-based adaptation (EbA) approaches. Both the RCR and EbA approaches focus on land, coastal and marine ecosystem connectivity, particularly around the resources and services that these ecosystems provide for community livelihoods.

Conceptually, RCR and EbA seek integration and coordination of land and sea-based stakeholders and their activities in line with the intention of the province-based approach. For example, marine protected areas need to be complemented with forest conservation areas and vice-versa. In addition, planned adaptation interventions to reduce coastal erosion by mangrove planting need to be complemented by planting fuel wood lots and promoting other non-fossil sources of fuel, such as biogas.

Through this assessment process, it is clear that both EbA and RCR approaches (see boxes 1 and 2) may be relevant to

the specific climate change vulnerabilities of the people of Choiseul. In order to assess this level of relevance and compare these options with conventional adaptation solutions (e.g. hard infrastructure), the adaptation planning process needs to accommodate a consideration of ecosystem services within its priority-setting phase (Hills, Brooks, Atherton et al., 2011). If the social acceptance and cost-effectiveness of EbA and RCR approaches can compare favourably against other alternatives in addressing key vulnerabilities, then such options should be presented as the preferred adaptation solutions. However, it should be noted that, while all adaptation options are consistent with an RCR framework, it is not expected that all adaptation solutions presented will be EbA.

It was also recognised from the outset that such an innovative approach will have to overcome a number of deeply ingrained issues, such as the predisposition of stakeholders to work independently, even if the benefits of collaboration are clearly discernible. Also, compared to other forms of adaptation, investment in adaptation based on natural capital represents a low proportion of adaptation activity in the Pacific region and elsewhere (Pramova, Locatelli, Brockhause et al., 2010). In order to effectively adapt, it is important to have a broad-ranging approach to adaptation, covering a multitude of approaches. Consequently, a pilot was needed to test this new approach, and the national government identified Choiseul Province as the pilot site. The success of this province-based approach to CCA rests on the coordination of stakeholders and their activities at the donor-government level, right down to the planning and implementation of climate change adaptation interventions in communities. It is hoped that this model of climate change adaptation can then be replicated and adapted to other provinces in Solomon Islands.

2 Rationale and aims

A number of national climate change V&A assessment studies have been carried out in the past and incorporated into reports such as the national reports for the United Nations Framework Convention on Climate Change. These national reports offer broad guidelines on impacts, vulnerabilities and adaptation measures required at the sectoral level. However, whilst providing context and guidance, they are too general to adequately inform the assessment of vulnerability and adaptation implementation at the community level.

Moreover, many previous V&A studies were sector-based and did not adequately consider cross- and multi-sectoral issues of CCA. It is better to base the CCA measures on a vulnerability assessment of the province with equal regard for climate change and non-climate change factors, and including pertinent cross- and multi-sectoral issues. Then adaptation options to reduce vulnerability are assessed and the adaptive capacity enhanced.

The V&A reported on here focused on a community approach in order to ensure relevance and ownership of issues at the community level. This recognises the fact that people and communities must adapt. To understand adaptation strategies, we must first understand the governance and social structures that drive current trends and relate them to people's ability to adapt. It also grounds the adaptation strategy in the real situation and not one based on an outsider's view of what needs to happen. As most of Choiseul Province is under customary land ownership, it is also imperative to strengthen communities' and landowners' abilities to manage resources.

Consequently, a field-based V&A study was carried out from 3 July to 5 September 2012, with the following objectives:

1. to assess provincial vulnerability, given the impacts imposed by climate change and non-climate change factors on systems;[1]
2. to assess and identify measures to reduce vulnerabilities and improve the AC of Choiseul communities;
3. to identify the four or five most suitable communities for demonstration of RCR and EbA adaptation approaches.

The expected outputs with respect to each of the objectives are given in Table 1.

1. Natural resource systems (agriculture, fisheries and coral reefs, coastal environments and systems, water resources, sustainable forestry management, human health, land use planning); human systems (health, infrastructure and human settlements); and enabling systems (government institutions and awareness and education)

Table 1. V&A expected outputs and products

Objectives	Outputs	Product
1	The vulnerability of Choiseul Province to climate change and other non-climate change factors is assessed and documented	Province-wide vulnerability and adaptation assessment report (V&A report)
2	Vulnerabilities, capacities, resources and institutions of the 27 communities are assessed and documented.	Community profiles and V&A report
3	4–5 communities are identified to begin implementation of adaptation measures	V&A report

3 Report audience

The report was prepared for Choiseul Provincial Government (CPG), local communities of Choiseul, the National Government, SPC/GIZ, SPREP, USAID and other NGOs and DPs who are currently or intending to plan and implement climate change adaptation activities in Choiseul Province.

4 Methodology

4.1. Community selection process

An invitation was sent to provincial government and non-government stakeholders to participate in the preliminary selection of communities to be visited during the V&A study. Based on the invitation, community selections came from provincial government officers (one each from the National Advisor Provincial Government Strengthening Project, the Provincial Climate Change Office, the Agriculture Office[3] and the Lands Office), two from The Nature Conservancy, one from the Lauru Land Conference of Tribal Community, one from Save the Children Australia, a community youth leader, and a marine protected area ranger. The selectors were asked to do a rapid vulnerability assessment of two communities based on the following criteria:

- high population (>100 people)
- geophysical factors (low-lying, unsheltered coastline or close to a river)
- already experiencing environmental degradation and over-exploitation of natural resources (stressed coastal fisheries, degraded forests and coral reefs)
- is experiencing reduced crop yields
- has experienced destruction of food crops, coastal erosion, severe storm surges and inundation as a result of tropical cyclones
- is an organised community (from previous experience and opinion) which will support a climate change programme.

Each of the selectors identified two communities per ward for all the 14 wards of the province. The ten lists were provided in confidence to the authors and merged into a single list showing concurrences and divergences amongst the local selectors with respect to their choices for each of the wards. The communities selected by the authors were the ones selected the most (6–10 times) by the individual selectors.

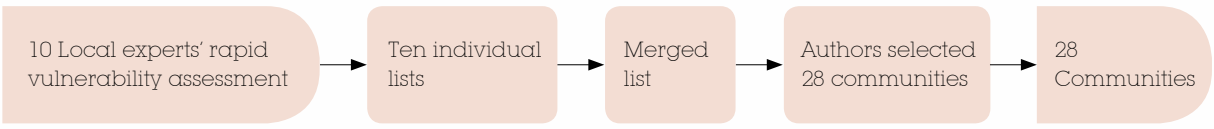


Figure 1. Community selection process

2. This was done by all the agricultural officers based in the Province. Six female officers were part of the group.

The provincial government communicated with community leaders to grant permission to the V&A assessment team to conduct assessments in their community. In the end, only 27 villages were visited, because elders of the 28th community did not receive the introductory letter from provincial government, and most community members were engaged with Pacific Festival of Arts during the relevant period for Northwest Choiseul. The following communities were visited on four round trips by the V&A assessment team on the dates shown (see Figure 2 and Table 2).

Figure 2. Map of communities selected and visited

4.2. V&A assessment components

The V&A assessment study was done in three components as depicted in Figure 3.

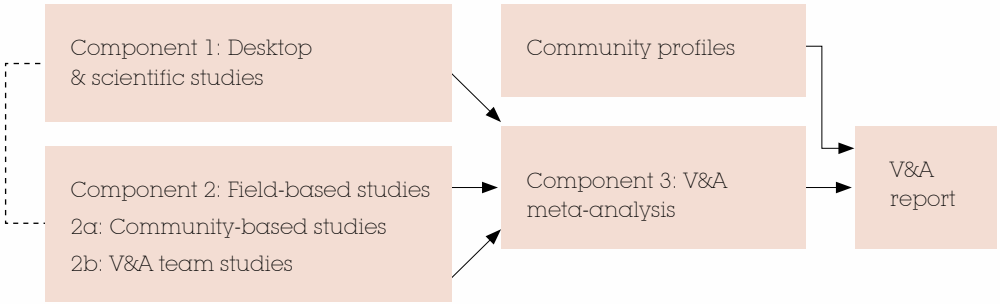


Figure 3. Components of V&A study

The V&A report was prepared as a synthesis of components 1 & 2. In addition to this report, a community profile was prepared for each of the 27 communities visited, outlining key V&A findings relevant to their community.

Table 2. Communities selected and visited

Trip No.	Date	Village
1		
	3/07/12	Loimuni
	4/07/12	Molevanga
	5-6/07/12	Vurango
2		
	9/07/12	Polo
	10/10/12	Ogho
	11/07/12	Bangara
	12/07/12	Voruvoru
	13-15/07/12	Susuka
	16/07/12	Soranamola
	17/07/12	Tabarato
3	6/08/12	Voza
	7/08/12	Saqigae
	8-9/08/12	Panarui
	10-12/08/12	Sepa
	13/08/12	Papara
	14/08/12	Katurasele
	15/08/12	Loloko
	16/08/12	Posarae
	17/08/12	Sasamunga
4		
	28/08/12	Zaru
	29/08/12	Taqibangara
	30/08/12	Nuatabu
	31/08/12	Pangoe
	2/09/12	Varunga
	3-4/09/12	Vaghena (Arariki and Kukitin)
	5/09/12	Boeboe

4.2.1. Component 1: Desktop and scientific studies

This component involved desktop compilation and assessment of relevant scientific and socioeconomic data and information concerning climate change, Solomon Islands and Choiseul Province. Sea level rise (SLR) and extremes' projections were reproduced from the projections made for Solomon Islands under the Pacific Climate Change Science Programme.

Observed rainfall data for Taro Island was supplied by the Solomon Islands Meteorological Service. The authors analysed the data and the outputs are presented graphically in this report.

SPC is undertaking coastal change detection using historical aerial photographs and recent high resolution images. This was intended to support the coastal biophysical assessment carried out in the communities. Other useful outputs are land cover change analysis and a digital elevation model of Choiseul. Unfortunately, the results from the coastal change detection study were not ready at the time this report was prepared because of the difficulty in obtaining cloud-free high resolution images of Choiseul. Nevertheless, it is anticipated that the results will be at hand before the implementation phase of this programme (especially activities concerning the coastal zone). It is important to note that this information will be valuable in further clarifying site selection and intervention design of the projects.

4.2.2. Component 2: Field-based studies

This component has two parts; one is based on community-led assessments facilitated by the V&A assessment team, and the second part consists of assessment studies led by members of the V&A assessment team.

4.2.2.1. Component 2a: Community assessment framework & process

The framework has two steps (See Appendix 1) with specific outputs. The process outlines the activities to be carried out to meet the objectives and outputs in the framework.

Step 1: This step sets the scene for the assessment process. The key deliverable is that community awareness about climate change is raised in order to assist the community to participate in the activities of step 2.

Step 2: In this step, the community did simple climate change and livelihood analysis to appreciate how the climate might have changed (or not changed), based on their experiences with tropical cyclones, storms, sea level rise and coastal erosion. They then assessed the vulnerability of their livelihood resources based on both climate change and non-climate change threats in order to appreciate the connectivity of threats and evaluate their coping strategies under present and future (up to 2030) climate conditions. In addition, the communities identified how government agencies and non-government agencies can contribute to addressing their climate change and non-climate change threats.

4.2.2.2. Component 2b: V&A team-based assessments

- A household socioeconomic survey was carried out in each community, covering 10% of the households. The data from this survey complemented data and information collected at the village level during the 2009 national census, the provincial health and household information and data (current up to August 2011), and relevant literature sources (See Appendix 2 for the survey instrument).
- A biophysical coastal assessment was carried out by assessors in consultation with community informants using the appended assessment tool (See Appendix 3).
- Agriculture and hinterland assessments were also carried out by the team.
- Written documentation of data, information, observations and discussions were complemented by photographs.

4.2.2.3. Group presentations, open discussions and feedback sessions

- Outputs of group-based activities were presented in plenary after completion of all activities. Group presentations were followed by open discussions based on presentations.
- Feedback based on coastal biophysical assessment and agriculture and hinterland assessment carried out by members of the V&A team were made after the group presentations.
- The V&A team were given the opportunity to inform the community about their respective work programmes. This was followed by open discussion.

4.2.3. Component 3 Meta-analysis

In this component, the authors drew from the field data, information and issues observed and discussed in the communities, and 'wove them' with relevant literature to produce a synthesis of the V&A study which is this report. Community-specific results and suggestions for adaptation have been summarised into community profiles.

5 The context for climate change adaptation

In order for CCA to be meaningful in Choiseul, it must be planned for and implemented in tandem with the geophysical, socioeconomic, cultural, environmental and political circumstances, as well as with community institutions. These non-climate change factors interact with each other and with climate change impacts to determine the vulnerability of communities to climate change. They are on their own intrinsically important as drivers of societal and biophysical changes, and affect the ability of people to cope with climate change. Minimising non-climate change threats will lead to greater resilience to the effects of climate change. The term 'resilience' refers to how well a system — ecological, social or economic — can maintain its critical functions and processes in response to a disturbance. An understanding of these contextual issues is essential to fully assess the vulnerability of Choiseul province to climate change. Most of the analysis in this section is based on data and information from the literature.

5.1. Solomon Islands at a glance

Solomon Islands consists mainly of a double chain archipelago located in the south west Pacific basin with a total land area of 28,900km2 and an exclusive economic zone about 46 times greater than its land area. The islands are separated by vast oceanic space and are endowed with abundant natural land and marine-based resources, which are pivotal to the cultures and livelihoods of its people. The biophysical environment is in relatively pristine condition. However, in some parts of the country, the environment has been degraded through unsustainable economic development pathways, population growth, and increased exposure to globalisation. The country has a relatively stable marine-influenced tropical climate with annual rainfall ranging from 3000 mm to 4000 mm, and average daytime temperatures in the vicinity of 300C. The country is intermittently affected by climate extremes such as droughts, floods, storm surges and tropical cyclones. Climate change poses serious risks to livelihoods and may heighten poverty and encumber development as a whole.

According to the 2009 census, the population stood at 515,870 and grew at 2.3% annually. About 80% of the population reside in rural areas. The people and their social organisations are characterised by a high degree of ethnic, cultural and linguistic diversity. A typical community is male dominated and thus there are inequities between males and females, with the former showing dominance in the political arena and the paid employment sector. At the time of writing, there was one female member of parliament and no females in the Choiseul Provincial Assembly. Most Solomon Islanders profess to be Christians, and churches represent one of the cornerstones of contemporary life in Solomon Islands.

Solomon Islands gained political independence from the United Kingdom in 1978. The governance and political systems are immature, unstable and encumbered by corruption and regular changes in political allegiances, especially at the national level. The links between formal political and governance institutions, such as the national government and provincial governments, are weak and disjointed. The judicial system is relatively fair but is encumbered by limited resources and a lack of links to the cultural and church justice systems operating in most rural communities.

Solomon Islands has a narrow economic base, with glaring dependence on natural resources, especially timber, tuna and agricultural cash crops (particularly copra and cocoa). Moreover, the country is also heavily dependent on overseas development assistance (ODA). Its narrow economic base and dependence on ODA increase its susceptibility to global and local economic and financial swings; it has a marked inability to cope with such swings. In the past 27 years GDP growth has been mostly positive and highly variable; on the other hand, this positive trend has generally not resulted in an improvement in the standard of living of the people. The country is a net importer of fuel, rice and manufactured goods and equipment. The need to diversify its economic base and strengthen the subsistence economy is pertinent.

Basic social services, such as education and health, are centrally controlled by the national government. These two particular services are also heavily supplemented with donor funds, which have long term sustainability implications. Most of the population, especially in rural areas, are without running water and a reliable source of energy, although solar energy is making some inroads into providing some basic lighting. Firewood forms the basis of energy for cooking and heating. Communication and transportation infrastructure throughout the country is grossly inadequate for a country of islands. Consequently, social and business transaction costs are often high, and in turn discourage commercial ventures and service provision to the majority of the population.

5.2. Frameworks for environmental management

Environmental management is enshrined in the national constitution. In terms of development planning, natural resources and environmental management have featured in nearly all national development plans, and more evidently in the 2011 approved National Development Strategy (NDS). On the other hand, it must be noted that, for a country fully dependent on its natural resources and their proper management, the implementation of environmental management plans, and enforcement of relevant legislation and policies since independence have been somewhat ineffective. The manifestations of such neglect include the prolonged timeframe (ten years) between the enactment of the environment and wildlife management and protection acts and their supporting regulations, and the increasing flow of waste into vacant lands, coastal areas and rivers.

Environmental management in the Solomon Islands is not only constrained by the lack of resources (e.g. expertise and finance) and geographical dispersal of the country, but also by the multiplicity of legislation covering various aspects of the natural and built environments, and the fact that the legislation is under the mandate of various national agencies (Mataki, 2011 and Pacific Horizons Consultancy Group, 2008), as illustrated in Appendix 4. More importantly, there is a lack of integrative programming across agencies and coordination of activities, often resulting in duplication and redundancy. Turf protection adds further strain on the capacity of agencies to integrate programming and coordinate activities. These problems have become entrenched in the government system, so it is not unusual to have closely related ministries (e.g. agriculture and fisheries) going into rural communities, each with their own programme but without any collaboration.

Some legislation is incongruent with the environmental and socioeconomic challenges presently confronting the country. A case in point is the forestry and timber utilisation act, which is structurally incoherent after several revisions and is ineffective with regard to addressing forest degradation and delivering tangible economic and social benefits to rural landowners. Also, the laxity in enforcement of legislation, coupled with inadequate resources

and corrupt practices, have made it difficult to achieve the objectives of the legislation. Moreover, the brevity of political agendas, given the frequent changes in government, does not help with the situation on the ground.

Despite this, the relatively new *Protected Areas Act 2010* is a modern piece of legislation providing for the declaration and management of protected areas and the protection of biological diversity. It provides a strong foundation for community-based management of protected areas in the face of climate change (Boer and Clarke, 2012). However, as mentioned above, in order for legislation to be effective, the resources must be prioritised if it is to meet the intended objectives. In addition, communities must not be deprived of access to resources required for subsistence and income generation.

While the coverage of aspects of environmental management in a variety of legislation reflected the cross-cutting nature of the environment, it also reflected the lack of dedicated institutional structure with an environmental management mandate. This was the case until the establishment of the Department of Environment and Conservation in 1985. Unfortunately, though, it was not properly resourced and its work was encumbered by the lack of supporting legislation. Environmental management and opportunities for better integration of activities was enhanced by the formation of the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM). However, much is still to be done with regard to getting the various sections of the ministry to work together. In terms of climate change, the establishment of the Climate Change Division is notable, but its effectiveness is undermined by the limited resources and expertise to coordinate, at the policy and implementation levels, the work of the various agencies, including government and non-government bodies, implementing climate change programmes in Solomon Islands.

Table 3. Dedicated environmental institutions

Institution	Commentary
Department of Environment and Conservation (1985)	The Department of Environment and Conservation was a minor department initially attached to the Ministry of Natural Resources. Its early days of operation were encumbered by the lack of supporting legislation and resources.
Setting up of MECDM (2008)	The consolidation of closely related departments into a separate ministry is a significant achievement for environmental management. It was the first institutional set-up at ministerial level allowing environmental management and sustainable development as a whole to gain higher visibility in the national government's agenda.
Setting up of the Climate Change Division (2009)	This was set up, given the high level of vulnerability of Solomon Islands to climate change and the high risks posed by climate change on sustainable development.

The work of MECDM, especially the divisions dealing with environment, conservation and climate change, are strongly influenced by the many multilateral environmental agreements (MEAs) to which Solomon Islands is a party (see Appendix 5). These MEAs are important, not only for global environmental governance but also because of the financial resource flows that arise from them, particularly the three Rio conventions (UNCCD, CBD and UNFCCC). The downsides of these MEAs are their demands for national agencies, including MECDM, to participate in their conferences and meet their reporting requirements. Overseas engagements often take away the few staff from their work for prolonged periods, resulting in limited progress of local priorities. Better management of these overseas engagements is required at all levels.

5.3. Law, custom and natural resource management

In Solomon Islands, people have developed diverse legal traditions, often referred to as 'custom' or 'customary law'. Throughout the country, customary law is usually applied at the local level, with decision making and enforcement taking place within the village. National legislation (the Customary Land Records Act, 1994 and the Customs Recognition Act, 2000 [See Box 3]) recognises and protects indigenous land tenure, and the majority of land (~90%) is held under customary communal title. Recognition of customary marine tenure has been less clear, reflecting a historical conflict between customary land tenure systems and the open access traditions of colonising European states (Govan, 2009).

Box 3. Summary of relevant land and natural resource tenure legislation

Customary Land Records Act, 1994:
Provides for: 'recording of customary land holdings to empower land holding groups to deal with customary landholdings, the establishment of an office of National Recorder of Customary Land and record offices in the provinces' (from Long Title of the Act).

Customs Recognition Act 2000:
Provides for: 'ascertainment of the existence of any customary law and the nature of such customary law in relation to a matter, and its application in, or relevance to a matter, and its application in, or relevance to, any particular circumstances; specifies facts that are relevant when customary right, usage or practice is in question and concerns proof and recognition of custom. Custom may generally be taken into account only in relation to: (a) the ownership by custom of rights in, over, or in conjunction with, customary land. This includes: (i) anything in, or on, customary land; or (ii) the produce of customary land, including rights of hunting or gathering; (b) the ownership by custom of rights in, over or in connection with, the sea or a reef, or in or on the bed of the sea, or of a river or lake, including rights of fishing; (c) the ownership by custom of water, or of rights in, or over water; (d) the devolution of customary land or of rights in, over, or in connection with, customary land; or (e) trespass by animals'.

