

Development, Forest Conservation and Adaptation to Climate Change: a Case for Integrated Community-Based Sustainability in Rural Vanuatu

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ABSTRACT

This paper is concerned with integrating adaptation to climate change with local development in the context of a mitigation project for reducing emissions from deforestation and forest degradation. It is argued that integration will enhance locally appropriate and sustainable outcomes necessary for effective mitigation in the context of rural Vanuatu. Concurrently, a community-based approach to assessing vulnerability is proposed whereby locally pertinent manifestations of climate-related risk and adaptive capacity form the baseline of adaptive decision-making. The approach is illustrated by a discussion of vulnerability and local development need in the Tangoa Island community, a rural Ni-Vanuatu community particularly affected by tropical cyclones. Although effective adaptive strategies have evolved over time in Tangoa, these are unlikely to withstand the likely changes in magnitude and (perhaps) frequency of cyclones into the future with climate change. This is due to evolving non-climate stresses that largely intersect with locally defined development need. Opportunities exist to reduce vulnerability to climate change by development that addresses particular non-climate stresses. This provides a practical and tangible way of engendering community-based adaptation that would otherwise be unlikely in rural Vanuatu. The approach has application in other rural developing communities, both in Vanuatu and other developing countries.

KEYWORDS: Adaptation, Climate Change, Community-Based, Mitigation, Sustainable Development, Vulnerability.

1. INTRODUCTION

This paper is concerned with integrating practical, community-based adaptation to climate change with local level sustainable development. The focus of this is in rural Vanuatu, a Pacific Island developing country particularly vulnerable to changes in climatic variability and extremes. Adaptation involves an “adjustment in natural or human systems [regional, national, sectoral, community, household] in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC, 2001). Adaptation and sustainable development are mutually reinforcing and should be linked, especially in developing countries. However, as in many other developing countries, efforts to mainstream adaptation into development policy and practise have yet to produce practical outcomes on the ground in rural Vanuatu.

The focus here is on climate proofing community-based development within the context of a mitigation project for avoided deforestation and forest degradation (ADD). Mitigation involves measures to reduce greenhouse gas emissions and has been the principal response to climate change by the United Nations Framework Convention on Climate Change (UNFCCC) and national governments. Even with the most stringent of mitigation efforts however, continued warming is unavoidable due to past emissions, rendering adaptation mandatory at all scales (Adger, et al, 2007).

Research contributes to the development of the Integrated Climate Change Mitigation and Sustainable Development Model (ICMSD), the purpose of which is to offset local deforestation drivers by providing rural, forest dependant communities with alternative means of meeting local development needs. The ICMSD model follows the principles of the Integrated Conservation and Development Project (ICDP) framework, utilizing foreign investment from voluntary market carbon credits to fund initiatives. Integrating an adaptation element into this process is essential to maximising local community co-benefits from projects with a principally mitigation focus.

Given this, a participatory vulnerability approach is taken to characterise the integrated and complex nature of vulnerability to climate change in the Tangoa Island community. Participatory methods are employed to interpret current and future exposure-sensitivity, adaptive capacity and how these intersect with socio-economic development issues. Assessment starts with local perceptions of climate risks and existing coping mechanisms, thus departing from many traditional adaptation analyses beginning with climate scenarios. Vulnerability in Tangoa Island is a product of multiple and interacting stresses, both directly and indirectly related to climate. Many opportunities therefore exist to reduce vulnerability to climate change via adaptive decision-making for carbon financed development. The following sections overview adaptation and vulnerability concepts, outlining the conceptual and analytical framework for integrating adaptation onto the ICMSD model. Findings and insights from the case study of Tangoa Island are outlined, illustrating the methodological approach.

2. A FRAMEWORK FOR INTEGRATING MITIGATION, DEVELOPMENT AND ADAPTATION OBJECTIVES

2.1 THE VANUATU CARBON CREDITS PROJECT

A pilot project called 'The Vanuatu Carbon Credits Project: Vanuatu Forests – Reducing Emissions from Deforestation'¹ was initiated in early 2005. The project is led by Victoria University in conjunction with an international team of experts. The project is operated in partnership with the Vanuatu Department of Forests, after approval by the Vanuatu Council of Ministers in December 2006. The overarching core goal of the project is to reduce CO₂ emissions from deforestation and forest degradation in Vanuatu, by building capacity to utilize carbon markets for mitigation projects. Project outputs will include 'test-driving' potential market-based incentive mechanisms² using the voluntary carbon market. Market-based mechanisms for reducing emissions from deforestation and forest degradation (REDD) are currently excluded