In recent years, recognition of the central role of traditional governance systems in the management of natural resources and ecosystems has resulted in a strong shift towards community-based natural resource management in Solomon Islands. Indeed, recent conservation initiatives through The Nature Conservancy (TNC) in Choiseul have focused on community-based conservation models. The rapid expansion of community based resource management (CBRM) initiatives in the country presents important questions regarding interaction, and potential conflict, between national laws and local governance systems.

Legal recognition of traditional resource tenure and decision making processes can enhance the effectiveness of CBRM (Boer and Clarke, 2012). Conversely, failure to recognise traditional resource tenure and decision making processes may lead to resource conflict and, when combined with limited governance capacity, can result in poor resource management outcomes.

In order for CBRM initiatives to achieve long-term effectiveness in Solomon Islands, significant legal and institutional reform is necessary. Given the customary land base and realities of resource management in the province, it is imperative that the strength of Choiseul's traditional resource management structures are built on and enhanced. This can be achieved through the emergence of hybrid models of governance — which respect local traditions, practices and resource rights — and shared responsibility for planning, implementation and enforcement of management measures between communities and government institutions, taking into account their respective strengths and limitations.

5.4. Legal and institutional frameworks for climate change

The legal and institutional framework for climate change in Solomon Islands closely follows developments in environmental management as discussed above. However, it differs from the latter on two main fronts; first, there is no specific legislation on climate change and, second, most of the programmes and projects on climate change are resourced mainly from external funds, with the national government providing co-funding support. The publication Pacific Adaptation to Climate Change for Solomon Islands, states that: 'Following the preparation of its INC [in-country consultation], the country has initiated efforts to create an institutional set-up that seeks to mainstream climate change issues into the national legal frameworks' (SPREP 2009). However, climate change issues are not reflected in any Solomon Island legislative provisions at this point.

A number of key national policies such as the National Adaptation Programme of Action, the National Biodiversity Strategic Action Plan, national communications for UNFCCC and, more importantly, the national climate change policy (2012–2017) and the NDS (2011–2020) have provided some guidance on how Solomon Islands might respond to climate change in terms of adaptation and mitigation. They also provide direction on strengthening the institutional framework for climate change through the recently established Climate Change Division in MECDM and the three bodies established under the national climate change policy: (i) a national climate change council (to oversee implementation, coordination, monitoring and evaluation of climate change policies and strategies); (ii) a climate change working group (to provide inter-agency and inter-stakeholder coordination for the implementation of the climate change policy); and (iii) thematic working groups (to provide technical and strategic advice and support to the MECDM and the former bodies). The national climate change policy was endorsed by cabinet

early this year, but these three bodies have not yet become fully operational. This highlights the gap between the enactment of laws and policies and their implementation, which is wider in developing countries such as Solomon Islands.

Given the link between disaster risk reduction and climate change adaptation, there has been discussion on the development of a joint national action plan for adaptation and disaster risk reduction. This was reiterated in the national climate change policy. However, to date, the above discussions have not been furthered. Whilst the close linkage between climate change adaptation and disaster risk reduction are clear, the institutional set-ups at the national level are still located in two different divisions. Moreover, the current mandate of the division charged with disaster risk reduction is still focussed on disaster management. The divide between climate change adaptation and disaster risk reduction is also evident at the provincial level, where there are national disaster committees that in practice are only activated during declared disasters. The preceding aspect of disaster risk reduction in Solomon Islands runs counter to climate change adaptation because the latter places emphasis on adaptive and ongoing management, whereas the former still predominantly focuses on episodes of disasters, although it attests to be also involved in disaster risk reduction.

5.5. Choiseul Province

Choiseul Province (Figure 3) lies between 1560 23' and 1570 53' E and 60 35' and 70 32' S and occupies an area of 3,292 km2 (Hansell and Wall, 1976). It consists of the main island, Choiseul, Vaghena Island, Rob Roy Island, and several islets, most of them lying off the south and north eastern coasts of Choiseul Island. According to the 2009 census, the population was pegged at 26, 372 and increasing at a rate of 2.8% annually. According to the 2009 census, there were 503 communities, 4,712 households, with an average household population of 5.5. The Choiseul population growth rate was surpassed only by that of Guadalcanal Province, and it surpassed the national growth rate by 0.5%. Should Choiseul Province maintain this annual growth rate, it is estimated that its population will double by the mid-2030s. Choiseul has one of the lowest population densities in the country (seven people/km2), with most of the population concentrated in thin strips of coastal lands.

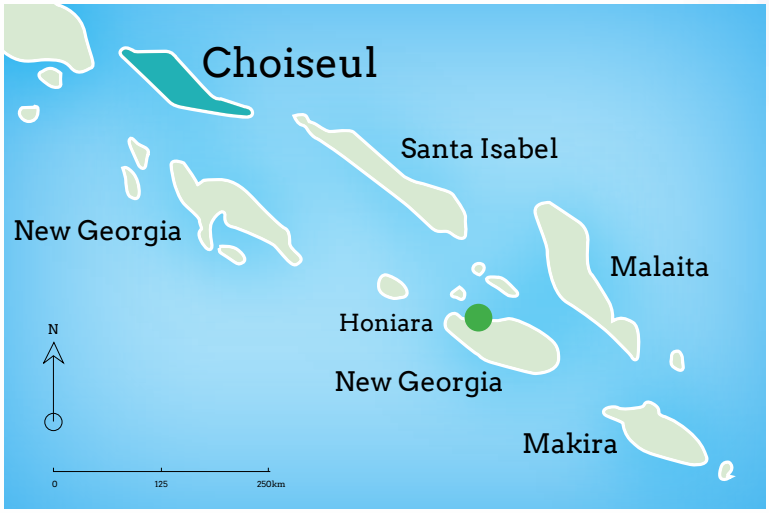


Figure 4. Choiseul Province Location Map

5.5.1. Topography and drainage

Hansell and Wall (1976) documented nine physiographic regions for Choiseul (Figure 5). These were reduced to five by Ridgeway, Coulson, Hackman et al. (1987) and form the basis of the descriptions and Figure 5 given below.

1. North-west hills: This area is characterised by rolling hills with intermittent rocky outcrops and gorge-like valleys Most of this region lies less than 400 m above sea level, and extensive areas are

Figure 5. Physiographic regions

less than 200 m above. The extreme north-western areas consist of 200 m high terraces, flanked by lower terraces and coastal swamps. The Vacho River dominates the drainage to the northern coast. The coastline is fairly recent, as indicated by the extensive mangrove swamps, freshwater swamps and young onshore reef formation.

2. Central highlands: The largest region and centrally located with rugged terrain and fault-controlled drainage patterns. Mount Maetambe dominates and influences the terrain. To the east, the drainage pattern is well developed with headwaters oriented north-west to south-east, whilst large streams and rivers break at right angles to the ridges toward the coast. The Kolombangara River drains most of this region to the southern coast. Lower reaches of the rivers tend to be wide and swampy. Fringing reefs are present in the northern and southern coasts and a barrier reef is intermittently developed in the northern coast.
3. Eastern lowlands: This section is a swampy depression. The hills and ridges around the main valley are generally below 300 m. The northern and southern coasts appeared to have submerged, as indicated by the drowned valleys, irregular shorelines and offshore islands and reefs.
4. Eastern ridges: This region is characterised by round, narrow ridges on ultramafic rocks with some areas (coastal and inland) having reliefs less than 200 m. Drainage is mainly dendritic; Mount Komboro (600 m) is drained by radial streams.
5. Eastern islands: low-lying islands, isolated reefs and shallow shelf seas. The land has low altitude ridges and hills. The main islands are Vaghena (emerged atoll with tidal rivers and abundant mangrove swamps), Rob Roy Island and Laena Island, which has the highest peak of 200 metres. Rob Roy Island and Laena Island show features associated with a submerged coastline.

5.5.2. People, culture and religion

Two major ethnic groups with distinct traditions and customs live in Choiseul. The majority and the first to have occupied these islands are of Melanesian stock. They moved in and settled about 3,000 years ago. The second ethnic group are Micronesians from Kiribati who were resettled by the colonial government in the early 1960s in Vaghena. A total of eight native languages and dialects are used in Choiseul: Avaso, Babatana, Katazi, i-Kiribati, Seqa, Tavula, Varisi and Ririo, which is now almost extinct. In Vaghena people use i-Kiribati as their native language; Babatana is commonly spoken throughout the province, while Pidgin and English are used in formal settings.

Possession of land in Choiseul is based on tribal landownership that connects tribe (*sinaqi*), sub-tribe (*jojolo*) and clan (*pupu*) as the communal unit that holds the right and authority over a piece of land. More than 300 tribal landowners are recognised in the province. In the indigenous context the land, sea, reefs, forests, rivers and other natural resources within a tribal land boundary are strongly connected to the tribes. Therefore, their rights to use and access natural resources are also bound within the tribal unit. Any form of development on tribal land has to be negotiated with the tribe.

People from other tribes who wish to access resources must properly seek permission from the rightful tribal landowners. Apart from perpetual ownership (*lua zinakutama*) of original tribal lands, tribal land laws of Choiseul Island also allow for: (a) land to be given as a form of compensation by a tribe hiring someone to take revenge (*lua panaka*); (b) land to be offered to settle disputes and normalise relationships (*lua sake*); and (c) land to be offered in relation to bride price[3] (*lua bani*) (UNDP/UNOPS and Ministry of Provincial Government and Rural Development, 2001). Tribal leadership is based on a patrilineal system where males of chiefly line of successive generations become the tribal head (boti sinaqi); the communities from Kiribati settled at Vaghena practice a similar system, which allows male heads to become leaders of the community.

Before the arrival of missionaries and during the height of the headhunting days, the majority of people in Choiseul lived in small groups in temporary tribal villages built on tribal lands, usually inland to protect themselves from enemies. Each tribal group was confined to its tribal lands to avoid being killed or taken as slaves, and for fear of sorcery. The introduction and expansion of churches by missionaries and the conversion of people to Christianity

3. Given to the woman when more than five kesa (valea kesa: referred to the land) is tendered as bride price.

resulted in mass shifts of people from their tribal villages inland to the coastal areas. There are three main churches in Choiseul. The United Church accounts for 56.2% of the population, 21.9% belong to the Roman Catholic Church and 16.0% belong to the Seventh Day Adventist Church (SDA) (UNDP/UNOPS and Ministry of Provincial Government and Rural Development, 2001). There are also a number of smaller evangelical churches.

Apart from spiritual development, churches also participate in the delivery of education and medical services around Choiseul. For example, Lauru rural training centre and Sasamunga mini-hospital were established and operated by the United Church in partnership with the government. Churches have been widely seen and used as binding agents to rally people to participate in important aspects of community development. Therefore churches are powerful institutions of influence over the daily lives of people in rural communities.

Land issues and disputes, as well as other issues, led to the establishment of the Lauru Land Conference of Tribal Community (LLCTC) in 1981. It seeks to promote justice, peace and reconciliation by documenting traditional history, culture and worthy customs, and by establishing tribal land rights in Choiseul. This was to ensure that people's sense of belonging and control of resources is secured. The LLCTC creates another important pathway that shapes culture, people and natural resources of Choiseul and encourages rural development. It strives to be active in the overall development of the communities and has assisted in identifying potential development programmes and projects and also in taking care of the sustainability of the land, seas, reef, rivers, forests and other natural resources of Choiseul.

5.5.3. Governance

Choiseul gained full status as a separate province in 1991; previously it was part of Western Province. The provincial headquarters is on Taro Island off the north western tip of the main island. The provincial government is the devolved arm of the national government. The provincial legislature comprises of fourteen[4] elected members (Members of the Provincial Assembly: MPAs) from each of the wards. The provincial government is headed by a premier elected by the 14 MPAs and supported by provincial ministers (akin to a cabinet at the national level) which have to be less than one half of the full assembly. In addition to the provincial politicians, there are three national constituencies in Choiseul Province (North-West, South and North-East) and therefore three national members of parliament.

The administrative operation of the province is led by the Provincial Secretary. The incumbent is supported by a technical planning group (consisting of senior finance and planning officers and technical advisors). The provincial government's link to the national government is through the Ministry of Provincial Government and Institutional Strengthening. Most government technical functions (e.g. agriculture, education, fisheries, forestry and health) are nationally controlled and headed by public service officers seconded to the provincial government by their respective national line ministries and supported by direct employees of the province. Heads of divisions are administratively answerable to the Provincial Secretary and communicate directly with their respective line ministries for technical as well as administrative aspects of their provincial work programmes.

Governance in rural communities is underpinned by an almost seamless blend between tribal/cultural leadership and the church (irrespective of the denomination). The blend also forges cross-fertilisation of leadership and governance principles across the two institutions. Tribal leadership is particularly crucial in land tenure issues, whereas the day-to-day affairs in rural communities centre on church leadership. The local influence of formal governance structures (provincial and national government) and political representatives is quite limited in the daily affairs of the village. Moreover, there is an apparent disconnect between community and formal governance structures in some areas, such as information, laws and resources. The increasing shift in government resources intended for rural communities from technical agencies to national politicians stands to increase the divide between these two types of structures, and may increase animosity towards formal governance structures. It also reinforces a growing expectation of politicians to render gifts at the individual level rather than through strategic rural development programmes.

4. In 2014, two additional wards were approved within the national North-West constituency.

5.5.4. Economy

The local economy in Choiseul centres on copra, logs and, to a limited extent, sawn timber. Economic development is constrained by poor infrastructure coverage (roads and bridges) throughout the province, its geographical isolation from Honiara and other commercial centres, and land tenure issues. Additionally, the limited political and economic powers of the provincial government, coupled with inadequate capacity and service grants, as well as limited collaboration between national and provincial politicians, further constrain the economic development of the province.

The major commercial operation in Choiseul is logging. In July 2012, eleven logging companies were operating in Choiseul, and many additional tracts of customary land have been placed through a timber rights' hearing process, which, if successful, will result in these tracts of land also being logged. From 1995 to 2005, 692,600 m3 was harvested from Choiseul (Pauku, 2009), and nearly the same amount (610,402 m3) was logged in the next five years, 2006 to 2010. This indicates the encouragement of logging by the national government, the 'tenacity' of loggers and middle men in acquiring timber rights to log customary lands, and the need for cash income in rural areas. Mineral prospecting has been done at various locations in the province, the most imminent one being the nickel and cobalt mine in eastern Choiseul.

Copra production is done at family and household level. In 2011, copra production in Choiseul stood at 1,152 tonnes, which was equivalent to 6% of the national copra tonnage, and was estimated to have fetched gross export earnings of about SBD 12 million (Choiseul Provincial Government, 2012). In Choiseul there are five agriculture opportunity areas (AOAs) covering 153 km2 which were identified by Hansell and Wall (1976). An AOA is defined as relatively flat land, under-utilised and with generally fertile soil suitable for commercial agriculture. However, some of these AOAs are now being utilised for subsistence agriculture as a result of population growth and logging. Consequently, AOAs need to be reassessed and, more importantly, subjected to land use planning with the direct participation of landowners, the national and provincial governments, and other key stakeholders.

The economies in rural communities comprise subsistence and cash sectors, which are closely intertwined and mostly complementary, though they sometimes compete against each other for resources. The subsistence sector centres on garden crops, vegetables, fish, shellfish and wild harvests for consumption and input to the cash sector. The cash sector centres mainly on copra and marketing of garden crops, vegetables, fish, seaweed (in Vaghena only) and to a limited extent cocoa and sawn timber. Other components of the cash sector are trade stores and canteens, which sell imported and locally manufactured goods.

5.5.5. Key social services

There are 26 health facilities around the island. These include one hospital, two area health centres, ten rural health clinics and 13 nurse aid posts. The health system is encumbered by staff shortages (e.g. one doctor serving the whole Choiseul population) and water and sanitation problems at the community level, with a relatively high incidence of gastro-intestinal health cases reported from the Vaghena Health Clinic.

There are 13 early childhood education centres, 52 primary schools and 14 secondary schools, a rural vocational training centre (Choiseul Province Government, 2012) and five community learning centres (pers com. Davis Pitamama [5]). Most of these schools are run by the Choiseul Province Education Authority; some are run by the United Church and SDA Education Authorities. Education up to the first three years of secondary education has been the focus since the province was set up. There are two secondary schools that offer secondary education up to Solomon Islands School Certificate level (year 11), and one offers year 12 but with limited subject options.

5.5.6. Transport, communication and energy

Solomon Airlines flies to two airstrips on the eastern and western ends of the main island. However, the main mode of transport around the province is outboard motor boats. The lack of proper roads is a major impediment to providing social services and up-scaling economic development. It also limits the access of farmers to the provincial capital and other communities with large populations to sell their produce.

5. Davis Pitamama is the Chief Education Officer for the Choiseul Provincial Government at the time of publication. This information was provided during the community workshops.

Food, medicine, fuel, general merchandise and people are transported to the province on privately operated ships and ships owned by Lauru Shipping, which is a business arm of the province. The return trips facilitate the transportation of timber, copra and people to Honiara and Western Province. Telephone and mobile network coverage around the island is still thin; although four other locations and surrounding areas apart from Taro have mobile coverage under Solomon Telekom Ltd. Internet access in Choiseul is even more limited than mobile coverage. The provincial government and TNC/LLCTC offices access broadband internet through an overseas internet service provider.

Electricity in Taro is generated from diesel or gasoline generators; rural communities mainly use kerosene lamps for lighting and firewood for cooking. According to the 2009 census, 4,588 households out of the 4,712 households in Choiseul depended on wood and coconut shells for cooking. A recent development has been the use of solar powered lights in rural communities.

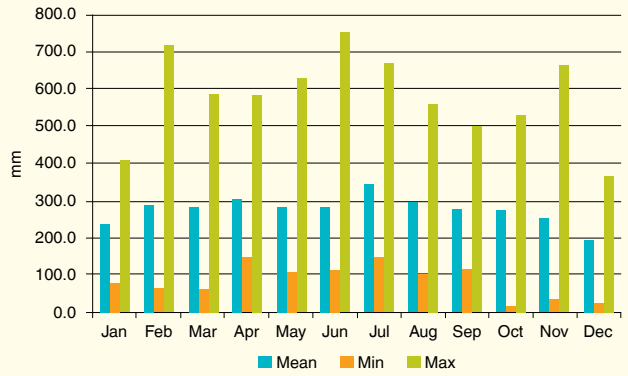


Figure 6. Observed rainfall 1975–2010 (Taro station)
NB: Raw rainfall data provided by Solomon Islands Meteorological Service

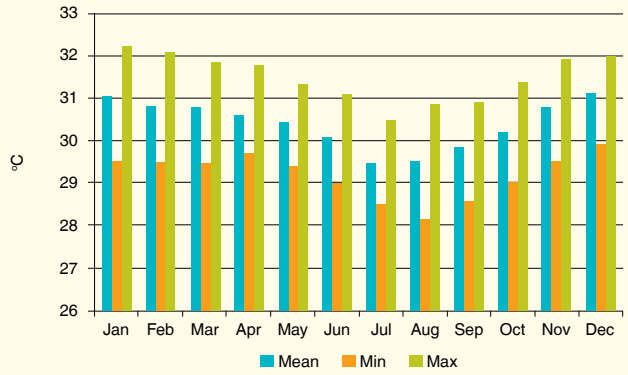


Figure 7. Minimum temperature Taro (1975-2010)
NB: Raw temperature data provided by Solomon Islands Meteorological Service

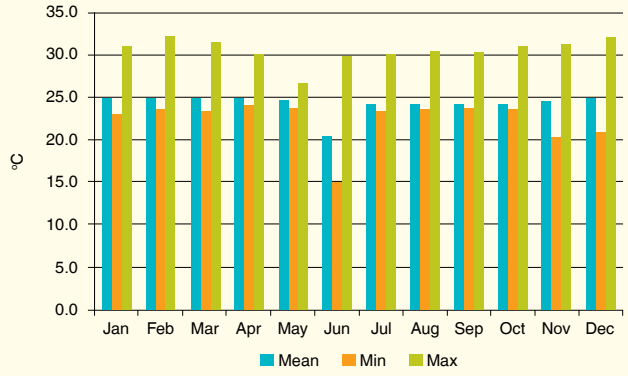


Figure 8. Maximum temperature Taro (1975-2010)
NB: Raw temperature data provided by Solomon Islands Meteorological Service

5.5.7. Climate

Choiseul, like the rest of Solomon Islands, has an equatorial maritime climate influenced by El Niño Southern Oscillation (ENSO) events, the South Pacific Convergence Zone and the West Pacific Monsoon. Between 1970 and 2010, eight tropical cyclones passed within 200 km of Taro Island (Australian Bureau of Meteorology, 2012) but none has passed within 50km. However, Choiseul has been affected by nearly all the tropical cyclones that hit other parts of the country. For example, tropical cyclone Namu was frequently referred to during this assessment as having caused damage to food gardens and strong storm surges, although it passed more than 200 km from Taro Island.

There is only one meteorological station on Choiseul province and it is on Taro Island. It is, therefore, quite difficult to accurately assess the climate of the province; nevertheless, the data from Taro are deemed sufficient for the purposes of this study.

Rainfall in Choiseul is highly variable, as illustrated by the difference between monthly minimum and maximum rainfalls. The difference ranges between 330 mm and 655 mm (Figure 6). This was highlighted by villagers, who said it affected natural resources and community livelihoods. Extreme and frequent rainfall is usually associated with river-based flooding and landslides, blocking of water supplies, and reduction of water quality, while low rainfall can threaten food and water security, especially in areas fully dependent on rainwater, such as Taro and Vaghena.

Apart from December, the mean monthly rainfall invariably stays within 200 mm to just above-300 mm (Figure 6), while differences between the mean and maximum rainfalls in each month are higher than the difference between the mean and

minimum rainfalls. This supports the reports from communities regarding the susceptibility of Taro Island and Choiseul in general to extreme and deficit rainfalls (very high and very low rainfall).

Minimum temperatures show relatively low variation — about 240C to 320C — between 1975 and 2010 (Figure 7). Maximum temperatures, however, show a trend (Figure 8). They drop in the middle of the year from about 320C to about 290C. The June–August dip period, which coincides with a period of maximum rainfall, most probably occurs because of increased cloud cover during the wet season and cooler air blowing from the south.

5.5.8. Environment

The recent past (2009–2011) and current provincial medium term development plans (2012–2014) provide political and development impetus for the protection of the environment and climate change response. However, the implementation of development plans is usually constrained by limited resources and expertise, and inattention to the plans in the ongoing programmes of stakeholders. A crucial policy document with immediate relevance to environmental protection and restoration, as well as climate change, is the Choiseul Province ridge-to-reef conservation plan, which benefited from wide consultations within the province, the support of TNC and LLCTC, and political backing from the province.

The Choiseul Province ridge-to-reef conservation plan registered 11 different types of forests in Choiseul (Figure 9). Choiseul is thought to have some of the last remaining primary forest in Solomon Islands. This needs verification, however, given the current extent and intensity of logging and population growth. The *Xanthostemon melanoxylyn* (ironwood) forests are of particular concern within the context of the nickel and cobalt mine that is about to commence operations in eastern Choiseul. It is also worth noting that the environmental impact statement by the mining company (SMM Solomon Ltd) indicates that trials on iron-wood regeneration are currently under way.

Figure 9. Broad vegetation types

Source: Lipsett-Moore et al., (2010)

In addition to its limited tangible economic and social benefits to most landowners and the province, logging operations are a major driver of degradation of land and aquatic ecosystems. Further, the influx of foreign logging workers, combined with logging royalties into the local economy has contributed to antisocial behaviours such as alcoholism and teenage pregnancy. In terms of pressure on the land and marine-based resources, an alarming trend is the increasing number of timber rights applications for previously logged areas. On the other hand, the commercial sector is poised to diversify when the nickel and cobalt mine in eastern Choiseul commences operation.

Barrier, fringing and patch reefs surround most coastal waters of the province (Figure 10). In general, fringing reefs followed by barrier reefs (especially around Vaghena) dominate the reef systems in Choiseul. Other important features are terraces and lagoons, which are also essential to artisanal fisheries.

Figure 10. General marine features of Choiseul

Source: Lipsett-Moore et al., (2010)

The provincial ridge-to-reef conservation plan maps low and high priority terrestrial and marine conservation areas of the whole province. Figure 11 shows that most of the high priority conservation areas are located adjacent to densely populated areas, which is indicative of areas that are most likely to be affected by human activities. Furthermore, inland terrestrial high priority conservation areas are limited, compared to marine areas. Nevertheless, the plan in general is a positive step towards promoting the integration of terrestrial and marine resources management under the ridge-community-reef (RCR) approach.

Since the plan's endorsement in 2010, however, there has not been much progress regarding the demarcation of more conservation areas, especially those that were assessed and designated as high priority conservation areas. It is therefore essential that agreements from this process are strengthened through further consultations with land-owners, and that action is taken to register these areas under the recently passed Protected Areas Act 2010 and the provincial fisheries ordinance.

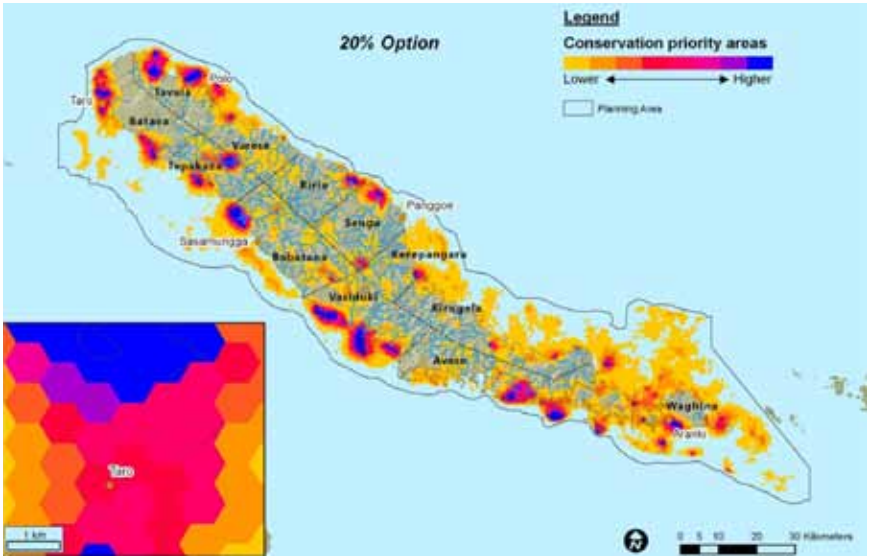


Figure 11. Priority conservation areas factoring in climate change

At the time of the preparation of the provincial ridge-to-reef conservation plan, the following marine and terrestrial protected areas were in existence or have been proposed (Table 4). Most of these protected areas lack management plans. Work towards developing management plans started in 2012.

Table 4. Protected areas as at 2010

Name	Designation	Zoning	Hectares
Zinoa	Locally Managed Marine Area	No Take	145
Parama	Locally Managed Marine Area	No Take	348
Redman	Locally Managed Marine Area	No Take	109
Chivoko	Locally Managed Marine Area	No Take	83
Rabakela	Locally Managed Marine Area	No Take	22
Tabubiru	Locally Managed Marine Area	No Take	78
Muzo	Locally Managed Marine Area	No Take	495
Moli	Locally Managed Marine Area	No Take	137
Vacho Islands	Locally Managed Marine Area	No Take	201
Sub-Total			**1,618**
Katurasele Managed Area	Managed Area - Existing	Unknown	339
Tuzu Managed Area	Managed Area - Existing	Unknown	132
Tandanai Managed Area	Managed Area - Existing	Unknown	374
Chivako Forest Protection Area	Protected Area - Existing	Unknown	516
Managed Area (no name)	Managed Area – Existing	Unknown	47
Sub-Total			**1,408**
Vuri Forest Protection Area	Protected Area - Proposed	Unknown	613
Sirebe Forest Protection Area	Protected Area - Proposed	Unknown	559
Padezaka – Forest Protection Area	Protected Area - Proposed	Unknown	448
Kubongava Forest Protection Area	Protected Area - Proposed	Unknown	897
Baukoalo Forest Protection Area	Protected Area - Proposed	Unknown	1,262
Boeboe Forest Protection Area	Protected Area - Proposed	Unknown	1,108
Sub-Total			**4,887**
Grand Total			**7,913**

Source: Lipsett-Moore et al., (2010)

In general, the natural environment of Choiseul is ecologically relatively intact when compared to other provinces such as Guadalcanal and Malaita. However, there are areas where the natural environment has been degraded to levels observed elsewhere. Such areas are usually those where logging is taking place (or has taken place) and support a high population. This assessment applies to both terrestrial and marine ecosystems.

5.6. Summary

As is the case for most of Solomon Islands, Choiseul Province has a host of geographical, social, political and economic limitations. However, there is also untapped potential, particularly in investing in natural and human capital and strengthening the subsistence economy. Livelihoods in rural communities are also affected by the limited political and economic powers of provincial governments, lack of development plans for rural communities, political indifference, and lack of coordination and integration of national and provincial governments' recurrent and development programmes. Additionally, ongoing challenges relating to basic social services such as transport, health and sanitation, as well as education and gender inequities, affect the sensitivity and adaptive capacity of Choiseul people.

It is foreseeable that, with the ongoing momentum of logging and the upcoming nickel mining, the terrain in areas logged and mined stand to be altered, and may not fully recover to its original state, even with restoration efforts. Moreover, the coastal zone, which is heavily influenced by human activities, will be subjected to enhanced coastal

erosion and shoreline recession, as well as sedimentation. As one moves from the western end of the province to the eastern end, especially in the main island, flat land ideal for development becomes less available. This is reflected by the location of three out of the five AOAs being on coastal areas on or close to the north-western end of the main island. Consequently, food gardens and cash crops (coconut and cocoa) tend to be planted on sloping land towards the eastern end, and occupy most coastal flat lands and offshore islets.

Most of the ~27,000 population, homes and key infrastructure (e.g. schools and clinics) are located in the thin coastal strips, which are often bisected by rivers and streams and bordered by swamps and hills on the landward side. Consequently, most communities are prone to be negatively impacted by sea level rise (SLR), storm surges, coastal inundation, river-based flooding, tsunamis and spring tides. In some areas, especially in the south-east where there are offshore islands, people have shifted to these islands because of population pressure, limited land for houses, storm surges and tsunamis.

With a climate already showing visible variation, especially in terms of maximum and minimum rainfall and surface air temperature, climate change is already being experienced in the form of intense and frequent rainfall and SLR. While some advances have been made in the area of biodiversity conservation planning through the province's ridge-to-reef conservation plan, progress on the ground is still limited. Moreover, other areas need strengthening. These include waste management, 'cleaning' of logging operations, and articulation of the interconnectivity of environmental issues with the economy and livelihoods of Choiseul people within development policies and provincial programmes.

The lack of transportation, the distance to internal and external markets, limited economic empowerment of rural communities, limited expertise and political indifference have all worked against efforts to realise the economic potential of Choiseul. Therefore, the capacity of the province and its communities to meet their basic needs is also limited. This situation reduces the adaptive capacity of the province and increases its sensitivity to climate change and other socioeconomic vagaries.

6 Results and discussion

The climate change impacts experienced by communities are underlain by both climate change and non-climate change drivers. It is, therefore, sometimes difficult to pin-down the impacts of climate change separately from those of non-climate change causes. The difficulty is indicative of the complexity of allocating impacts to causes and, more importantly, the need to assess impacts within a pretext that climate change impacts cannot be assessed in isolation from other ongoing drivers of change affecting local communities, their resources and their livelihoods.

In this report, the impacts will be discussed separately according to the following sub-sections, coastal/marine impacts, land-based impacts (agriculture, forestry and water) and community livelihood impacts. Table 5 summarises the main climate, sea level and tidal changes experienced by the 27 communities.

Table 5. Community perceptions of climate change and sea level and tidal changes

Parameter	Observation/Experiences	Comments
Rainfall	Increase in frequency Intense and prolonged episodes	
Air temperature	Increase (hotter)	
Weather pattern (calm and rough)	Out of sync with established norms	More stormy than before
Sea level	Increase (rise)	
Tide[6]	Extreme lows and highs Shift in season and duration	

6.1. Coastal and marine impacts

The coastal and marine impacts have been divided into two main categories:

- Community safety and assets (houses, churches, clinics, roads and coconuts)
- Coastal and marine ecosystems (mangroves, coral reefs and inshore fisheries)

6.1.1. Community safety and assets

Of the 27 communities visited during the study, only one had the majority of community and key assets located inland and above 10 metres from mean sea level. This statistic can be generalised as follows, most communities in Choiseul are located in thin low-lying coastal strips of land which are often bordered on the landward side by creeks, swamps and hills, and bisected or adjacent to rivers and streams.

Consequently the following impacts have been observed in communities.

- Coastal erosion (Figure 12 and Plates 2&3)
- Net shoreline recession over the past 2-5 decades (landward migration of the shoreline from net loss of sediment) averaging at about 0.4–0.8 metres per year (based on anecdotal information supplied by informants)
- Houses, coastal roads, water standpipes and graves have been lost to the sea as a result of erosion and shoreline recession
- Waves overtopping into villages during spring tides and local storms
- Waterlogged community grounds
- Saltwater intrusion into wells (Vaghena)

The close proximity of Choiseul to some of the most active seismic regions in Western Province and Bougainville suggests the likely role that tectonics could play in enhancing subsidence and thereby increasing the relative sea level, inundation and shoreline recession. A case in point is the section of Nuatabu village, which has experienced rapid inundation within the past two years (Plate 1). Further specialised studies to assess the influence of tectonics and subsidence together with SLR are required (Ballua, Bouin, Siméoni et al., 2011), but the need to relocate is self-evident and does not need to be postponed until the cause of rapid inundation is established.

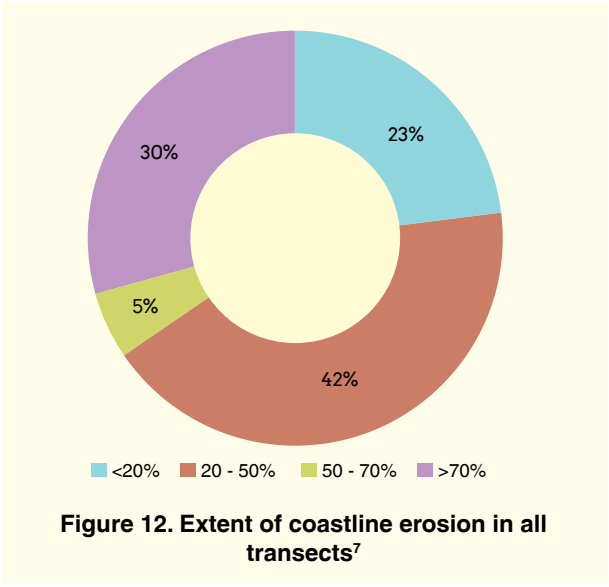


Figure 12. Extent of coastline erosion in all transects[7]

Plate 1. Inundated section of Nuatabu community at low and high tide

7 The coastline of each community was assessed through 3 x 40 m transects..

All 78 transects showed visible signs of erosion (net loss of sediments). Transects were estimated at 40 metres along the coastline (Appendix 3). Figure 12 indicates that 42% of the transects were eroded by as much as 20–50% of their length. 30% of the transects showed more than 70% erosion (most eroded), 5% registered between 20% and 50% erosion and 23% showed less than 20% erosion (relatively stable coastline). The transects that registered the least level of erosion (<20%) were usually located on coastal sections where the main substrate between the low and high water marks consists of rocks and boulders (rocky outcrops), sheltered coastline (less exposed to prevailing winds and strong wave action) and areas intervened by mangroves. The converse of the above trend largely explains transects that were assessed to have the highest level (>70%) of erosion. It is also worth noting that the inappropriate location of logging ponds, rudimentary stone sea walls and groynes, and mangrove deforestation have also been observed to enhance erosion and subsequently coastline recession. Plate 2 illustrates enhanced coastal erosion through the obstruction of longshore sand deposition by a former logging pond.

Plate 2. Enhanced coastal erosion as a result of an ill-planned log pond

Plate 3. Coconut palms lost to erosion

Buildings and coconut palms are the most affected by coastal erosion in many communities (Plates 2 & 3). For a number of communities, setting new developments further inland and relocation of existing infrastructure are clearly the most appropriate adaptation measures. However, these measures have been subdued by land disputes, concerns about loss of community cohesion and the cost of relocating existing infrastructure. The resistance to relocating existing infrastructure was observed to be exacerbated by prior inappropriate location of key social infrastructure, such as schools and clinics, and subsequent reinvestment through government and private projects. For example, in Panggoe, significant investment and reinvestment into the area health centre and school did not seem to consider the low-lying topography and the close proximity of the sites to an inland swamp and the coastline. Yet it was glaringly visible that the ground under these two buildings is almost permanently waterlogged.

From Figure 13, it is clear that sand (coral and riverine-based) is the predominant substrate of community coastlines in Choiseul. This is also indicative of the aesthetic preference for sand, which often results in people removing mangroves to allow sand deposition that inadvertently increases the potential for coastal erosion and shoreline recession. Moreover, coastal erosion is also enhanced through increasing population and particularly increased activity on the coastline such as aggregate extraction, human trampling (no designated points of beach access), domestic pigs digging sandy areas and water supply standpipes being allowed to run down the beach. These impacts are exacerbated by SLR and storm surges, making shoreline recession very severe in many communities in Choiseul.

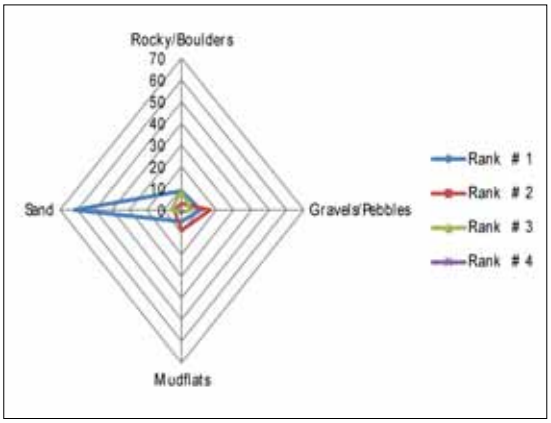


Figure 13. Dominant coastline substrate between low and high water marks

Man-made coastal protection (MCP) measures such as seawalls and groynes (Plates 4 and 5) are generally not popular. In fact only seven of the 27 communities visited have some form of MCP measures along their coastline, though they are not extensively used. Only Arariki and Kukitin have extensive stone seawalls but they were evidently breached during spring tides. In two villages, seawalls constructed of stones in gabion wire were also observed to be used as groynes (at 900 to the coastline: see Plate 5) to trap longshore drift sediments, resulting in accretion on one side of each groyne and recession on the other side. Other MCP measures used were constructed of a mix of local materials such as stones, sticks and timber. In one of the communities, a stone seawall had been constructed on a coastline bearing mangroves at the fore. This seawall has obstructed the landward migration of mangroves. What is apparent from the communities with MCP measures is that they were not advised of the fundamentals of coastal protection and the measures were technically faulty and inadequate to remedy erosion and recession.

Plate 4. A seawall constructed of stones, sticks and timber. This area was previously protected by mangroves, which have since been removed, resulting in erosion, even after the construction of the seawall.

Plate 5. A local attempt to build a groyne to slow down rapid coastal erosion. This groyne made from gabion wire and rocks fell apart in less than two years. The other side of the groyne experienced rapid erosion after it was built.

The overwhelming evidence of the loss of coastal trees, other vegetation, graves, homes and water supply standpipes; sub-soil saltwater intrusion in coastal areas; collapsed MCP measures; and net shoreline recession of 0.4 to 0.8 m per annum indicate that present foreshore protection measures are inadequate to remedy coastal erosion and recession (Plates 6 & 7). Moreover, mangrove deforestation needs to be discouraged and mangrove reforestation encouraged as an adaptation measure worth taking up now.

Plate 6. An elder pacing out the extent of coastline recession

Plate 7. Mangrove removal heightened the damage by the 2007 tsunami on the coastline, and increased the susceptibility of the coastline to erosion and recession.

The connectivity between the impacts of climate change and SLR and tsunamis was observed in two communities in the southern coast. In one community, prior to the 2007 tsunami, the coastline was noted to be stable, and erosion was not intense; however, after 2007, they observed that erosion intensified. In another community, the 2007 tsunami annihilated all coastal trees and vegetation and extensively damaged the coastline (Plate 7). This could have been a result of mangrove removal (the seafront used to have mangroves), exposing it for ongoing erosion through wave action and SLR. One positive impact of the 2007 tsunami was the relocation of homes inland by members of affected communities without any external coercion.

6.1.2. Coastal and marine ecosystems

The two most significant coastal and marine ecosystems in terms of their support to community livelihoods are mangroves and coral reefs. These two ecosystems and resources will be the foci of this sub-section.

- Mangrove dieback and removal
- Decline in coral health as a result of increased sediment input from rivers in logged forests and waste disposal
- Declines[8] in fin-fish and commercial invertebrates

Apart from deforestation of mangroves, mangrove die-back was reported by some communities. This could be indicative of the changes presently confronting coastlines such as changes to sediment transport and wave dynamics. Mangrove die-back and deforestation were evidenced by stumps, anecdotal accounts and "stranded" mangrove trees (Plate 8). The stranded mangroves, deprived from sediment input from land and overlain with sand, usually die-back after some time. They also indicated the extent of coastline recession and the limit to which mangroves can migrate inland against rising sea levels and intensifying storm surges.

Plate 8. Stranded mangroves in two adjacent communities

In some areas in Choiseul, mangrove forests are still intact, especially those located away from population centres or areas where there has been less conversion, albeit being close to population centres. Nevertheless, mangrove clearing was evident in all communities visited. Mangroves provide food, housing materials, firewood, income (sales of shells, crabs and mangrove fruits), and habitats for fish and shellfish. The functions of mangroves to attenuate storm surges and stabilise the coastal zone were not as well understood as their need for food, firewood and building materials accruable from mangroves.

Based on our observations and discussions with local communities, this study asserts that mangrove clearing is driven by aesthetic considerations, and the need for log ponds and firewood. In particular, the illegal intrusion by logging companies into swamp areas and their need for log ponds have been noted to increase the removal and pollution of mangroves. In addition, the increasing distance between communities and forests and the decrease in trees preferred for firewood has shifted the pressure to the easily accessible mangroves as firewood for cooking and copra drying.

8 It was also noted that over-harvesting and the use of indiscriminate fishing techniques (e.g. use of poisonous vines (Deris spp) and small-mesh size gill nets) according to fisheries experts and some community elders were largely responsible for these declines.