¹ Refer to the Vanuatu Carbon Credits Project homepage for more information:
<http://www.vuw.ac.nz/geo/research/climate-change/vanuatu-forests/index.html>

² Three mechanisms will be tested. These are:

1. The Carbon Stock Approach developed by ClimateFocus, Rotterdam, Netherlands:
<http://www.climatefocus.com/start.htm>

2. The Sectoral Approach developed by GTripleC Global Climate Change Consultancy, Wellington, New Zealand: <http://www.gtriplec.co.nz>

3. The Direct Barter Approach developed by Victoria University of Wellington

from Kyoto compliant carbon market process such as the Clean Development Mechanism (CDM), thereby restricting opportunities for tropical developing countries to participate in incentive-based mitigation activities. This is problematic given that up to 28% of global anthropogenic carbon emissions come from deforestation and comprises the largest source of emissions in many developing countries (Santilli et al, 2005). The experiences and findings from the voluntary market 'test-drives', will contribute to negotiations at the UNFCCC regarding the inclusion of REDD activities in Kyoto compliant carbon market processes.

A fundamental component of the project is maximizing socio-economic co-benefits, from avoided deforestation activities at the community level. It is recognized that (especially) in a carbon market context, the quality, permanence, sustainability and ultimate marketability of forest conservation projects for mitigation purposes are inextricably dependant on the impacts and outcomes on local forest-resource dependant communities. Vanuatu, like many other tropical developing countries, faces significant economic pressure on forest resources for meeting basic socio-economic development needs. These pressures are apparent at all levels, from the national to the local. As a resource periphery, economic development opportunities are structurally challenging in Vanuatu and there are few tangible alternatives to resource extraction (Stringer, 2006; Weaver, 2007; Waddell and Connell, 2007). Therefore, deforestation threat exists even where natural forests are still intact, as is the case in the Tangoa Island community. Offsetting the drivers of deforestation requires proactively providing alternative ways of relieving economic pressures at all levels, in this instance, via carbon finance.

2.2 THE INTEGRATED CLIMATE CHANGE MITIGATION AND SUSTAINABLE DEVELOPMENT (ICMSD) MODEL

Locally, offsetting deforestation drivers requires a specific way of providing alternative development initiatives addressing place-specific, locally defined needs that, inevitably, are or eventually will be at the root of deforestation. Establishing these proactively, before unsustainable deforestation begins at any significant scale, is preferable. It is the intention within the Vanuatu Carbon Credits Project, that a degree of carbon finance will be inwardly invested in local non-deforestation development projects that are designed in conjunction with the community in question. This avoids the shortcomings of traditional conservation approaches that have tended to prioritize conservation of ecological 'public goods' at the expense of local

people, whose livelihoods and culture are often inextricably linked to these resources (Becker and Ghimire, 2003; McShane and Wells, 2004). In line with this, a conceptual, 'best-practice' model for an integrated approach to conservation with sustainable development is proposed. This model is the Integrated Climate Change Mitigation and Sustainable Development (ICMSD) model, the purpose of which is to ensure alternative, sustainable, locally appropriate and climate proofed, development for local communities. The model follows the principles of the integrated conservation and development project (ICDP) framework, in particular, by requiring a community-based and locally owned process for meeting socio-economic goals whilst conserving natural resources (see Brandon and Wells, 1992; Salafsky and Margoluis, 1999; Salafsky and Wollenberg, 2000; Berkes, 2003; McShane and Wells, 2004).

2.3 ICMSD 'BEST-PRACTISE': INCORPORATING ADAPTATION FOR SUSTAINABILITY

In the context of sustainable development, adaptation is an indispensable co-benefit of the ICMSD integrated approach. Although development *per se* is not the core goal of mitigation projects, it is an integral means to a mitigation end in the context of avoided deforestation and forest degradation. Ensuring the sustainability of development initiatives is therefore paramount to mitigation success. As is widely recognized within climate change literature and policy frameworks, integrating adaptation to climate change into the development process is a fundamental component of shifting development to a truly sustainable form (Smit and Pilifosova, 2001; Huq et al, 2003; Huq and Reid, 2004; Huq et al, 2005). The recently released Intergovernmental Panel on Climate Change (IPCC) Working Group II (WGII) Report of the Fourth Assessment Report (FAR) reinforces this, emphasizing the mutual inextricability of climate change and sustainable development issues (see Adger et al, 2007). In particular, climate change poses a risk to development 'deliverables' (such as infrastructure, food security, human health and natural resource management); and development deliverables themselves can increase or decrease vulnerability to climate change (Adger et al, 2007; Klein et al, 2007).