Nearshore reefs adjacent to communities are usually under a lot of pressure from human activities such as harvesting of corals, fishing, transport and pollution. However, we were unable to conduct reef checks as part of this study because of the unavailability of provincial fishery experts after the second trip. For this reason, the information presented will draw mainly from the literature and anecdotal information gathered during community discussions. According to Lipsett-Moore et al. (2010), coral reefs in Choiseul are relatively healthy and largely unaffected by coral bleaching and crown of thorns. Moreover, food fish populations are relatively healthy compared to other provinces. This could also be indicative of the lack of commercial fisheries in the province.

On the other hand, during this study, communities have attested that coral death as a result of sediment input from logging operations and exposure to sun during periods of prolonged low tides is now being observed in their reefs, especially in the near shore reefs. Moreover, most communities noted declines in fin-fish catch, clams and commercially important invertebrates such as trochus and pearl oysters. Their observations were congruent with findings by Ramohia (2006) based on field assessments in Choiseul and six other provinces. Additionally, most communities attributed the declines in fin-fish catch and invertebrates to have been caused by climate change. However, they also recognised that non-climate change factors, such as over-fishing and harvesting triggered by increasing population and pollution, are the most immediate threats to coastal ecosystems.

Plate 9. Harvested coral for lime (for betel nut chewing)

Plate 10. Coral providing habitat for juvenile fish

Apart from their biological and physical importance, reef ecosystems are important to the livelihoods of communities. All communities stated that they depend on reefs for food, income (fish and shellfish sales), housing materials (sand, gravel and stones) and lime for betel nut chewing. Most reefs are still in good condition, as is evident from the high dependency on reef ecosystems. Some communities also reported increased shark activity, and changes to reef structure. The changes were attributed by communities to local storms, tsunamis and changes to the hydrology. The declines are indicative of the imminent threat to the status of reefs and the land-based pressures affecting them.

There is no commercial inshore fishery operation in Choiseul, yet there was consensus amongst communities that there is a decline in near shore fishery productivity. There is now mounting pressure on offshore reefs as artisanal fishers shift their preferred fishing grounds from near shore to offshore reefs (patch and barrier) and sea areas.

Fisheries and marine resources are also affected by population pressure and the decline in traditional village controls regarding access to customary fishing grounds. The reasons for this decline are complex but it appears that an increased community population and a generational shift in traditional authority have led to a feeling of powerlessness with regard to resource management by community elders.

Positive developments to improving marine resource management at the policy level are the enactment of the provincial ridge-to-reef conservation plan and the establishment of some locally managed marine areas. At present, the locally managed marine areas are designated as no-take zones (Lipsett-Moore et al., 2010). These locally managed marine areas were established jointly by communities and TNC/LLCTC, but most of them presently lack

management plans[9] and are therefore not conducive to efforts to gazette them under the national *Protected Areas Act.*

However, the missing link in terms of marine resource management lies in the incongruence of western principles of conservation with cultural approaches to marine resource management. Whereas western conservation approaches seek to limit access to particular ecosystems for long or indefinite periods, local approaches to conservation seek to restock resources for particular occasions, such as custom feasts and church obligations. Moreover, 'protected areas' in the local conservation context are spatially and temporally mobile. These points illustrate the importance of marine resources to the livelihoods of people, and the need for innovative approaches to sustainable marine resources management beyond the establishment and management of protected areas.

6.2. Land-based impacts

The land-based impacts are disaggregated into natural resources (agriculture, forestry and water) and community livelihoods, and they are discussed independently for clarity, although they are closely intertwined. The impacts are also heightened by non-climate change factors such as logging and its indirect impacts such as the displacement of wild pigs to gardens coupled with the reduction in hunting pressure, inappropriate farming practices, opening up of forest canopy, soil erosion and the lack of land-use planning. Whilst the discussion in the next sub-sections will be focused on impacts with immediate links to climate change, these non-climate change factors combine to reduce the resilience of people to climate change and therefore need to be managed in order for adaptation actions to be effective.

6.2.1. Agriculture

Most villages reported a perceived change in climate variability, stating that this was making agricultural production more challenging. Increases in the frequency and intensity of rainfall events were specifically identified as significant threats for crop production. Soil erosion, loss of fertility, landslides and forest damage by strong winds are all likely to become more prevalent, given current land-use decisions. An erratic weather pattern is particularly disturbing to rain-fed agriculture. In addition, erratic weather and increasing temperatures keep people away from their gardens and inadvertently reduce crop production and yields.

Cultural changes, particularly with regard to youth less interested in making and working food gardens, and repeated concerns about theft of agricultural products also heighten the impacts of climate change on agriculture. Whilst traditional and church leadership have blended well in communities and improved governance and social order, aspects of social decay were evident in the overwhelming identification of pilferage as a threat to food security and as well as complaints about alcohol abuse.

In all communities visited, it was clear that a combination of climate and non-climate related threats are combining to increase the vulnerability of communities to food insecurity. The following impacts have been reported and observed locally:

- increase in pests and diseases in food gardens;
- flooding of food gardens and cash crops (coconuts and cocoa) by rivers/streams;
- waterlogging of gardens on river terraces;
- top soil erosion;
- increased incidence of landslides on sloping land garden areas;
- reduced crop yields.

Plate 11. A notice with a bible verse to stop people picking coconuts

9 TNC has started working with the communities from September to develop management plans for marine protected areas they have helped to establish.

The net impact of both climate change and non-climate change factors (e.g. repeat gardening and lack of crop rotation) on agriculture is the observed reduction in the yields of crops. Taro, which used to be a staple crop throughout Choiseul, has been noted to be under-performing in terms of yield. The increasing temperature could be a key factor. A study on taro in Makira reported that reduced taro yield is positively correlated with increasing temperature (Ministry of Environment, Conservation & Meteorology, 2008). Additionally, increasing numbers of pests and diseases were observed to be also contributing to the reduction of taro yields (Plate 12).

Plate 12. Pest and disease infected taro

Plate 13. Pest (Monolepta violacea) infested sweet potatoes

According to the agriculture experts in the V&A assessment team, community complaints about food garden pests and diseases may be driven in part by the increasing rainfall regime which favours fungal and water mould types of diseases. On the other hand, a decrease in crop rotation could be a factor — planting sweet potatoes over and over in the same place can lead to a build-up of weevils or other pests (Plate 13). In addition, an increase in air temperatures and water-logging, and a decrease in soil fertility could all be making crops more susceptible to pests and diseases.

Whilst agricultural techniques have evolved and been utilised over generations, it is clear that the environment is changing and with growing population demand for higher productivity of food gardens, old techniques such as slash and burn and shifting cultivation are less appropriate. Whilst the agriculture division recommended ten to fifteen years fallow periods for gardens, many garden sites were being used repeatedly due to a shortage of land to move to and land dispute aversion. Food gardens on steep slopes and unstable soils have experienced increases in landslide frequency and topsoil erosion during heavy rainfall events. The susceptibility of lands to landslides increases eastwards and inland throughout the main island. On the other hand, increasing rainfall and failing crop yields have also triggered reactionary adaptation measures such as the resurgence in planting and usage of water tolerant crops such as swamp taro and *kakake* (king's food).

Soil fertility was an obvious issue at some sites, and it is affected by a variety of factors such as the gradient of the site, farming practices, climate and the land system. There are 28 land systems with varying soil properties in Choiseul (Hansell and Wall, 1976). Nine of these land systems are unique to Choiseul, and three are the most prevalent in Choiseul. The land systems, in combination with the climate and gradient, can support a variety of crops. However, not all food crops can be grown effectively in each land system without careful consideration of factors such as crop suitability and the most appropriate soil management and farming practices. Some land systems are naturally acidic (pH of soil less than seven) and therefore susceptible to acidification with repeat gardening, while others are poorly drained and susceptible to waterlogging. For example, the Panggoe land system in north-east Choiseul is naturally acidic, so repeated use of garden areas without long fallow periods and soil amendment can further reduce pH levels and affect crop yields. On the other hand, land systems with soils that retain water as a result of their soil properties or location (e.g. swamp land and alluvial flats) cannot properly support crops requiring well-drained soils such as sweet potatoes (Plate 14). In yet other land systems, the soil profile is thin and susceptible to landslides (even if the terrain is of moderate relief) and therefore not conducive to intensive agriculture without contouring and terracing (Plate 15). Unfortunately, most communities were not fully aware of these fundamental aspects of their lands, and their ignorance was heightened by poor technical agricultural support.

Plate 14. Garden on alluvial flats

Plate 15. Garden on slope land

Coastal flat lands are usually taken up by village dwellings, coconut and cocoa plantations and, more recently, exotic timber tree species such as teak and mahogany. In communities with immediate access to flat lands (for example, in the AOAs) or hills with moderate relief, gardens are seldom placed on slopes with extreme gradients. On the other hand, in some villages, the lack thereof or limited flat lands naturally pushes gardening towards slope lands. Gardening on alluvial flatlands and river banks is mainly driven by access and fertility of the soil. For communities with such hinterlands, the impacts of waterlogging and river-based flooding can be reduced by proper drainage and crop rotation in line with rainfall patterns. In some communities, enforced riparian buffers could alleviate impacts on crops and built assets.

Most of the communities with limited flat lands (e.g. Bangara, Kirugela and Katupika wards) have no choice but to make gardens on slope lands where some areas have relatively sharp gradients and are now experiencing an increase in frequency of landslides. Plate 16 illustrates a landslide following the clearing of land for gardening. According to a World Bank study in 2011, Choiseul Province has medium to high risk of landslides (Figure 14) and the increasing intensity and frequency of rainfall stand to exacerbate the above risk.

Plate 16. Recent landslide

6.2.2. Forests

The key drivers of impacts on the hinterland forestry are subsistence farming, cash crops (coconuts and cocoa), and commercial logging. In contrast to agriculture, climate change impacts on forestry could not be clearly discerned based on our discussions with communities and rapid assessment by forestry experts on the V&A assessment team. However, the key climate change related impacts noted are as follows:

- forest fires during drought;
- landslides during or after prolonged and intense rainfall;
- increased top soil erosion and sedimentation due to prolonged and intense rainfall.

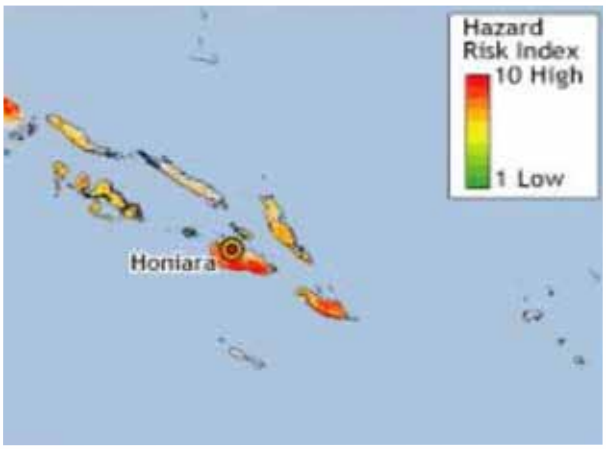


Figure 14. Landslide risk in Solomon Islands
(Source: World Bank Group, 2011)

The majority of the rural population depends on forests for food gardens and cash crop land, housing materials, firewood, timber (cubic), bush food and traditional medicine. The strong dependence of communities on forests for housing materials and firewood reiterated the findings of the 2009 national census, where 50–60% of the 4,712 households were reported to depend on the forest for traditional building materials and 97% depend on wood and coconut shells for firewood. Although this study's sample was not sufficient to make precise extrapolations to the whole province, the above directional concurrences indicate the reliability of its findings and, more importantly, show that communities' dependence on forests is still high. As such, the maintenance and improvement of forests is pivotal to life in rural communities and Choiseul as a whole.

It was noted that the relatively high global demand for timber and conversion of forests to other land uses as a result of increasing population and clearing for gardens and cash crops has led to declines in forest cover and quality over the last 30 years. Commercial logging activities in particular have been noted to be responsible for the rapid decline in forest quality and cover since the 1990s. Logging has not only opened forest canopies and reduced the quality of ecosystem services but has also led to the shifting of gardens further inland (Plate 17). While limited reforestation and afforestation are under way to remedy commercial wood shortage, forest supported ecosystem services such as water protection, soil protection, microclimate regulation, biodiversity refuge, and traditional and cultural facets of forests have declined and proven difficult to restore.

Plate 17. Gardens follow logging roads and located further inland

This study assessed the frequently used community hinterland forests to be relatively healthy and forested mainly by secondary regrowth, but localised degradation is occurring, especially in logged over areas. The increasing rate of new applications for logging concessions is poised to increase the acreage of localised degraded areas, which may eventually connect if remedial action is not taken to curb the rate of logging and to ensure that logging companies adhere to the code of logging practice and their logging agreements with land-owners. Other visible legacies of logging are the thriving of invasive species such as *Meremia peltata* (Plate 18), soil erosion and increased sedimentation of rivers and coastal waters and reefs. At this stage, logging is continuing unabated and unfettered; this trend has been supported largely by the out-dated *forestry and timber utilisation act* (and its various amendments) and landowners' desire for fast cash. What is more alarming with respect to the ability of forests to recover is re-entry logging taking place less than the minimum 45 year harvest cycle recommended for Solomon Islands to operate on a sustainable basis (SKM, 2012). Between 2006 and 2011, about 22,200 hectares of logged-over areas in Choiseul were placed under re-entry logging (SKM, 2012).

Plate 18. An eroded former logging road encroached on both sides by Meremia peltata

The forests' capacity to be carbon sinks has also been reduced. In fact, greenhouse gas emissions from this sector were recently estimated to be 5,688 gigagrams of carbon dioxide equivalent, which amounted to about 91% of all greenhouse gas emissions in 2007 (MECDM, 2011). With some primary forests remaining in Choiseul, and given the rapidly expanding logging operations, incentives to maintain these forests are extremely important. Schemes such as REDD+ and other means of valuing the services provided by these healthy forests could allow land-owners to make more informed decisions when consulted about giving over their timber rights to logging companies. NGOs (Live and Learn and Natural Resources Development Foundation) have been consulting some communities in South Choiseul in order to pilot community REDD+ projects.

Plate 19. Sedimentation set off by logging on riparian forest

Plate 20. The flow-on effect of logging in the marine environment

The effects of logging in Choiseul Province clearly and visually demonstrate the connectivity of land based activities and marine ecosystems and therefore the need for a RCR approach. With logging occurring in an unfettered way, and rainfall becoming frequent and intense, sedimentation of rivers and onward transport of sediments and potential pollutants to the coastal and marine environment are inevitable (Plates 19 and 20). The round trips afforded the authors first hand observation of the impacts of logging on terrestrial and fresh water aquatic ecosystems, and coastal ecosystems. Most communities noted the negative impacts of logging on the land-based ecosystems quite easily; however, in most cases the short- and long-term impacts on coastal ecosystems and community cohesion did not appear to be fully understood.

Plate 21. Logs on a log pond built over a mangrove forest

Reforestation using exotics such as teak and mahogany by families and communities is currently taking place under the support of the Ministry of Forestry and Research. However, the provincial forestry division's effort to encourage families and individuals to have at least 0.5 hectare of local, fast growing exotics and high valued species has not been seriously taken up by stakeholders. From 2000 to 2012, only 400 hectares of exotics (this excludes replanting of about 1000 hectares by a logging company) have been planted under the out-growers programme, whereas the forestry division annual target is set at 350 hectares. It is clear that reforestation and afforestation in the province are not keeping up with deforestation driven by logging and other land uses (Plates 21 and 22).

Plate 22. Reforestation and afforestation ≠ deforestation

The slow pace of reforestation is affected by numerous factors, from the supply side to the demand side of the reforestation programme. On the supply side, the limited number of forestry nurseries, staffing and transportation constraints have been identified by forestry personnel and communities. On the demand

side, a lot of villagers are hesitant to purchase seedlings despite the relatively low cost of SBD$1/seedling. This hesitance might be due to the lack of immediate financial benefits from the trees. On the other hand, when seedlings are provided free, communities readily accept the seedlings. Nevertheless, unrestrained logging and increasing conversion of forests into food gardens and cash crop plantations, including exotic hardwoods, underlie deforestation and the difficulty to match reforestation and afforestation with deforestation.

6.2.3. Water resources

The key impacts of climate change on potable water resources are mainly related to the reduction in quality of water and the increasing incidence of water supply blockage as a result of the increased intensity and frequency of rainfall. On the other hand, all communities visited also recalled the last El Niño event in 1997/1998, which severely reduced the water flow in rivers and streams, and affected the water supply in most communities. The impacts observed so far are linked with extremes (lots of rain and droughts).

Except for communities in Vaghena and Loimuni village, which depend entirely on well and rain water; other communities visited during the study have a water supply or fetch water from rivers and streams. Surface fresh water (rivers and streams) are still in good condition but have also suffered from human activities such as logging and gardening near river/stream banks. Moreover, droughts associated with El Niño have been known to reduce water flows and ultimately affect the availability of potable water in most communities throughout the province. In the case of Vaghena and Loimuni, where there is heavy dependence on coastal wells for fresh water, salt water intrusion into coastal aquifers has been noted to be a problem. It is anticipated that salt water intrusion will become more frequent and could permanently contaminate the freshwater lenses in these low-lying communities under rising sea level.

6.3. Adaptive capacity

Adaptive capacity (AC) refers to all the capacities, resources and institutions needed to plan and implement effective adaptation options. The term adaptive capacity refers here to existing key sources of livelihood, resources (natural and man-made), ecosystem services, institutional support, and individual and community problem-solving capacity that can facilitate the implementation of adaptation actions. A key indicator for AC in this case is the capacity of communities to assess climate change, and plan and implement adaptation measures without external assistance.

Overall, the AC of local communities is not strong enough to enable them to assess, plan and implement adaptation measures without external assistance. However, there are some adaptation measures that can be implemented without much external assistance. For example, the decision to relocate to higher ground is one that communities are best placed to make rather than external stakeholders, because community members are also landowners. One underlying, cross-cutting determinant of whether existing AC at the community level can be harnessed for adaptation is community organisation and cohesiveness. For example, some landowning groups had repeatedly resisted requests to undertake commercial logging in the interests of protecting natural and cultural resources of their area. It could be argued that these villages have a higher AC, particularly with regard to EbA approaches, as their ecosystems and social structures appeared more intact.

This study was unable to provide an in-depth analysis of AC at the family and individual level. The focus on communities was considered sufficient for the purposes of the V&A study. It is noted that an in-depth analysis of AC within a village could provide useful information on intra village variability on AC and more detailed information based on gender, age and other factors.

6.3.1. Subsistence livelihoods

Local communities still have control over their subsistence livelihoods, especially in food production. However, their grip on food production has come under stress from a number of different factors, ranging from external (climate change) to internal (inappropriate farming practices, wild pigs, over-harvesting and population growth) factors. Taking measures to strengthen subsistence farming and secure wild harvests from the sea and forests will improve their adaptive capacity and reduce their sensitivity to climate change and external anomalies such as inflation and global market aberrations.

6.3.1.1. Food and income

The centre of livelihoods in communities is subsistence-based, where food gardens, wild harvests (forest) and fishing (fin-fish and shellfish) are indispensable to rural communities. Their high dependence on local foods helps to reduce their exposure to international food price inflations, which has a positive effect on their adaptive capacity. On the other hand, it also increases their exposure to climate vagaries. Consequently, securing the capacities of food gardens, forests, mangroves and reefs to maintain or increase yields under climate change and increasing population cannot be over-emphasised.

Table 6. Main Foods

Food for Consumption	Food Sold for Income
Taro	Taro
Swamp Taro	Swamp Taro
Sweet potatoes	Sweet potatoes
Cassava	Cassava
Banana (plantain)	Banana (plantain)
Yam	Yam
Pana	Pana
Leafy Vegetables	Leafy Vegetables
Kakake	Kakake
Coconut	Coconut
Fruit trees (e.g. cut-nut and ngali)	Fruit trees (e.g. cut-nut and ngali)
Rice	
Flour	
Noodles	
Canned (fish, beef)	
Fish	Fish
Crustaceans	Crustaceans
Shellfish (mangrove and marine)	Shellfish (mangrove and marine)

Table 6 shows the major types of food eaten and sold for income in communities. Manufactured foods are seldom sold for income (apart from shops), although they can be bartered or used as a medium of exchange in place of cash for labour. Upland rice planting has only recently started in a few communities and is, therefore, an insignificant contributor to food security. It is worth noting that food preferences in rural communities have changed substantially since colonial days; this was evidenced by the frequency in which rice, flour and canned foods have been included in lists of foods for subsistence purposes.

Subsistence food production and income generation are intertwined, since local and external marketing of food crops and wild harvests from the sea and forests are also sold for income. In other words, food production and harvests for subsistence and income generation go hand in hand. For areas where agricultural production is not encumbered by pests, diseases and the climate, the intertwining is still functioning well. On the other hand, where either wild harvests (sea and forests) or agricultural production are presently under-performing, the connection between food production for subsistence and income generation has begun to degenerate. Nevertheless, all communities visited are still engaged in some form of internal marketing of food and fish.

Apart from Vaghena where they depend heavily on food from shops, all communities in Choiseul indicated that their main food sources are food garden, sea/reefs, shops, and wild harvests from mangroves and the forest. The main uses of the forest are land for gardening, cash crop plantations, housing materials, firewood, timber (income), bush food and traditional medicine. The main uses of mangrove forests are food, housing materials, income (shells, crabs and mangrove fruits), firewood, and breeding sites for fish. The main uses of reef ecosystems are food, income (shells and fish), local housing materials (sand, gravel and stones), and coral for lime (for mixing with betel nut).

Except for seaweed on Vaghena, aquaculture in Choiseul Province is limited and not considered a traditional practice due to the abundance of products available from highly productive marine ecosystems, particularly coral reefs (Pinca, Vunisea, Lasi et al., 2009). The Planning for Fish Security in Solomon Islands (Weeratunge, Pemsl, Rodriguez et al., 2011) report uses a number of future scenarios based on a number of different futures, including population increases, fish catches, and exports and imports of fish, and concludes that aquaculture will be critical to meeting the future nutritional needs of Solomon Islanders.

The above descriptions underline the significance of maintaining and enhancing the ecological health of terrestrial and marine ecosystems in order to maintain food security in communities. The mode and means of maintaining or improving the ecological health of forests, rivers, mangroves, coral reefs and nearshore waters have to be carefully selected to ensure that the access of communities to these ecosystems to obtain food and materials

is not completely denied. Moreover, the need to establish alternative source of fish supply through aquaculture is pertinent. To this end, the Ministry of Fisheries and Marine Resources has a strategic plan for aquaculture development.

6.3.1.2. Energy sources and issues

The majority of the rural population depends on firewood and coconut shells and husks for cooking. This finding is also in line with the 2009 census, which noted that 97% of households in Choiseul depend on firewood for cooking. It was noted that the increasing population is putting more pressure on this resource, both through an increase in demand for firewood and increased clearing for gardens and cash crop plantations. In Choiseul, two particular tree species (*Pometia pinnata and Vitex coffasus*) are favoured for firewood, yet despite the dependence on these two species and increasing pressure for their use as timber, they are not replanted through a dedicated reforestation programme. Importantly, it was noted that mangrove wood was favoured as a firewood source for copra drying.

For lighting, many rural households use solar power (some donated by politicians) and kerosene lamps. Some have only dry batteries and use their relatives' or family friends' solar panels to charge their batteries. While solar lighting is increasingly used to remedy the high cost of kerosene, limited action has been taken to remedy wood shortage. A variety of options — ranging from planting woodlots to using alternative low-cost energy measures such as biogas generated from livestock wastes (e.g. pigs and cows) — has to be carefully studied for introduction to communities. Biogas generation is also useful as it reduces waste input into rivers and coastal waters, which is a common practice in most community pig pens. Furthermore, biogas use will also reduce indoor pollution and its negative effects on the health of women who are mostly responsible for cooking.

6.3.1.3. Infrastructure and services

In terms of transport and communication, the communities visited ranked the lack of roads and high fuel costs for outboard motor-powered boats as being more crucial than communication, although the need to have more mobile connectivity[10] throughout the province was expressed. The lack of roads connecting communities to Taro and larger communities with markets severely limits opportunities for rural women to trade their market produce, and to access specialised medical assistance in Taro and Honiara. Some have suggested the refurbishment of logging roads but this option needs to be properly assessed because most logging roads were haphazardly built with little intention to have them vehicle-worthy beyond logging operations. There also needs to be consideration that greater access to areas through roads has led to increased deforestation and land clearing in other parts of the Pacific region, so increasing access would need to go hand in hand with improved land-use planning and protection measures.

In terms of health services, there was general satisfaction with access to nurse aid posts and rural health clinics. However, there were concerns regarding nursing staff shortages in rural health facilities, and the cost and difficulty of transport and access to Taro hospital, and hospitals in Gizo and Honiara for referral cases. Additionally, lack of access to specialised medical services such as dental and women's health are also of concern to the communities.

Water supply, tanks and rivers/streams are the main sources of potable water. In four communities visited, their water supplies have fallen into disrepair, some need urgent repair (Plate 23) and in one community a recently constructed water supply was vandalised. In terms of sanitation, safe methods such as pit latrines, water sealed toilets and flush toilets are not in common

Plate 23. Water supply standpipe in need of repair

10 At present Solomon Telekom mobile network covers four locations (Mamarana, Pangoe, Vaghena and Sasamuqa) in the province apart from Taro.

currency. In most communities, designated spots along coastlines and rivers are used as toilets. The situation has not changed much from the 2009 census, where 3,416/4,712 households in the province did not have proper toilet facilities. Clearly, there is a need to promote hygienic and environmentally friendly sanitation methods.

In terms of education services, access to primary schools was considered satisfactory but access to secondary schools and especially those offering forms 4–6 and early childhood education were considered to be in need of improvement. There were also concerns expressed about the lack of resources (school materials) and qualified teachers, and low literacy levels. Issues regarding the adequacies and inadequacies of the school curriculum, especially whether it prepares the younger generation for life in the village, were also raised during discussions. Whilst the importance of education is unassailable, the present education system also alienates young people from villages and this could have in part contributed to social disorder within communities.

Plate 24. Community leader in front of a nurse aid post which is about one metre above sea level and less than 30 metres from the coastline

Plate 25. This community high school is located on a low-lying area and is 'sandwiched' between the coast and a swamp.

Two of the difficulties affecting the adaptive capacity of communities with respect to the location of key infrastructure pertain to land tenure and land-use decisions at the community level. Key social infrastructure is often located in areas that are naturally prone to SLR, flooding and storm surges (Plates 24 and 25). For example, most of the health facilities, including Taro hospital, are within 50 metres of the coastline. The lack of community planning for village developments and expansion also reduces the adaptive capacity of communities.

6.3.2. Income and Expenditure

Table 7 summarises the main sources of income and expenditure areas per household per month. The data have limitations driven by the following factors:

- the number of communities covered in this study accounted for 5% of the total number of communities in Choiseul;
- the focus was on the major sources of income and expenditure areas only.

The key assumption here is that income and expenditure variability within wards is low. Furthermore, all wards were represented in this study, so the data were considered sufficient for the purpose of estimating the levels of income and expenditure and potential savings that can be tapped for adaptation. Figure 15 shows the main sources of income in Choiseul to centre on a few commodities

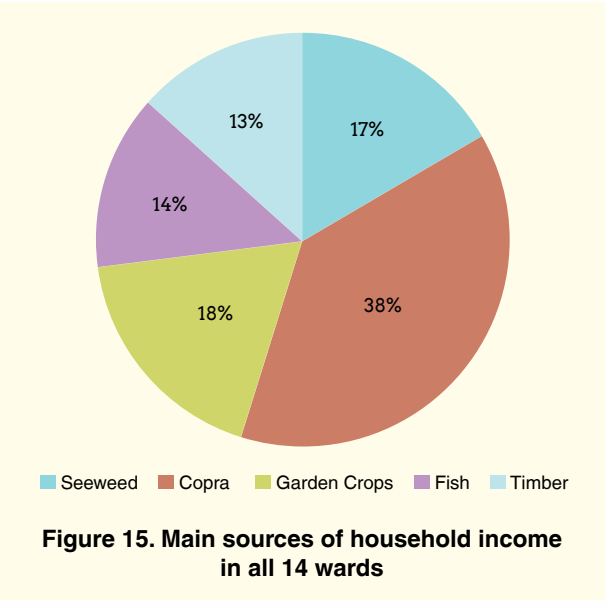


Figure 15. Main sources of household income in all 14 wards

dominated by copra. Fish, garden crops and timber (cubic) are the next important sources of income. Seaweed is a particular high income source for the people of Vaghena. Beside these regular sources, remittances, employment (labour) and running trade stores were also noted but less frequently.

Copra has been the main basis for rural economies since colonial days. Small-scale coconut oil production has started through externally funded projects and was noted in three of communities visited. Nevertheless, copra production is still the dominant commercial coconut product in Choiseul. Income from copra was reported by the communities to be affected by declining yields (aging coconut palms and climate), coastal erosion and, more importantly, unstable market prices. Because of remoteness to external markets and the lack of functional fisheries centres, fish (including shellfish) sales are mostly done internally. When fish catches are high, artisanal fishers also sell their catches at adjacent large communities and Taro (for communities near it). Garden crops are also important sources of income for communities, especially those with sustainable yields. Income from timber (cubic) could not be precisely estimated because of the lack of data. Furthermore, respondents could not easily recall their average monthly income as a result of its irregular production. Interestingly, royalties from logging were seldom referred to as a main source of income, even in communities that are presently participating in logging. This finding strengthens the limited tangible benefits accruable to communities from logging.

Table 7. Household main income and expenditure by ward (SBD)

Ward Names	Communities	Main sources of income/household/month						Main expenditures/household/month					
		Sea-weed	Copra	Garden Crops	Fish	Timber	Σ Income	Food	Household items and clothing	School fees	Transport	Σ Expenditure	Income less Expenditure
Vaghena	Arariki & Kukitin	2880	0	0	0	0	2880	1320	580	170	700	2770	110
Katupika	Boeboe & Posarae	0	650	270	350	420	1690	300	140	270	80	790	900
Vasiduki	Loloko & Katurasele	0	450	160	200	No data	810	180	80	170	No data	430	380
Viviru	Papara & Sepa	0	440	90	110	No data	640	210	100	150	150	610	30
Babatana	Panarui & Sasamunga	0	490	230	160	No data	880	360	130	200	No data	690	190
Tepazaka	Saqigae & Voza	0	640	240	150	No data	1030	280	No data	120	100	500	530
Batava	Loemuni & Molevaqa	0	630	430	170	No data	1230	570	160	210	340	1280	–50
Tavula	Vuraqo	0	450	320	No data	No data	770	110	110	80	50	350	420
Polo	Polo & Ogho	0	440	170	170	No data	780	150	120	230	410	910	–130
Bangara	Voruvoru & Bangara	0	340	120	240	5000	5700	290	140	130	370	930	4770
Susuka	Susuka & Soranamola	0	750	320	280	No data	1350	570	140	110	430	1250	100
Senga	Tabarato & Paqoe	0	530	380	240	1000	2150	380	150	200	240	970	1180
Kerepaqara	Zaru & Taqibangara	0	200	150	150	580	1080	200	140	100	80	520	560
Kiruqela	Nuatabu & Varuga	0	430	200	110	300	1040	270	140	100	80	590	450

Figure 16 shows the relation between incomes from fish and garden crops per ward, indicating that access to markets is most likely the limiting factor in generating incomes from these products. Income from garden crops surpassed income from fish in seven wards. On the other hand, in Katupika ward, income from fish surpassed income from garden crops because of its relatively poor soils and vibrant fisheries sector. In three other wards (Viviru, Polo and Kerepangara), income from fish and garden crops was almost the same. Communities close to larger settlements or logging camps were more likely to generate income from garden crops and fish.

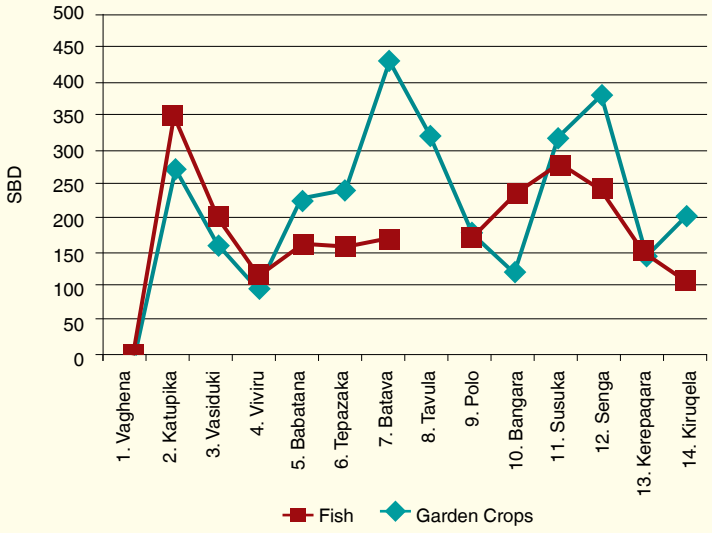


Figure 16. Incomes from fish and garden crops per ward

Variety in income sources was noted to have a buffering effect on the limitations arising from the lack of access and availability of markets, and commodity price fluctuations. In other words, when communities have a variety of income sources, they are able to shift focus to accommodate the above limitations. Vaghena ward is a vivid example of the lack of variety in income sources. Prior to the advent of seaweed production, income generation in Vaghena was mainly based on fish and commercial marine invertebrates. The lack of focus on alternative sources of income has its advantages as well as disadvantages. In terms, of advantages, it allows Vaghena people to develop specialised skills in seaweed farming and reduce their pressure on other marine products such as trochus and beche-de-mer (currently banned but the ban might be lifted if the recent national assessment proves that they have recovered). On the other hand, their single focus on seaweed increases their vulnerability to international sea weed market price fluctuations and environmental vagaries. It is unclear how sea temperature rise, marine pollution and ocean acidification may affect seaweed farming yields but members of the community did request that this information would be important to them. The key factors determining the dominance of any particular commodity as source of income are sustainable yields, access to markets, and reasonable market prices (especially for copra).

Food, basic needs (clothing and school fees) and transport are the major areas of expenditure for rural households (Figure 17). The relatively high monthly expenditure on food throughout the wards reflects the growing importance of manufactured foods such as rice, flour, noodles and canned fish in household diets. Changing food preferences and reduction in the productivity of subsistence food gardens were noted to be responsible for the above trend. Transport expenditure in Vaghena was particularly high because of the need to commute by boat to seaweed farms on nearby islands.

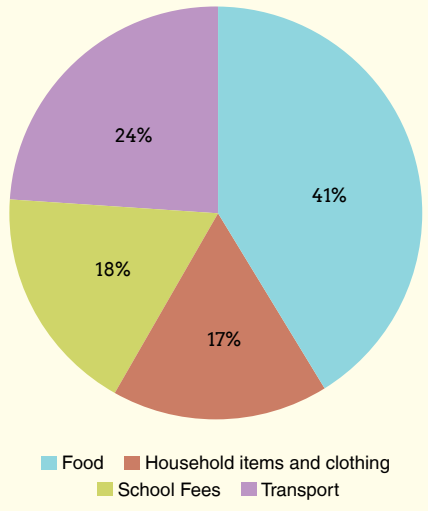


Figure 17. Main household expenditures in all 14 wards

Estimates of potential savings based on the difference between income and expenditure reveal that in two wards (Batava and Polo), their expenditure surpassed their income. This could have been an artefact of the limitation of this study or could well be an indication of unaccounted incomes such as gifts and remittances from relatives. The high level of savings reported for Bangara ward was driven mainly by the large income reported from sawn timber (cubic). However, cubic

production is not a regular source of income because of its labour intensiveness and dependence on shipping and local buyers. Beside the above 'extremes', potential savings from the other 12 wards ranged from as low as SBD 30 to a maximum of SBD 1,180 per household per month. These 'gross savings' are low and reduces the capacity of households to engage in capital intensive adaptation initiatives on their own. In addition, the above also indicates that economic activities should be factored into adaptation measures planned for communities because, without doing so, it is quite likely that their pre-occupation with generating adequate income to meet their needs can work against adaptation implementation. The need to factor economic development to adaptation concurs with the latest provincial medium-term development plan, where economic development was ranked ahead of all other issues requiring attention.

6.3.3. Key ecosystem services and EbA

The future of Choiseul Province is inextricably linked to its terrestrial and coastal biodiversity and ecosystems. Therefore, the AC of Choiseul Province is closely linked to its ability to continue to use ecosystem services provided by these ecosystems for both the subsistence and cash economies at the community level. Furthermore, intact ecosystems also provide a buffer against extreme climatic events. For example, mangrove and other coastal vegetation can help protect people and property from storm surge events (Hills, Brooks, Atherton, et al., 2011). EbA contributes to reducing vulnerability and increasing resilience to both climate and non-climate risks, and provides multiple secondary benefits for people (Table 9). As natural buffers to climate change, ecosystems are often more cost-effective to maintain than physical engineering structures such as sea walls and water tanks (Colls, Ash and Ikkala, 2009). It is, therefore, a readily available adaptation strategy for low income rural areas and can harness the local skills and knowledge of people rather than external engineering experts. Thus adaptation solutions are owned and controlled by local communities.

Water catchment management is an important EbA response for Choiseul. Watershed degradation was reported in some villages, with population growth, logging of important catchment areas and changes to rainfall regimes all reported as contributing factors. Also, communities adjacent to rivers and streams reported an increase in flooding events within the village and surrounding food garden areas. The role of vegetation within a water catchment area, particularly riparian and riverine vegetation, in minimising flood risk is an important response in consideration of the predicted climate change impact of future increases of flooding events. Bringing together landowners and communities within a water catchment area to undertake integrated water catchment management planning is a recommended approach to addressing these issues.

The valuing of ecosystem services and cost benefit analysis of resource use decisions is an important part of assisting decision makers both at the government and community level to make informed decisions in the use of their natural resources. This is particularly pertinent to the current trend to allow commercial loggers on customary land in Choiseul Province. If landowners had a better understanding of the value of these forests and the ecosystem services they provide, better informed decisions over their extraction could be made.

A study on the subsistence and income generation value of forests to Nukiki village in 1991 estimated the value of selected forest goods and services to be about SBD 10,512 per annum (~USD 1500 under present exchange rate) which is substantial (Cassells, 1993) (Table 8). The full value is anticipated to be well above this sum when other ecosystem services such as possible carbon storage payments (e.g. REDD+), micro-climate regulation and aesthetic considerations are factored into such valuations. Although, the above study is more than ten years old, its findings are pertinent, given its contextual relevance, and therefore instructive for the purposes of this V&A.

Table 8. Total annual value of forest produce to a household

Product	Value/annum (SBD)
Garden (produce)	8,679.70
Nuts and fruit trees	250.00
Other forest foods	100.20
Firewood	912.58
Housing	305.00
Canoe	40.00
Miscellaneous forest produce	102.33
Custom medicine	122.34
Total/annum	10,512.15

Barring the limitations of the above study and the individual circumstances of the 27 communities visited in this study, a simple extension of the above valuation to take into account the number of households (4,712) under the 2009 census, puts the total annual value of forest

goods to households in Choiseul at about SBD 49,533,251 (USD 7,076,178) which is about 424 times greater than the estimated provincial revenue for the 2011/2012 period. The glaring difference underscores the importance of forest ecosystems to the livelihood of communities of Choiseul.

Cassells (1993) also applied the valuation to Kuku village, whose lands were logged (without their consent) and noted that on an annual basis, each household (21) made a loss of SBD 7,545.28. This reinforces the well known fact that royalties from logging are grossly inadequate to compensate for the subsistence losses incurred as a result of logging. This could well explain the lack of reference to logging royalties in this study as a major source of income, even in communities which have participated in the past or are currently engaged in logging.

In terms of mangrove forests, the latest economic valuation on mangrove forests in Malaita Province by the World Fish Centre (Albert, Warren-Rhodes, Schwarz et al., 2012) offered the most relevant estimates that can be applied to Choiseul, barring contextual circumstances. The above study estimated that the total value of mangroves (fruit, firewood, timber, fish and invertebrates) per household stand at SBD 8000–22,818 (USD 1,140–3,249) per annum. Once again using this valuation as a guide, it is estimated that households in Choiseul derive environmental goods worth SBD 37,697,000–107,508,416 (USD 5,385,286–15,358,345) annually, which is also substantially greater than the annual provincial revenues.

The above economic studies show that households in Choiseul and the rest of Solomon Islands derive substantial value from both ecosystems. On the other hand, such valuations have not discouraged logging and the removal of mangroves. This is evidenced by the expansion and intensification of logging in Choiseul Province since the early 1990s. Moreover, a logging operation is ongoing near Nukiki village at the time this report is being put together. The above scenario underscores the fact that economic valuations alone are insufficient to coerce action. Their outputs need to be communicated properly to all stakeholders at all levels, and socioeconomic challenges and legislative setbacks must be addressed. Moreover, it shows that the meagre economic benefits gained from the immediate exploitation of forests often outweigh the subsistence value and cash income accruable from ecologically vibrant forests (Cassells, 1993).

Furthermore, protection and restoration of natural defences such as mangrove ecosystems can play a vital role in coastal protection and disaster risk reduction in Choiseul Province. There are two main EbA functions that are relevant to coastal vegetation: reducing coastal erosion from storm surge/cyclones and protection of coastal inhabitants from loss of livelihoods and life. Coastal EbA approaches in Choiseul must focus on ecosystem function with careful consideration of species selection, hydrological considerations and rehabilitation design. Whilst coastal rehabilitation based on ecosystem function are often more complex to design and implement, this is preferable, given the large failure rate in restoration programmes and the additional livelihood benefits of this approach (e.g. fish nursery functions of mangrove forests).