Given this, the ICMSD best-practice model needs to incorporate an adaptation element that is practical and feasible, given multiple (and perhaps competing) objectives within the Vanuatu Carbon Credits Project context. A community-based vulnerability assessment approach is proposed whereby adaptation synergies can be achieved by climate proofing development. A particular emphasis is placed on enhancing adaptive capacity within this approach because

adaptive capacity can be most easily addressed by integration with development. Adaptive capacity is often limited by factors such as poverty, inequality, lack of resources, poor infrastructure, food and water security, and livelihood opportunities; factors that are typically the focus of development (Klein et al, 2007).

2.4 THE COMMUNITY-BASED VULNERABILITY APPROACH

As a concept, vulnerability has evolved from related research fields such as natural hazards, (Hanmer, 2003), political economy (Hewitt, 1983; Blaikie et al, 2004), food security (Downing, 2003), poverty and entitlements (Sen, 1981; Kelly and Adger, 2000) and socio-ecological systems (Turner et al, 2006). Brooks (2003) and Adger (2006) and provide a comprehensive overview of vulnerability traditions from the perspective of climate change. Only recently has vulnerability become established as a concept within the climate change field, perhaps because of growing recognition of i) the significance of more immediate changes in variability and extremes, as opposed to longer term average changes, and ii) the importance of non-climate stresses (such as poverty, inequality, food insecurity, and environmental degradation) to climate change impacts, especially in a developing country context such as in Vanuatu (Smit and Pilifosova, 2001; Smith et al, 2003; Smit and Pilifosova, 2003; Downing and Patwardhan, 2004; Huq et al, 2005; Adger et al, 2007).

There is consensus that vulnerability is a function of both a community's exposure to climatic risk and its adaptive capacity. Exposure relates to the frequency and magnitude of climatic risk and the characteristics of a community influencing sensitivity to these. Adaptive capacity refers to the ability to prepare for, cope with and recover from, these exposures (Smit and Pilifosova, 2001; Smit and Pilifosova, 2003; Ford and Smit, 2004; Adger, 2003; Smit and Wandel, 2006). Importantly, the vulnerability approach recognizes that adaptive capacity (and to a degree, exposure) is determined by context and time-specific system characteristics indirectly related to climate such as wealth, equality, infrastructure and social capital, which in turn, reflect broader socio-economic conditions (Kelly and Adger, 2000; Adger, 2003; Brooks, 2003; Adger and Vincent, 2005; Adger, 2006). Hence, vulnerability is anchored in the condition of the human-environment system (Turner et al, 2006).

Community-based vulnerability assessments aim to identify practical adaptation initiatives by focusing on the processes determining adaptive capacity as functioning in a particular system (Smit and Wandel, 2006). The focus is on facilitating practical and tangible adaptation through 'mainstreaming' vulnerability reduction into decision making processes such as those for sustainable development and resource management. Building on existing activities of relevant institutions is often the focus as it recognized that adaptation initiatives are rarely feasible or successful when attempted in view of climate change alone (Huq et. al, 2003; Huq and Reid, 2004; Huq et al, 2005; Smit and Wandel, 2006).

Invariably referred to as a 'bottom-up' approach, community-based vulnerability assessments are becoming increasingly prevalent in the adaptation field (see Adger, 1999; Ford and Smit, 2004; Sutherland et al, 2004; Nakalevu, 2006), having evolved in response to the shortcomings of conventional 'top-down' impact-based approaches in engendering practical and feasible adaptation. These approaches generally begin assessment with scenarios of long term average changes, and focus on 'specific adaptations' or discrete adaptation measures (Smit and Pilifosova, 2003; Ford and Smit, 2004; Smit and Wandel, 2006; Klein et al, 2007). In contrast, 'bottom-up' assessment begins with the community in question, examining conditions giving rise to vulnerability based on local knowledge and experience. Local stakeholders are placed at the centre of adaptation efforts that build from community-specific vulnerability and internal strengths and capacities, and fit into local social and cultural situations and decision-making structures (Huq et al, 2005; Smit and Wandel, 2006; Blanco, 2006).