Table 9. EbA measure, additional benefits and current threats to ecosystems

Adaptation		Additional Benefits (Secondary Services)			Threats to Services
Adaptation Measure	**Adaptive Function**	**Social and Cultural**	**Economic**	**Biodiversity**	**Threats to Ecosystems**
Management of tidal wetland systems for coastal protection	Protection against storm surge and coastal inundation. Adaptation to sea level rise (through migration of mangroves). Protection of beaches and islands from wave erosion	Protection of coastal cultural sites Protection of coastal community buildings Maintenance of shellfish and other important foods	Production and maintenance of fisheries Protection of coastal buildings Provision of firewood Carbon sequestration	Conservation of species that live or breed in mangroves Trapping of nutrients and sediments from drainage into nearby ecosystems (i.e. coral reefs).	Mangrove and coastal vegetation clearing. Over use of mangrove for firewood Infrastructure that blocks the ability of mangroves to migrate with sea-level rise.
Management of slope vegetation for landslide risk	Reduction of landslide risk	Provision of local timber/ bush-building materials Protection of cultural sites and traditional ecological knowledge.	Ongoing source of income for sustainable selective harvesting of forest species. Carbon sequestration.	Conservation of habitat for forest plant and animal species. Maintaining freshwater ecosystem health Maintenance of coral reef health due to less sedimentation	Unsustainable logging practices Mining proposals involving forest clearing. Clearing for large scale agricultural production (e.g. oil palm plantations).
Integrated water catchment management	Ecological connectivity Maintenance of nutrient and water flow. Coral reef and marine health Decrease the peak and size of floodwaters	Protection of cultural sites. Maintenance of local medicines, and traditional ecological knowledge. Multiple stakeholder engagement and collaboration.	Planned approach to economic development of natural capital. Protection of agricultural crops from flood damage	Planned conservation of species allowing migration through habitats with climate change.	Lack of an integrated approach to land use. Deforestation of riparian and important water drainage areas. Mining proposals involving pollution and sediment runoff Unsustainable logging practices
Establishment of diverse agricultural and agroforestry systems in agricultural land	Protective vegetation and agricultural yield stability. Food security and maintenance of agricultural genetic diversity. Maintenance of soil fertility	Healthy and varied diet. Maintenance and strengthening of traditional food crops and methods.	Subsistence food security. Cash crop diversity – less reliance on copra markets	Agroforestry trees can have benefits for species	Large-scale mono-culture agricultural production (i.e. oil palm plantations). Excessive fertilizer/pesticide use. Deforestation

6.3.4. Institutional support

In rural communities, the national and provincial governments are at the periphery of leadership and governance. The government is visible and heard at the community level through teachers and health care workers (more widespread than other technical divisions such as agriculture and forestry), and the services they provide in education and health respectively. In addition, government's contribution to their livelihood is also experienced through government-led projects. Tribal leaders and churches are the key players in most communities.

This being the case, all communities visited they felt that they need more technical support from the province (e.g. agriculture, forestry, fishery and development planning) and the national government to address their livelihoods and economic aspirations. The communities also expressed the need for improved two-way flow of information and advice required for development in rural areas. Whilst they acknowledged the geographical dispersal of the province, limited funds and staff shortages, the communities pressed for improved contact and collaboration between the provincial government and rural communities.

The above situation was observed by communities to be deepened by the lack or limited visits by both national and provincial politicians. In addition, the 'politicisation' of various government financial supports, especially through national politicians, was viewed to have many demerits as well as merits. For example, most people from the 27 communities visited in this study were not aware of the redirection of financial flows for copra/cocoa rehabilitation, tourism and reforestation through national politicians. The resources, capacity and legislative limitations described in Chapter 5 are also at play in determining the type and level of institutional support rendered by government, NGOs and churches to rural communities.

As a leading agency in rural communities, the church is partly responsible for shifting the population and establishing communities in coastal areas. The shift increased the sensitivity of communities to SLR and tsunamis. As a leading institution shaping people's behaviour, the churches can on the one hand facilitate adaptation and yet on the other hand they can encumber adaptation if their teachings are misconstrued by their members. For example, in a number of communities, climate change was considered a punishment for humans' sinfulness. Consequently, human beings cannot do much to change that fate. Yet in other communities, it was also expressed that human beings are endowed with intelligence to cope with any problem they might encounter, including climate change. Misconceptions need to be rectified and churches need to be involved in the provincial approach to climate change adaptation.

6.3.5. Capacity issues

Capacity in the context of this report refers to problem-solving capabilities of communities to enhance adaptation and improve their adaptive capacity. A general assessment of communities' problem-solving capacity can be 2 on a scale of 1 to 5, where 5 indicates a high capacity and 1 a low capacity. This assessment is based on the following aspects:

- communities' understanding of climate change and its impacts on their livelihoods;
- key individual capacity needs to strengthen their adaptive capacity.

All communities visited were aware of climate change through the public media (radio, newspaper, person-to-person and NGOs) but they could not distinguish it from weather and, more importantly, did not fully understand its impacts and implications for their livelihoods, safety and standard of living. Nevertheless, they conceptualised climate change in terms of the impacts of present climate variability as experienced through their sources of food and cash income, and sea level rise. However, most communities did not understand how increasing sea temperature and rainfall on the one hand, and non climate change factors, such as overharvesting of marine resources and logging, on the other hand, connected with the status of their marine resources. Their limited understanding of climate change and its ramifications, in addition to climate change's long-term perspective, made it a low priority, as evidenced by the limited adaptation actions being implemented so far in communities visited under this study.

The increasing monetisation of local food production requires communities to also have the technical knowledge and skills to enhance subsistence production and income generation, and manage their finances. In addition, communities also need to be aware of the national and provincial governments' modalities of assistance and

services which they can tap. These skill sets and awareness were observed to be low if not lacking in most communities. Yet such skills and knowledge are pivotal to the improvement of the adaptive capacity of communities. For example, the improvement of food production and income generation (given the importance of garden foods for income generation) require communities to have more knowledge and practical skills in agriculture, such as soil conservation and improvement, crop rotation, pest and disease management, and agroforestry. Options on slowing coastal erosion (as evidenced by continued clearing of coastal vegetation) in communities were not well understood. Whilst the importance of maintaining other ecosystem services such as forests and coral reefs to maintain livelihoods was recognised, the links between the effects of actions on these ecosystems was not so well understood. Additionally, communities also needed to have basic financial management skills such as running small businesses and budgeting. The national government and provincial government need to improve their contact, collaboration and engagement with communities through new approaches, which need to be carefully thought out and tested, especially at the provincial level.

6.4. Sensitivity of communities

The sensitivity or the degree to which land ecosystems, community assets and livelihoods, and coastal/marine ecosystems can be beneficially or adversely affected by climate change is also determined by internal and external factors. Internal factors refer to those trends, behaviours, practices and decisions that communities have direct control over, i.e. they can make and implement decisions). External factors refer to factors that external stakeholders have more control over than communities. Most of the factors can be internally controlled or require both internal and external collaborative control. The focus of this section will be on a set of generic sensitivity factors that have been assessed to exacerbate impacts set off by climate change and SLR (see 6.1 and 6.2). The sensitivity factors are summarised below.

Internal

- Increasing population
- Land and reef tenure disputes
- Lack of deliberate land-use plans and natural resource management plans
- Loss of power of control over management of their own resources
- Not implementing adaptive measures that are not capital intensive
- Over-emphasising the 'victims' approach to climate change
- Communities located on thin coastal strips of land bisected by streams and bordered by swamps and hills
- Limited arable land - forcing the conversion of sloping lands and river terraces as gardening and plantation sites

External

- Fluctuating commodity prices
- Rapid transition to monetise the subsistence sector

Internal/External

- The declining quality of critically important natural capital (reefs/sea, forest, land & gardening) and ecosystem services for subsistence and income generation
- Limited range of tested alternative sources of income
- Unabated and unfettered logging
- Shift towards specialisation on how to meet livelihood needs
- Communities are already under stress from limited socio economic opportunities, infrastructure, and social services
- Limited visits by politicians
- Apparent disconnection to government agencies
- Villagers have few coping strategies identified to cope with present threats to their livelihood sources.
- Limited awareness of climate change and adaptation options
- Rapid socio-cultural changes
- Feeling of a loss of power and control over the management of their own resources and of strategies to deal with threats on their natural resources and livelihoods

The above categorisation was intended to differentiate sensitivity factors that communities can work on without a lot of external assistance from those that can be reduced only through collaboration with relevant external stakeholders. Only two of the sensitivity factors can be classified as being externally controlled; most can be internally controlled by communities or would require collaboration with external stakeholders.

If sensitivity is downscaled to family and individual level, a variety of factors in addition to the above factors will be apparent. For example, the erosion of cultural attributes such as social safety provided by the extended family, and whether families and individuals are receptive to making changes in their personal behaviour and natural resource management practices will be more prominent at the family and individual level. The key point is that multiple factors are responsible for heightening the sensitivity of communities to climate change. Therefore, actions to reduce their sensitivity must also be multi-pronged, carefully thought out and integrated to avoid any unintended consequences.

6.5. Climate change projections

The following projections on temperature, sea level rise and extreme events are reproduced from the Pacific Climate Change Science Program's report Climate Change in the Pacific (2011b). It is to be noted that the projections are for the whole country, as specific climate future data were not available for Choiseul Province. The rainfall projections are derived from a web-based climate projections tool — Pacific Climate Futures (available at www.pacificclimatefutures.net). The outputs were prepared by the Solomon Islands Meteorological Service through its climatology division.

6.5.1. Temperature and rainfall

Recorded temperatures in Honiara have increased by an average of 0.150C per decade (Figure 18), which is consistent with the global warming trends. Both the maximum and minimum temperatures have been increasing.

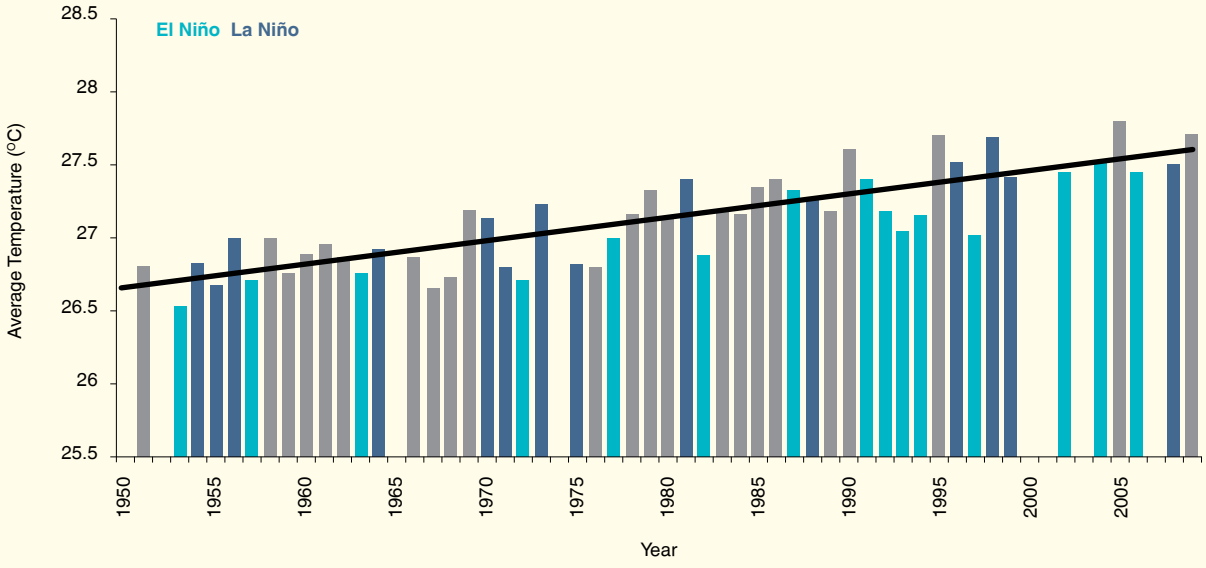


Figure 18. Annual average temperatures for Honiara from 1951–2010

Source: Australian Bureau of Meteorology and CSIRO, 2011. Climate Change in the Pacific: Scientific Assessment and New Research

Table 10. Temperature projections for Solomon Islands under three different emissions scenarios

	2030 (°C)	2055 (°C)	2090 (°C)
Low emissions scenario	0.2–1.0	0.7–1.5	0.9–2.1
Medium emissions scenario	0.4–1.2	0.9–1.9	1.5–3.1
High emissions scenario	0.4–1.0	1.0–1.8	2.1–3.3

Source: Australian Bureau of Meteorology and CSIRO, 2011. Climate Change in the Pacific: Scientific Assessment and New Research

Temperatures are projected to continue to rise (Table 10) with an increase of 0.4–1.0oC by 2030 predicted under a high emissions scenario. Under this scenario, the incidence of very hot days and warmer nights will also increase, with a decrease in cooler weather.

On the other hand, rainfall projections for 2020–2039 and centred on 2030 revealed insignificant monthly variations from the observed data. This means that rainfalls on Taro are projected to be relatively consistent with current rainfall patterns (Figure 19). On the other hand, the Pacific Science Climate Change Programme attested that the majority of models project that the current one-in-twenty-year extreme rainfall events will occur, on average, three to four times per twenty-year period by 2055.

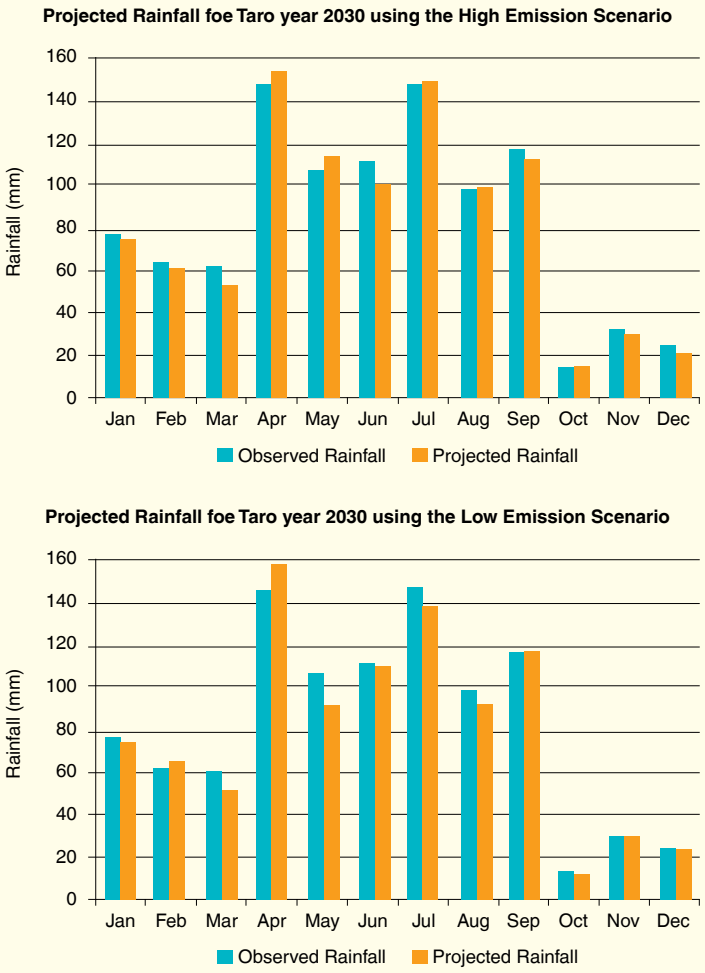


Figure 19. Projected and observed monthly rainfalls

Source: Solomon Islands Meteorological Service

6.5.2. Extremes

The frequency and intensity of the number of days of extreme heat and rainfall will increase (Pacific Climate Change Science Programme Partners, 2011a). Observed air temperatures in all meteorological stations also show an increasing trend, in line with the above projection. Moreover, communities are already complaining of the increasing heat and rainfall. Droughts, on the other hand, are projected to decrease, in keeping with the projection for more intense and frequent extreme rainfalls.

Tropical cyclones are projected to decrease in frequency in the South-West Pacific basin over the 21st century. It is projected, however, that most of the tropical cyclones that do occur will be more severe or intense. No tropical cyclone has passed within 200 km of Taro since colonial days, although communities have experienced bad weather when cyclones passed over other parts of the country, but the projection for more intense tropical cyclones means that the peripheral damaging effects will affect communities even more than they do now, even if the cyclones do not pass directly over Choiseul.

6.5.3. Sea level rise

Sea level rise (SLR) is projected to continue throughout the 21st century and the confidence on this projection is high (Pacific Climate Change Science Programme Partners, 2011a). The above programme also made the following projections for the following periods centred on 2030, 2055 and 2090 relative to 1980–1999.

Table 11. SLR projections for Solomon Islands

Emissions Scenario	2030	2055	2090
Low	4–14	10–26	17–45
Medium	5–14	8–30	19–58
High	4–15	8–30	20–60

Source: Pacific Climate Change Science Programme Partners (2011a)

Whilst the projected SLR might appear to be small, its combination with ongoing variability, extreme tides and coastal biophysical alterations could result in accelerated coastal erosion and shoreline recession.

In addition to SLR, ocean acidification is anticipated to continue. This will have serious implications for the reef ecosystems and the resources that communities depend on for their sustenance and to earn income. The potential impacts will be graver when coupled with unsustainable land-use practices, which increase sediment and contaminant transport to coastal waters under the projection for more intense and frequent rainfall.

6.6. Present and future vulnerabilities

Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity. AC can be high or low. When high, it will reduce the impacts and, eventually, the vulnerability; when low (close to zero) it will not have much reducing effect on the sensitivity and exposure (impact) of the climate threat on that system (sector) under consideration. The above relationship can be expressed as follows:

$f(V) = (\text{Exposure} \times \text{Sensitivity}) \pm AC$ (1)

$\text{Impacts (I)} = (\text{Exposure} \times \text{Sensitivity})$ (2)

$f(V) = I \pm AC$ (3)

Generally speaking, the AC of rural communities is low and this is a recognised aspect of climate change adaptation in developing countries. From the discussion in section 6.3, it is clear that AC amongst communities in Choiseul is low and this was evidenced by the limited adaptation options being implemented and the limited amounts of gross monthly income savings. If we let this low AC be equivalent to zero, then the following equation holds for vulnerability:

$f(V) \approx I$ (4)

In other words, vulnerability under present conditions is almost equal to the impacts of climate change presently experienced. The above relationship, in addition to the climate change projections, will form the basis of the ensuing discussion.

Figures 20 and 21 offer an illustration of the present relative vulnerability based on the vulnerability factors considered significant for Choiseul from RCR and EbA perspectives. These indices were derived from the assessors' observations and from community perceptions on the sensitivity of the factors from relevant climate change and non-climate change exposures. The assessment involved a low-medium-high-not applicable (N/A) scoring approach for each village for a number of categories of vulnerability. This was then converted into an index as follows: High = 3, Medium = 2, Low = 1, N/A = 0. Note that each sub-category of vulnerability was considered of equivalent weight. The sub-categories considered within each of the four broad aspects of vulnerability are as follows:

1. Coastal-based vulnerability

Coastal erosion

Shoreline recession

Waves overtopping into the village

Salt-water intrusion in the wells

Removal of coastal vegetation (mangroves etc.)

2. Land-based vulnerability

Increase pests and diseases in food gardens

Flooding of food gardens

Top soil erosion

Increase in incidences of landslide

Reduced crop yields

Forest fires during droughts

Forest degradation

3. Community-based vulnerability

Reduced income from gardens

Reduced income from sale of fish

Food insecurity

4. Sea-based vulnerability

Decline in coral health

Decline in fish availability

Decline in commercial invertebrates

Details of the vulnerability scores are in Appendix 6. The rankings provided are subjective, based on assessors' and community perceptions. Nevertheless, they are an important step in quantifying the relative vulnerability of various communities. They also provide guidance on what adaptation actions should be targeted in specific communities.

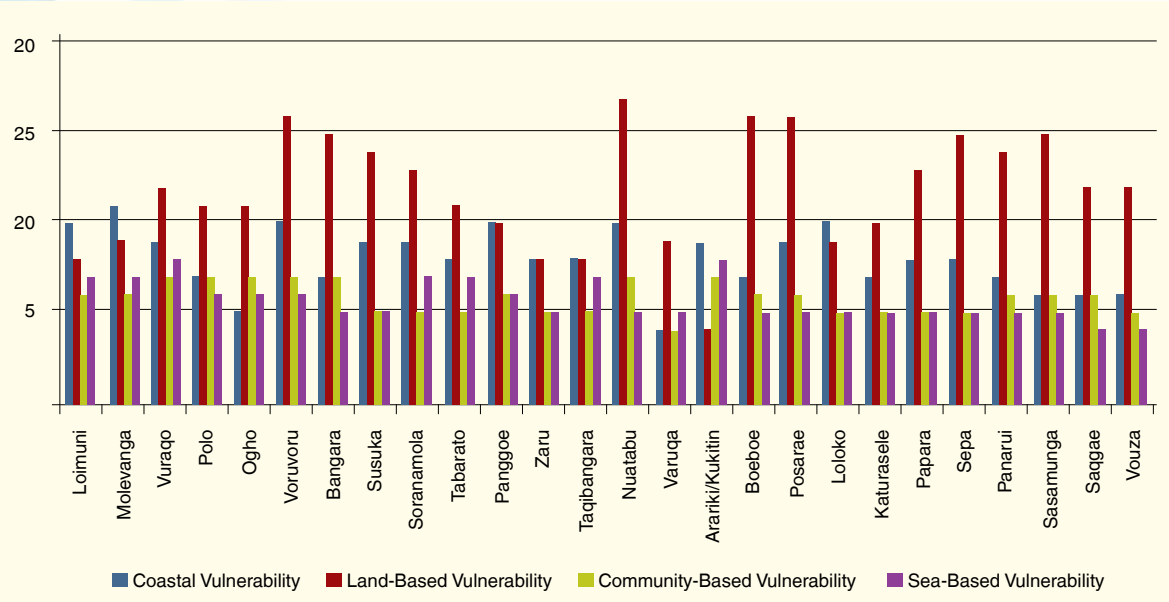


Figure 20. Community sector-based vulnerability indices

The prominence of land-based vulnerability is strikingly visible. Coastal vulnerability comes in second place, followed by sea and community-based vulnerabilities. The prominence of land-based vulnerability over coastal vulnerability departs from the perspective at the international level, where the latter often dominates other sectoral vulnerabilities (because of the emphasis on sea level rise) within the context of Pacific Islands. In this case, SLR was considered within the context of its impacts on the coastal zone, where its impacts were noted by the communities but assessed to be not alone[11] in driving shoreline recession and erosion. On the other hand, the dominance of land-based vulnerability might have been an artefact of it being an aggregation of agriculture and forestry factors, whereas coastal and sea-based vulnerabilities were disaggregated. Nevertheless, the data in Figure 20 are instructive for the purposes of allocating vulnerability from an RCR perspective.