Importantly, the approach begins with assessing current exposure and adaptive capacity, before considering future manifestations of these. The assessment sequence is illustrated in Figure 2. In this way, adaptation acts to reduce current vulnerability, making initiatives 'no-regrets', or those which accrue benefit regardless of climate change – a feature that is particularly salient in a developing country context (Huq et al, 2005; Blanco, 2006). Accordingly, this assessment approach forms the conceptual framework for assessment in the Tangoa Island community, based on its merits in facilitating practical initiatives, consistent with other development and resource management priorities. This paper focuses on current vulnerability assessment in the Tangoa Island community, as a basis for adaptive decision-making.

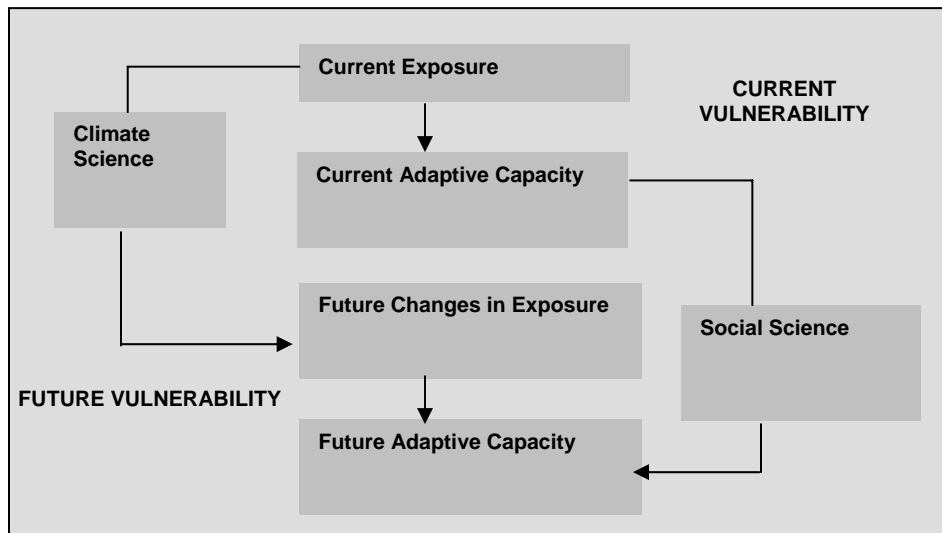


Figure 1. Research framework for vulnerability assessment (adapted from Ford and Smit, 2004; Huq and Reid, 2004; Sutherland et al, 2005; Smit and Wandel, 2006)

2.5 CLIMATE PROOFING DEVELOPMENT: ADAPTIVE DECISION-MAKING

How can this framework be applied to elicit practical adaptation outcomes in the context of the Vanuatu Carbon Credits Project: a multi-objective, mitigation/development project? A community-based vulnerability assessment can provide the groundwork for adaptive decision-making for climate-proofed development. Figure 3 outlines a simplified conceptual model of how development can be climate proofed within ICMSD best practice.