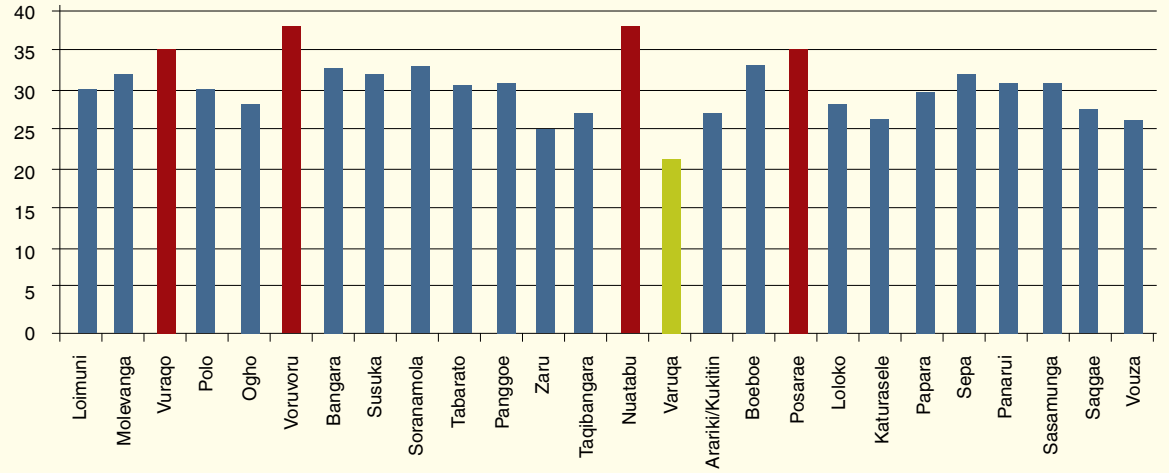


Figure 21. Total vulnerability indices for communities

Apart from four communities (red bars) that registered vulnerability indices greater than or equal to 35 and one community that registered a vulnerability index just above 20 (green bar), most of the communities registered vulnerability indices within the range of 25–33, indicating a relative uniformity in their vulnerability to climate change (Figure 21). For diagnostic purposes, if the maximum vulnerability index is set at 40, all communities registering total vulnerability indices greater than 20 (50%) and can be regarded as being vulnerable to climate change, and those communities surpassing 75% (30) can be regarded as being very vulnerable to climate change.

11 There are other significant non-climate change factors such as mangrove clearance, aggregate removal and inappropriate location of MCPs and log ponds, which contribute to coastal erosion and shoreline recession.

Table 12. Present and future vulnerabilities (NC no change; I/E increase/ensue; D decrease)

Present vulnerability	Relevant climate change projection	Projected future vulnerability		
		NC	I/E	D
Coastal erosion	SLR continues through 21st century.		X	
Net shoreline recession	SLR continues through 21st century.		X	
Waves overtopping into built and natural environment	SLR continues through 21st century.		X	
Intense tropical cyclones.			X	
On-going astronomical tidal regime			X	
Waterlogging of communities grounds	SLR continues through 21st century.		X	
Increase in extreme rainfalls			X	
Loss of coastal coconut palms and trees	SLR continues through 21st century.		X	
Intense tropical cyclones.			X	
On-going astronomical tidal regime			X	
Mangrove dieback	SLR continues through 21st century.		X	
Intense tropical cyclones			X	
On-going astronomical tidal regime			X	
Decline of reef health	Increase in extreme rainfalls		X	
Declines of fin-fish and commercial invertebrates	Increase in extreme rainfalls		X	
Ocean acidification			X	
Reduced crop yields	Increase in extreme rainfalls and temperature		X	
Intense tropical cyclones			X	
Increase in pests and diseases	Increase in extreme rainfalls and temperature		X	
Soil erosion	Increase in extreme rainfalls and temperature		X	
Increased river-based flooding	Increase in extreme rainfalls		X	
Salt water intrusion	SLR continues through 21st century		X	

Table 12 shows that all present vulnerabilities stand to increase or ensue in the future, given the current climate change projections. The above assessment, although it may be rudimentary, is instructive on a number of grounds:

- none of the present vulnerabilities is anticipated to remain unchanged or will reduce in extent and magnitude;
- planned adaptation as opposed to reactionary adaptation is already a need but it is not given the due attention to advance it at all levels;
- RCR consideration is particularly relevant for the holistic management of both land and marine based resources and activities.

7 Securing the future now

Securing the future of Choiseul under a changing climate now is imperative. It cannot be postponed or taken lightly because of the ramifications that climate change and other factors increasing vulnerability (e.g. population growth, unsustainable use of natural resources, thin economic base and biophysical characteristics of inland and coastal areas) have on the livelihoods of communities and the resources they depend upon.

Adaptation to climate change cannot be implemented in a vacuum or independently of the socioeconomic issues and challenges confronting local communities. Rather, it must be tailored to address a variety of inter-related problems (vulnerabilities), including the key challenge of securing and improving the capacities of the subsistence and cash sectors in the province. Addressing current vulnerability will have immediate to medium-term impacts but the challenge lies in addressing future vulnerabilities, given the uncertainties in how climate and non-climate factors might unfold in the future. Nevertheless, the uncertainties of the future should not be used to undermine the drive to address present vulnerabilities.

Moreover, implementers and planners alike must also innovate in terms of the array of adaptations they choose to implement in consultation with all stakeholders. The selection of pilot sites and adaptation measures must be made with the intention of instilling and internalising adaptation to the point that it becomes the norm and the 'gold standard' for climate change adaptation in Choiseul and Solomon Islands.

7.1. RCR and EbA demonstrations

Two key findings of this study pertinent to the implementation of adaptation were the invariably low adaptive capacity and high vulnerability. This being the case, any of the communities visited could be selected as a pilot. However, given the dispersed nature and number of villages, and because of the need to maintain transparency, the following criteria, in association with AC and sensitivity factors, were flexibly used to select pilots:

- community was assessed to be organised and has potential to be a successful pilot site;
- adaptation measures consistent with RCR and, where relevant, EbA can be applied in the community or within the pilot.

Although the initial thrust of this programme was focused on communities, it became apparent during the community consultations that it would also be useful to implement a few adaptation activities at the 'provincial level', where all communities in the province can draw benefits and learn about RCR and EbA and, more importantly, put into practice the principle of integration across different layers within the province. In addition, some pilots have technical requirements that require regular visits by provincial technical divisions. Furthermore, after the V&A assessment, other development partners either currently implementing or intending to implement climate change-related activities in Choiseul have expressed interest in forming an integrated climate change adaptation programme in Choiseul. Therefore, whilst this list covers the implementation directions for the SPC/GIZ and SPREP/USAID projects, there are likely to be more adaptation activities to be jointly implemented in the Province.

7.1.1. Community Level Adaptation

Table 13 identifies the selected communities and summarises the type of adaptation options which can be carried out in each respective community. These adaptation options were identified by the communities themselves and represent the initial menu of options that will subsequently be discussed in detail, costed and designed and implemented in partnership with communities and other partners. As an integrated programme it is intended that the SPC/GIZ and SPREP components will complement each other and work in some communities together but on separate aspects. Through using a number of adaptation measures based on RCR and EbA approaches and utilising the different skills and expertise of multiple partners and sectors of the provincial and national governments, a holistic approach to adaptation will be achieved.

Table 13. Selected pilot communities with combined activities from the SPC/GIZ and SPREP projects

Adaptation Responses		Suggested specific activities at community level						
Adaptation Measure	**Adaptive approaches**	**Susuka**	**Posarae**	**Voruvoru**	**Mboeboe**	**Loimuni**	**Nuatabu**	**Sepa**
Measures to minimise damage to village infrastructure	Community housing and infrastructure planning including sea-level and flooding projections	Community housing and infrastructure planning	Community housing and infrastructure planning	Community housing and infrastructure planning	Community housing and infrastructure planning	Community housing and infrastructure planning	Community housing and infrastructure planning Relocation of community housing.	Community housing and infrastructure planning
Management of inter tidal and coastal systems for coastal protection	Protection against storm surge and coastal inundation. Adaptation to sea level rise (through migration of mangroves) Protection of beaches and islands from wave erosion	Coastal trees/shrubs protection revegetation. Maintenance of existing ecosystem functions	Mangrove reforestation and protection of existing areas.	Coastal trees/shrubs revegetation	Coastal trees/shrubs revegetation	Mangrove reforestation (include Molevanga) and protection of existing coastal ecosystems.	Mangrove reforestation and protection of existing areas close to relocated village areas.	Coastal trees/shrubs revegetation Create 25m buffers around river banks and reforest with natives and mangroves (at river mouth)
Increasing food security and livelihoods	Technical agricultural assistance (crop rotation, crop diversity, agricultural techniques) Agroforestry, cash crop and fruit trees	Agroforestry with cattle tethering Reforestation of previously logged areas with valuable timber species (natives and exotics)	Contour planting and terracing Agroforestry	Improve agriculture practices for poor and thin soil profile Agroforestry	Encourage planting of cocoa Ironwood germplasm centre	Contour planting and terracing Improve agriculture practices (pest and disease control) Agroforestry (cattle)	Improve agriculture practices for waterlogged soil	Contour planting and terracing Cocoa processing facilities Explore small village hydropower possibilities

Table 13. Selected pilot communities with combined activities from the SPC/GIZ and SPREP projects (cont'd)

Adaptation Responses		Suggested specific activities at community level						
Adaptation Measure	**Adaptive approaches**	**Susuka**	**Posarae**	**Voruvoru**	**Mboeboe**	**Loimuni**	**Nuatabu**	**Sepa**
Protection of Water resources (water security)	Protection and/ or restoration of water catchment areas Increasing water storage capacity	Restoration of water supply Protection and management of freshwater streams	Sediment control of freshwater streams Water quality testing of drinking water Water tanks on large buildings	Riparian and freshwater ecosystem management	Develop RCR natural resource management plan (for existing forest conservation and marine conservation areas)	Dam coastal water gallery Install Rainwater tanks	Install rainwater tanks	Water catchment management planning
Marine and fisheries management	Coral reef and mangrove ecosystem management Minimise fishing pressure on reef of key species Locally managed marine management areas including monitoring Trial fish aggregating devices (FADs)	Establish reef monitoring programs to monitor populations of key marine species Marine and fisheries management planning	Capacity building around fisheries management	Capacity building and awareness around links between freshwater and marine ecosystems (RCR)	Develop RCR natural resource management plan (for existing forest conservation and marine conservation areas)	Develop near shore marine resource management plan factoring in marine protected areas and Fish Aggregating Devices (FADs)	Establish reef monitoring programs to monitor populations of key marine species Marine and Fisheries Management Planning	Capacity building around links between freshwater and marine ecosystems (RCR)
Increase disaster preparedness	Emergency management procedures for tropical cyclones and flooding or tsunami events. Planning for food shortages from disasters	Tsunami/ TC/ river-based flooding emergency management procedure[1]	Tsunami/ TC flooding emergency management procedure	Tsunami/ TC/ river-based flooding emergency management procedure	Tsunami/ TC/ river-based flooding emergency management procedure	Tsunami/ TC flooding emergency management procedure	Tsunami/ TC/ landslide emergency management procedure	Tsunami/ TC/ river-based flooding emergency management procedure

The strong presence of logging in the province and its increasing pressure on terrestrial and marine ecosystems calls for some large forest and watershed management initiatives. It is planned to undertake a larger scale multi-jurisdiction approach to catchment management planning in the Mt Maetambe area. Landowners from this area have repeatedly resisted the approaches from logging companies to log, and have expressed interest in sustainably managing these areas for future generations. Therefore, it is envisaged that, by using Mt Maetambe as a central point, water catchment management planning approaches can demonstrate the ridge-to-reef multi-sector approach for building resilience to the adverse affects of climate change. In addition, the growing pressure on fin-fish resources as a result of increasing population necessitates the consideration of deployment of fish aggregating devices (FADs) in strategic and need-based locations and therefore it is proposed to initiate a FADs and marine resources management planning programme in locations adjacent to large communities and accessible to markets.

7.1.2. Provincial level adaptation

These adaptation actions will be supported by the partners (SPC/GIZ and SPREP/USAID) in conjunction with respective technical divisions.

- Expand capacity (coastal trees, fruit trees and mangroves) of forestry nursery at Tarakukure.
- Refurbish and restock piggery at the agriculture demonstration farm, and install biogas digester.
- Pilot one large scale wild pig capture programme that can be linked to a forestry conservation area.
- In conjunction with national and provincial government, develop an invasive species strategy.
- Design and develop climate change awareness and teaching aids for schools.
- Develop climate change communication materials, focussing on adaptation options appropriate for province and community levels.
- Review provincial ordinances and pursue options around ecosystem-based adaptation, particularly strengthening community-based land and sea management initiatives.
- Encourage management of population increase (family planning).
- Mobilise churches to be advocates for climate change adaptation.

Some of these adaptation measures are in line with the new provincial Medium Term Development Plan (2012–2014), and the others are new measures proposed, based on the findings of this report.

7.1.3. Special cases

Two communities have particular vulnerabilities driven mainly by their dense populations, low-lying locations, sole dependence on a single commodity for income and lack of agriculture (Vaghena), and obvious land tenure complications.

- **Vaghena (Arariki and Kukitin)** Seaweed is their single major source of livelihood. Agriculture is almost non-existent, although the island is fertile and was identified as an AOA. Furthermore, its main source of livelihood is under threat from mining, and both communities are largely located on low-lying coastal areas.
- **Panggoe** This is a low-lying large village (~1000 residing population), threatened by sea level rise, tidal inundation and tsunamis. Relocation and development set backs are the most appropriate measures to apply but neither measure is favourable because of land disputes and a lot of private and public investment (community high school and area health centre — major one in north Choiseul). For example, the rural development programme will be investing about SBD 460,000 into refurbishing the area health centre.

8 Conclusions

- The main conclusions with respect to the objectives of this study are summarised in Table 14 and highlighted in the commentary column.

Table 14. Commentary on achievement of V&A assessment objectives

Objectives/Outputs	Indicators	Commentary
1. The vulnerability of Choiseul Province to climate change and other non-climate change factors is assessed and documented	Province-wide vulnerability and adaptation assessment report (V&A report)	YES This report is a culmination of the assessment of the vulnerability of Choiseul Province to climate change. Its vulnerability is strongly influenced by both climate and non-climate change factors. Therefore, adaptation measures proposed to address current vulnerabilities must also address non-climate change factors.
2. Vulnerability, adaptive capacity, resources and institutions of the 27 communities are assessed and documented	Community profiles & V&A report	YES Community vulnerabilities are high and their adaptive capacity is low. Their low AC is driven by multiple factors such as their thin and climate-dependent resource base, and constraints imposed on them by political indifference, economic disparities, population growth, and land tenure and social issues. Only 26 profiles were produced because Arariki and Kukitin are considered as one community for the purpose of this study.
3. 4-5 communities are identified to begin implementation of adaptation measures	V&A report	YES Seven communities have been selected in the interim. In addition, some provincial level adaptation activities in agriculture, fisheries, forestry and education have been proposed.

- The vulnerability of communities to climate change is inextricably linked with non-climate change factors that naturally predispose communities to be more vulnerable by exacerbating impacts, increasing sensitivity and reducing adaptive capacity.
- Adaptation pilots need to be implemented at the community and provincial levels to ensure pilots reduce vulnerability at both levels and foster ownership of the programme throughout the province.

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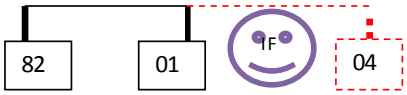
Appendices

Appendix 1. Framework and process for community-led V&A assessment

Framework		Process
Step 1	Outputs	Activities
Setting the scene for assessment		V&A team introductions V&A trip purposes: (i) to assess climate change impacts at the community level, and (ii) raise awareness about climate change Brief Introduction: Climate change
Introduction to climate change	Community members are introduced to the basic science of climate change and its impacts globally	Activity 1 Show 2 or 3 videos about climate change (75 minutes): Climate change science (Nat-Geo Climate Change 101 & Inconvenient Truth, first 35 minutes only) Climate change impacts and adaptation in the Pacific & Solomon Islands ("Open up your eyes, "Grim reality" and "Chivoko and Sasamunga conservation stories") Materials: multimedia projector, generator, laptop Facilitator: focus/reiterate key aspects of each video clip, and answer questions raised
Community Assessment (community driven) with facilitation by V&A assessment team)		
Baseline Information	Assessment team is made aware of the community's awareness about CC.	Activity 2 Group work (15 minutes) NB: It is vital to keep all groups within sight of each other and core facilitators should move to check on progress and address any difficult issues that may arise from the discussion. In three groups (youths[12], women and men), discuss among themselves the following questions (10 minutes): What is climate change? What causes it? Is climate change visible in the village? [(Yes/No), elaborate on your answer] Materials: 1 x butcher sheet & 1 permanent marker/group
Step 2	Outputs	Activities
Past and future climate event analysis[13]	Local knowledge of how climate events have affected communities is documented Heighten self awareness amongst community members about climate change at the local level	Activity 3 Group work (40 minutes) In three groups (youths, women and men), draw a timeline 1982 – 2012 – 2042 on butcher paper (alternatively tie a string and attach markers based on the above sequence).  List names and year of tropical cyclones, storms and droughts that affected the village and arrange them from 1982–2012. Comment on the level of destruction (e.g. number of houses destroyed, destruction of food crops) and assign low, medium or high and how long they depended on relief supplies. IF the above types of events (tropical cyclones, storms and droughts) increase in strength and frequency within the next 30 years, what measures should you take now to prepare for such eventualities? Facilitator to guide discussions, and highlight the divergences and convergences in responses to the tasks. Materials: 4 x butcher sheets and 3 x permanent markers

12 Females and Males
13 The If question is posed to get members of the group think about the actions that need to be taken now to address climate change

<table>
<tr>
<td>Identification of key livelihood resources[14]</td>
<td>Key livelihood resources (marine, agricultural, forestry and income earning population) are identified</td>
<td>Activity 4
Group Work (25 minutes)
In three groups (youths, women and men), ask each group to list the most important resources for livelihood:
Subsistence (food):
Income generation ($$):
Materials: 4 x butcher sheets and 3 x permanent markers</td>
</tr>
<tr>
<td>Assessment of the key non-climate change threats (including non- climate disasters and threats such as earthquakes and tsunamis) to the livelihood resources and evaluation of current threats' coping strategies</td>
<td>The 5 most significant non-climate change threats for 3 livelihood resources are identified
Local coping strategies for threats are evaluated.</td>
<td>Activity 5
Group Work (30 minutes)
Maintain the 3 working groups used in "activity 4", perform the following sub-activities for one livelihood resource:
Transfer the livelihood resource (choose 1subsistence and 1 income generation resources from your list) to the 'livelihood' column in the table below
Evaluate the current quality/status of livelihood resource to perform livelihood functions by assigning the following ranking (very good, good and poor)
Discuss and identify the 3 most significant (most damaging to the resource) threats to the livelihood resource
Describe how the threats are addressed in the village (give examples)?
Copy the table below to butcher paper and complete it
<table>
<tr><th>Livelihood</th><th>Rate status/ quality (very good, good, poor)</th><th>Threat</th><th>Rate the threat (low, medium, high)</th><th>Threat Coping Strategy (also comment on efficacy)</th></tr>
<tr><td rowspan="3">A</td><td rowspan="3"></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
Materials: 4 x butcher sheets and 3 x permanent markers</td>
</tr>
<tr>
<td>Assessment of key climate change related threats to the livelihood resources, and evaluation of current threats' coping strategies</td>
<td>The 5 most significant climate change[15] threats to 3 livelihood resources are identified
Local coping strategies for threats are evaluated.</td>
<td>Activity 6
Group Work (20 minutes)
Maintain the 3 working groups used in Activity 5, perform the following sub-activities for the livelihood resource you used in Activity 5. Transfer the livelihood resource to the 'livelihood' column in the table below
Identify the 3 most significant [most damaging (holds potential) to the resource] climate change threats for the livelihood resource
Describe how the threats are or will be addressed in the village (give examples)?
<table>
<tr><th>Livelihood</th><th>Threats</th><th>Rate the threat (low, medium, high)</th><th>Threat Coping Strategy (also comment on efficacy)</th><th>Threat Coping Strategy (also comment on efficacy)</th></tr>
<tr><td rowspan="3">A</td><td rowspan="3"></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
Materials: 4 x butcher sheets and 3 x permanent markers</td>
</tr>
<tr>
<td>Documentation of the communities views on how government and non-government agencies should assist them adapt to threats</td>
<td>Modes of assistance for key stakeholders to local communities are identified.</td>
<td>Activity 7
Group Work (20minutes)
In three groups (youths, women and men), discuss and suggest how each of the agencies in the table below can assist your community adapt to climate change.
<table>
<tr><td>National Government</td><td></td></tr>
<tr><td>Provincial Government</td><td></td></tr>
<tr><td>NGOs/Donors</td><td></td></tr>
</table>
</td>
</tr>
</table>

14 Human activities undertaken to maintain life, standards of living, and lifestyle. Livelihood includes both subsistence and income generating activities.

15 Increasing temperature; intense tropical cyclones and local storms; droughts; intense rainfall; storm surges, flash flooding, sea level rise and ocean warming.