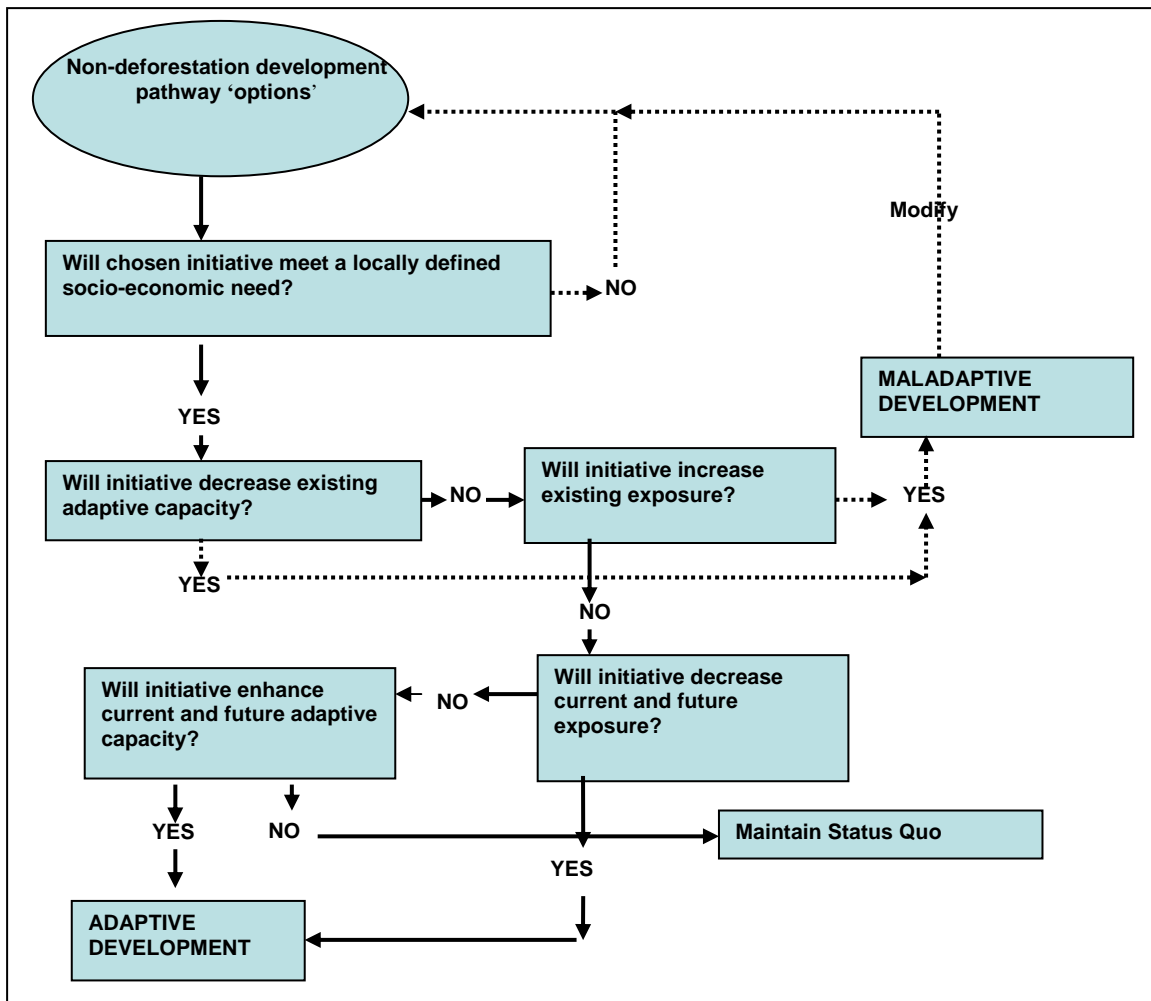


Figure 2. Conceptual model for the adaptive decision-making process, as part of the ICMSD model

The adaptive decision-making process assumes a ‘pool’ of development options or pathways. These options can then be prioritized based on adaptive merit, and/or modified to enhance this, by a process involving both relevant ‘external’ institutional actors and ‘internal’ local stakeholders³. By this process, meeting locally defined socio-economic need is paramount as the core goal is to offset unsustainable deforestation and forest degradation economic activities in the community. From here, maintaining the status quo of community vulnerability is a minimal requirement of development. Based on locally relevant aspects of vulnerability to climate stresses, development must not compromise existing adaptive capacity or increase exposure. To

³Community involvement in the generation and selection of alternative development ‘options’ or pathways is fundamental to project success in Vanuatu. The details of this process are outside the scope of this paper, however, it is important to recognise that there are varying levels and forms of local stakeholder participation. These are summarized comprehensively by Ericson (2006).

actually achieve *adaptation*, however, decisions will need to actively reduce vulnerability by some combination of enhancing adaptive capacity and/or reducing exposure-sensitivity. This process is essentially ‘mainstreaming’, as it addresses climate risk in decision-making for development at a practical level (i.e Huq and Reid, 2004; Smit and Wandel, 2006; Klein et al, 2007).

Obviously, a considerable amount of groundwork is required before any decision-making process can be applied in a community. Importantly, a baseline of locally defined socio-economic need and vulnerability to climate change must first be established to facilitate the bottom-up approach.