Appendix 2. Household survey instrument

(Assessment foci: socio-economic services and status, livelihood resources and natural assets)

Assessor: .....Site:..... Date:.....

Interviewee: .....Occupation/Role:.....

Demographics, Education and Health

Fill in the table below based on how many people are in the household?

Age Group	Number
Number of children <15 years	
Youths level (15–4 years)	
Adults (≤25 years)	
Total	

What would be the highest level of education attained in that household?

(Circle the most appropriate answer)

A. Primary B. Secondary C. Tertiary (college or university)

Do you think you have adequate access to schools and financial resources to meet your children's basic education need (up to form 1)?

(Circle most appropriate number, where 1=not met to 5= fully met)

1 2 3 4 5

Please identify 3 main issues with education, 1 = being the most important issue

1.....

2.....

3.....

Do you think you have adequate access to clinic/hospital and financial resources to meet family's basic medical needs?

(Circle the most appropriate answer, where 1 = very low to 5 = fully met)

1 2 3 4 5

Please identify 3 main issues with education, 1 = being the most important issue

1.....

2.....

3.....

Transportation

How often do you need to travel to other places within Choiseul?
(Please tick the most appropriate box)

Weekly Fortnightly Monthly Yearly

State 2 main reasons/needs for travelling, 1 being the most important.

1.....

2.....

What are the 2 main forms of transport system that you use?
(Please indicate which one is the most important (1) and which one is second (2): e.g. by ship; on foot; paddling; out board motor; truck/car; airplane)

Within Choiseul: 1.....

2.....

Outside Choiseul: 1.....

2.....

Do you or your family members have access to transports when you need it most?
(Please circle the most appropriate, where 1=very difficult to 5=very easy)

Within Choiseul: 1 2 3 4 5

Outside Choiseul: 1 2 3 4 5

Communication

How often do you need to communicate to other persons outside your village?
(Please tick the most appropriate box)
Daily Weekly Fortnightly Monthly

Main reason/need for communication?
(State 2 main reasons, where 1 is the most important reason.)

1.....

2.....

What is the main form of communication?
(State 2 main ones, where 1 is the most important.)

1.....

2.....

Do you or your family members have access to communication when you need it most?
(Please circle most appropriate, where 1 = very difficult to 5 = very easy)
1 2 3 4 5

Energy

List 2 main sources of fuel for cooking (e.g. gas, kerosene stove, wood, etc.) where 1 is the most popular.

1.....

2.....

Compared to the past 10 years, do you think it is easier to obtain fuel for cooking now?

(Please circle most appropriate answer)

Yes No No Change

If your answer is No then state the 2 most obvious changes that have happened, where 1 is the most obvious change e.g. less firewood, firewood source became far, high cost of kerosene or gas, etc.

1.....

2.....

What could be 2 main causes or reasons of each change?

(List as 1= the most important cause)

1.....

2.....

State 2 main ways you respond to those changes.

(List as 1= the most important)

1.....

2.....

List 2 main sources of energy for lighting at home (e.g. solar, electricity, kerosene lamp, wood resins, firewood, etc.)

(List as 1= the most important)

1.....

2.....

Compared to the last 10 years, do you think it is easier for you to access energy for home lighting now?

(Please circle most appropriate answer)

Yes No No Change

If your answer is No above, state the 2 most obvious changes that have happened, where 1 is the most obvious change e.g. less wood, high cost of kerosene, etc.

1.....

2.....

What could be 2 main causes or reasons of each of the change?

(List as 1= the most important)

1.....

2.....

State 2 main ways you respond to those changes.

(List as 1= the most important)

1.....

2.....

Sources of Income and Expenditure Areas

What are the top THREE main income generating activities that your family does: (e.g. marketing of food crops, marketing fish, copra, timber, etc.)

(Please rank from 1–3 with 1 = most important and ask interviewee to estimate their family monthly income from each activity)

Activity	Est. Monthly Income ($)
1	
2	
3	

What are the top THREE main expenditure areas for your family? (e.g. food, transport, school fees, household items, etc.)

(Please rank from 1–3 with 1 = most important and ask interviewee to estimate their family monthly expenditure for each area)

Expenses	Est. Monthly Income ($)
1	
2	
3	

Reliance on Ecosystem Services

What are your family's top three main food sources (e.g. garden, forest, reefs, mangroves, rivers/streams, deep sea, shop and relatives)

(Please ask the interviewee to rank from 1–3 starting with 1 = most important)

1.....

2.....

3.....

What would be the top three main sources of your household for freshwater?

(Please ask interviewee to (a) list from 1 = most important): piped water, springs, well, river/stream, tank (own one or community), (b) how reliable (tick box) and (c) indicate at least 2 most important issues that you observe about each water source)

Water Source	Availability			Issues (e.g. pollution, flooding, etc.)
	All Year	Seasonal	Irregular	
1.				
2.				
3.				

Apart from making a garden for food, what are the THREE most important uses of the bush or Land for your household?

(Please ask interviewee to rank from 1–3 with 1 = most important): e.g. bush food, firewood, timber for sale, timber for local use, local housing materials, traditional medicine, royalties from mining or logging, others-specify)

1.....

2.....

3.....

Apart from food, what are the THREE most important uses of the reefs or sea for your household? (Please ask interviewee to rank from 1–3 with 1 = most important): e.g. local housing materials, traditional medicine, income, tourism, others-specify)

1.....

2.....

3.....

Apart from food, what are THREE other very important uses of the mangrove for your household? (Please ask interviewee to rank from 1–3 with 1 = most important): e.g. local housing materials, traditional medicine, income, tourism, shelter for birds and animals, others — specify)

1.....

2.....

3.....

Perceptions on Ecosystem Health

Go through each of these resources one at a time with the interviewee and rate the state of health of each ecosystem as indicated in the table below

Resource	Health (1=not healthy; 2=healthy; and 3=very healthy)	Change over past 30 years (where 1= worse, 2=no change, 3 =improving)
Reef		
Garden areas		
Mangroves		
Sea grass		
Forest and bush		
Fresh water (i.e. rivers, springs)		

Do you think that the natural resources that your household uses are being well managed?
(Please circle most appropriate, where 1= no management at all to 5 = very well managed)

1 2 3 4 5

Appendix 3. Biophysical coastal assessment instrument

Climate Change Factors: Sea level rise, storminess (coastal erosion and inundation) and Intense/prolonged rainfall (flooding)

Assessor:[16].....Village: ..... Date: .....

Informant: .....Occupation/Role:..... Time .....

Biophysical Settings of the Village

Estimate length of the village shoreline:……(metres)

Using the shoreline as the baseline, set up three 40 m x 40 m transects (20 m landward and 20 m seaward), it can be estimated by pacing or tape measure.

Description of Transects

Transects	Location	Main features (e.g. home/tree density)
Transect 1		
Transect 2		
Transect 3		

Assess the features in the table below

FEATURE	TRANSECT 1			TRANSECT 2			TRANSECT 3		
	Landward Vegetation (HWM to 20m inland) (% coverage for grass, clearing & Nos. for trees & coconuts)								
Coconuts									
Mangroves									
Trees									
Coastal Shrubs									
Grass									
Fully exposed (sand or ground exposed)									
Coastline Substrate (between HWM and LWM) (Rank them with 1=most dominant, for substrates not on the transect indicate by NA)									
Rocky/Boulders									
Gravel/Pebbles									
Mudflats									
Sand									
Seaward Vegetation/Reef (from LWM to 20 metres into the sea) (Estimate % coverage)									
Mangroves									
Seagrass									
Coral Reef									
Extent of Coastline Erosion at HWM along transect									
	Tick	Presence of MCP (Yes/No)	Type of MCP	Tick	Presence of MCP (Yes/No)	Type of MCP	Tick	Presence of MCP (Yes/No)	Type of MCP
<20%									
20 – 50%									
50 – 70%									
>70%									

NB: MCP= man-made coastal protection, Types of MCP: concrete seawall (CS), stone seawall (SS), stones in gabion wire (SGW) and mix local – stones/sticks (ML), LWM: low water mark, HWM: high water mark

16 This community transect walk is meant to be guided by a community informant

Homes

Count the number of homes (dwellings for sleeping/living) and estimate the relative distance and elevation with respect to the following features (sea, river/stream and swamp), and complete the table below.

Feature	Horizontal distance (m)	Number of homes	Relative elevation with respect to feature (m)		
			~same elevation	< 1m	>1m
Sea (shoreline)	Closest (<20 m)				
	Close (20–50 m)				
River/Stream	Closest (<20 m)				
	Close (20 - 50 m)				
Swamp	Closest (<20 m)				
	Close (20–50 m)				

Other Community Infrastructure

Estimate the relative distance and elevation with respect to the following features (sea, river/stream and swamp) and complete the table below.

Feature	Infrastructure	Average horizontal distance (m)	Relative elevation with respect to feature (m)		
			~same height	<1m	>1m
Sea (shoreline)	Road				
	School				
	Church				
	Clinic				
	Standpipes				
	Graveyard				
	Others (specify)				
River/Stream	Road				
	School				
	Church				
	Clinic				
	Standpipes				
	Graveyard				
	Others (specify)				
Swamp	Road				
	School				
	Church				
	Clinic				
	Standpipes				
	Graveyard				
	Others (specify)				

Agriculture and Forestry

Estimate the relative distance and elevation with respect to the following features (sea, river/stream and swamp). Where feature is not applicable, indicate with NA

Feature	Agriculture/Forestry	Horizontal distance (m)	Relative elevation with respect to feature (m)			
			~same height	< 1m	1–2m	>2m
Sea	Food gardens					
	Coconut plantation					
	Commercial trees					
	Fruits and nuts					
	Sago plantation					
	Swamp taro					
	Giant taro (Kakake)					
	Livestock (pigs & poultry)					
	Others (specify)					
River	Food gardens					
	Coconut plantation					
	Tree plantation					
	Fruits and nuts					
	Sago Plantation					
	Swamp taro					
	Giant taro (Kakake)					
	Livestock (pigs & poultry)					
	Others (Specify)					
Swamp	Food gardens					
	Coconut plantation					
	Tree plantation					
	Fruits and nuts					
	Sago plantation					
	Swamp taro					
	Giant taro (Kakake)					
	Livestock (pigs & poultry)					
	Others (Specify)					

Appendix 4. National plans and environmental legislation

Plans/Acts	Commentary	Main Implementers (Enforcers)
National Development Strategy (NDS: 2011–2020)	The NDS recognises the importance of environmental management in the development of the country. Objective 7 of the NDS intends "to effectively manage and protect the environment and ecosystems and protect Solomon Islanders from natural disasters". The NDS recognizes that it is longer appropriate to isolate economic development from environmental protection and social progress.	Ministry of Development Planning and Aid Coordination Line ministries Provincial governments and Honiara City Council
Medium term development strategies	National development goals of successive governments since independence favoured a formal economy that is anchored on large-scale and export-oriented resource development projects, and stated a determination to develop rural areas and protect the natural environment. Nevertheless, sustainable development has not been given high priority in previous development plans.	Ministry of Development Planning and Aid Coordination Line Ministries Provincial Government and Honiara City Council
National environmental strategies (NEMS) 1993	A first blueprint for environmental management in Solomon Islands. It had 29 strategies and 48 programmes to address environmental problems. It suffered from a lack of resources (e.g. finance, capacity, scientific knowledge and technology) and therefore has not been implemented to an extent which could gain grounds for sustainable development.	Department of Environment and Conservation
Environment Act 1998 Environment Regulations 2008	The Act established the Department of Conservation and Environment. The objects of the Act are as follows: (a) To provide for and establish integrated systems of development control, environmental impact assessment and pollution control; (b) To prevent, control and monitor pollution; (c) To reduce risks to human health and prevent the degradation of the environment by all practical means, including the following: Regulating the discharge of pollutants to the air, water or land; Regulating the transport, collection, treatment, storage and disposal of wastes; Promoting recycling, re-use and recovery of materials in an economically viable manner; and (d) To comply with and give effect to regional and international conventions and obligations relating to the environment. It is worth noting that regulations for this Act were only developed and finalized 10 years after the Act, indicating the delays which often encumber efforts to implement Acts.	Department of Environment and Conservation
Protected Areas Act 2010	The objects of the Act are – (a) To establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity; (b) To develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity; (c) To regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use; (d) To promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings; (e) To promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of the protected areas; and (f) To rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, such as, through the development and implementation of plans or other management strategies.	Department of Environment and Conservation

Plans/Acts	Commentary	Main Implementers (Enforcers)
Wildlife Protection and Management Act 1998 Wildlife Protection and Management Regulations 2008	The object of this Act is to comply with obligations of Solomon Islands under the Convention or otherwise to further the protection and conservation of the wild flora and fauna of Solomon Islands by regulating – (a) The export of specimens that are, or derived from, native Solomon Islands animals or native Solomon Islands plants; (b) The export and import of specimens that are, or are derived from animals, or plants of a kind that are threatened with extinction; (c) The export and import of specimens that are, or are derived from, animals, or plants, of a kind that require, or may require, special protection by regulation of international trade in such specimens; (d) The import of animal specimen or plants specimen which could have an adverse effect on the habitats of native Solomon Islands animals or native Solomon Islands plants; and (e) The management of flora and fauna to ensure sustainable uses of these resources for the benefit of Solomon Islands.	Department of Environment and Conservation
Fisheries Act 1998	The objective of fisheries management and development in Solomon Islands shall be to ensure the long-term conservation and the sustainable utilisation of the fishery resources of Solomon Islands for the benefit of the people of Solomon Islands.	Ministry of Fisheries and Marine Resources
Forestry and Timber Utilisation Act 1984 (revision of 1969 Act)	Governs the licensing of felling and milling of trees, disposal of customary timber rights, and also deals with forest reserves.	Ministry of Forestry and Research
River Water Act 1964	The Act provide for the control of river waters and for their equitable and beneficial use, and for matters incidental to river waters.	
Environmental Health Act 1999	The Act makes provisions for securing and maintaining environmental health and for matters connected with and incidental to environmental health.	Ministry of Health and Medical Services Provincial Governments and Honiara City Council

(Source: Mataki, 2011)

Appendix 5. Multilateral environmental agreements

Convention/instruments	Status	Purpose/Aim	Agency Responsible & related Projects
Waigani Convention	Ratified 7/10/1998	Ban the importation of into Forum Island countries of hazardous and radioactive wastes and to control the trans-boundary movement and management of hazardous wastes within the South Pacific region.	Department of Environment and Conservation
Pollution Protocol for Dumping	Ratified 10/9/1989	Prevention of pollution of the South Pacific region by dumping.	Marine Division Department of Environment and Conservation
Pollution Protocol for Emergencies	Ratified 10/9/1989	Cooperation in combating pollution emergencies in the South Pacific region.	Marine Division Department of Environment and Conservation
Natural Resources and Environment of South Pacific (SPREP Convention)	Ratified 10/9/1989	Protection of natural resources and environment of the South Pacific Region in terms of management and development of the marine and coastal environment in the South Pacific region.	Department of Environment and Conservation
International MEAs			
Chemicals, Wastes and Marine Pollution			
Liability for Oil Pollution Damage	Ratified	Strict liability of a ship owner for pollution damage to a coastal state within a certain amount	Marine Division
Marine Pollution Convention (London)	Ratified	Prevention of marine pollution by dumping of wastes and other matter	Department of Environment and Conservation Foreign Affairs
Persistent Organic Pollutants Convention (Stockholm)	Acceded 28/7/2004	Protection of human health and environment from persistent organic pollutants	Department of Environment and Conservation
Environmental Health Divisions			
Biodiversity			
United Nations Convention to Combat Desertification (UNCCD)	Acceded 16/4/1999	Agreement to combat desertification and mitigate the effects of drought in countries experiencing drought or desertification	Ministry of Agriculture & Livestock Department of Environment and Conservation
Cartagena Protocol on Biosafety	Acceded 26/10/2004	Protection of human health and the environment from possible adverse effects of the products of modern biotechnology, especially the living modified organisms while maximizing its benefit	Department of Environment and Conservation
Convention on Biological Diversity (UNCBD)	Ratified 3/10/1995	Conserve biological diversity through the sustainable use of its components and the fair and equitable sharing of the benefits arising out of utilising genetic resources	Department of Environment and Conservation
Convention on Illegal Trade in Endangered Species of Flora and Fauna (CITES)	Acceded 24 /6/ 2007	Regulation and restriction of trade in specimens of wild animals and plants through a certification system for imports and exports.	Department of Environment and Conservation
World Heritage Convention	Acceded 10/6/1992		Museum Department of Environment and Conservation
Climate and Ozone			
Kyoto Protocol	Ratified 13/3/2003	Reduce greenhouse gases especially carbon dioxide for the 39 industrial/ developed by an average of 5.2% by 2012.	Climate Change Division
United Nations Framework Convention on Climate Change (UNFCCC)	Ratified 28/12/1994	Sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change.	Climate Change Division
Montreal Protocol	Acceded 17/6/1993	Allows phase out of substances that deplete the ozone layer according to a fixed schedule.	Energy Division
Ozone Layer Convention (Vienna)	Acceded 17/6/1993	Protection of the ozone layer through intergovernmental cooperation on research, systematic observation of the ozone layer and monitoring of chlorofluorocarbon production	Energy Division

(Source: Mataki, 2011)

Appendix 6. Ranking of vulnerability for the communities using a variety of indicators

Rank [High - Medium - Low - NA (Not Applicable)]	Loimuni	Molevanga	Vuraqo	Polo	Ogho	Voruvoru	Bangara	Susuka	Soranamola	Tabarato	Panggoe	Zaru	Taqibangara	Nuatabu	Varuqa	Arariki/Kukitin	Boeboe	Posarae	Loloko	Katurasele	Papara	Sepa	Panarui	Sasamunga	Saqigae	Vouza
Impacts (Vulnerability)																										
Coastal Vulnerability																										
Coastal erosion	M	H	H	M	M	H	M	H	H	H	H	H	M	H	L	M	M	H	H	M	M	M	H	M	M	M
Shoreline recession	L	M	H	M	L	H	M	H	H	H	H	M	M	H	L	M	M	H	H	M	M	M	M	M	M	M
Waves-overtopping into the village	M	H	M	M	L	H	M	M	M	L	H	M	L	H	L		M	M	M	M	L	L	L	L	L	L
Saltwater intrusion into wells	H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	H	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Removal of coastal vegetation (mangroves,	M	H	L	L	L	L	L	L	L	L	L	L	L	L	L	M	L	L	M	L	L	L	L	L	L	L
Land Based Vulnerability																										
Increase food garden pest and diseases	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	L	L	M	M	M	H	H	H	H	M	M
Flooding of food gardens	L	L	H	M	M	H	H	M	M	M	M	L	L	H	L	NA	H	H	L	L	H	H	M	H	L	M
Top soil erosion	L	L	L	L	L	H	H	M	M	L	L	L	L	H	L	L	H	H	L	L	L	H	M	M	H	H
Increase in incidences of landslides	L	L	L	L	L	H	M	M	L	L	L	L	L	H	L	NA	H	H	NA	NA	L	L	M	M	NA	NA
Reduced crop yields	L	L	L	M	M	M	M	M	M	M	M	L	L	H	L	NA	H	M	M	M	M	M	M	M	M	M
Forest fires during drought	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Forest degradation	L	M	H	M	M	M	M	H	H	M	L	L	L	M	M	L	M	M	M	H	M	M	M	M	H	M
Community-based Vulnerability																										
Reduced income from gardens	M	M	M	M	M	M	M	M	M	M	H	M	M	H	M	H	H	H	M	M	M	M	M	M	M	M
Reduced income from sale of fish	H	H	H	H	H	H	H	L	L	L	L	M	M	L	L	L	L	L	L	L	L	L	M	M	M	L
Food insecurity	L	L	M	M	M	M	M	M	M	M	M	L	L	H	L	H	M	M	M	M	M	M	M	M	M	M
Sea-based Vulnerability																										
Decline in coral health	M	M	M	L	L	L	L	L	H	H	M	L	L	L	L	M	L	L	L	L	L	L	L	L		
Declines in fish	M	M	H	M	M	M	L	L	L	L	L	L	H	L	L	H	L	L	L	L	L	L	L	L	L	L
Decline in commercial invertebrates	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
No. of ranking-type																										
High (3 points)	3	5	7	2	2	8	4	4	5	4	5	2	2	10	1	5	6	7	3	2	3	4	3	3	3	2
Medium (2 points)	7	6	5	10	8	6	9	8	7	6	5	5	5	2	3	4	5	5	7	7	6	6	9	9	7	8
Low (1 point)	8	6	5	5	7	3	4	5	5	7	7	10	10	5	13	5	6	5	6	7	8	7	5	5	5	5
NA (0)	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	1	2	2	1	1	1	1	2	2
Σ Weights of ranking-type																										
High (3 points)	9	15	21	6	6	24	12	12	15	12	15	6	6	30	3	15	18	21	9	6	9	12	9	9	9	6
Medium (2 points)	14	12	10	20	16	12	18	16	14	12	10	10	10	4	6	8	10	10	14	14	12	12	18	18	14	16
Low (1 point)	8	6	5	5	7	3	4	5	5	7	7	10	10	5	13	5	6	5	6	7	8	7	5	5	5	5
NA (0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	**31**	**33**	**36**	**31**	**29**	**39**	**34**	**33**	**34**	**31**	**32**	**26**	**26**	**39**	**22**	**28**	**34**	**36**	**29**	**27**	**29**	**31**	**32**	**32**	**28**	**27**