3. DEVELOPMENT NEEDS AND BASELINE VULNERABILITY IN THE TANGOIA ISLAND COMMUNITY

The Tangoia Island community resides on a very small, raised coral island just off the coast of South Santo, the largest island in the Vanuatu Archipelago. The community consists of approximately 300 people within eight family (or ‘clan’) groupings. Traditional local governance structures predominate alongside a strong Presbyterian Church influence. Subsistence activities are an integral component of livelihoods although the monetary economy is playing an increasingly important role in wellbeing. Although Tangoians reside on a small island, the majority of subsistence and monetary livelihood activities are undertaken on the coastal lowlands of South Santo. Tangoia Island is separated from the mainland by a two hundred meter channel that is crossed each day using outrigger canoes. The land used by Tangoians is approximately two thousand hectares of mixed primary and secondary forest and coconut plantations. Natural resources are integral to livelihoods and wellbeing in terms of food, income, medicine, building materials, and culture. Subsistence activities involve mainly mixed-cropping style cultivation, hunting and gathering activities and fishing. Copra⁴ from coconut plantations predominates as the major income generating activity.

What are the opportunities for reducing vulnerability by local development initiatives in the Tangoia Island community? To work towards answering this, a participatory approach was taken to gain a holistic understanding of both the nature of vulnerability, and development needs.

⁴ The dried meat of a coconut from which oil is extracted. Coconut products are exported in the dried form.

Methods (as summarized in Table 1), drew on tools from under the Participatory Rural Appraisal (PRA) umbrella (see Mukherjee, 1994; Kumar, 2002). The research process broadly reflected the framework outlined in Figure 1, with an emphasis on current exposure and adaptive capacity as a baseline for adaptive decision-making. The target was local knowledge and perceptions about:

- i) Climatic risks and aspects of these perceived as problematic
- ii) Specific affects and implications of risks on livelihoods and wellbeing
- iii) Coping mechanisms and effectiveness of these
- iv) General socio-economic, cultural and environmental issues and concerns indirectly related to climate (to elicit ‘multiple stressors’ relevant to vulnerability to climate change)
- V) Development needs and priorities

Table 1. Research Methods		
Method	Participant Scale	Research theme
Matrix Rating	Individual	i, ii
Timeline Construction and Discussion	Group	i, ii, iii
Trend Analysis	Both	ii, iii, iv
‘Brainstorming’ Posters	Group	iv, V
Open and Semi-structured interviews	Individual	All

So as to be culturally and socially appropriate, groups for relevant exercises were structured according to Tangoa Island community social structure. This resulted in separate groups of mixed gender youth, mixed age women, mixed age men, and elders (all men). A particular effort was made when employing individually focused methods to target a roughly even mix of

individuals from various age, gender and 'livelihood strategy'⁵ groups.



Womens group undertaking 'brainstorming' activity. Photo: Warrick, 2006

Research design drew on insights and methods from similar approaches in similar contexts, in particular, see Sutherland et al (2004), Conde and Lonsdale, (2005), Nakalevu (2006).

The intention was to understand how development needs and vulnerability to climate change may intersect in the community, so as to help overcome limitations and constraints on adaptive capacity. It is recognized that this approach cannot be expected to address all the components and determinants of vulnerability in the Tangoa Island community – not all these will have the potential to be addressed within development initiatives. Likewise, not all development needs will be relevant to vulnerability. However, this approach targets those aspects of vulnerability that *can* be potentially reduced by development decisions, thereby optimizing adaptation potential within the bounds of a project with other core priorities (principally, climate change mitigation) It makes optimal use of resources available to deliver practical and feasible adaptive outcomes, given the context.

⁵ As most families engage to some degree with a range of livelihood strategies, this particular parameter of categorization was not as important to understanding vulnerability in Tangoa Island as purported in other cases in the literature (i.e Adger, 1999; Downing, 2003). However, a small degree of livelihood 'specialization' was apparent, allowing some analysis by predominant livelihood strategy

3.1 DEVELOPMENT NEEDS

Locally defined development priorities were generally perceived to be at the family-scale and community-scale two scales. Two major priorities were identified: the need for more lucrative and secure income generation, and the need for improved and reliable infrastructure. Ultimately the greatest overarching priority of men, women and youth is improving the economic, social, and cultural wellbeing of their immediate families. As expected, many of the issues identified as priority from a 'development need' perspective also emerged in the vulnerability assessment component of the participatory research; there are clear intersections between socio-economic issues and the ability to cope with climatic-related stress.

3.1.1 NEEDS AT THE FAMILY SCALE

Increasing need for monetary incomes has emerged over time out of the transition from traditional to more 'modern' systems. This transition is proving difficult for many communities in Vanuatu, as people grapple with clashes between traditional, subsistence socio-economic and value systems and modern, capitalist pressures⁶. Meeting every-day household cash needs is the greatest economic pressure at the family level on Tangoa Island. Cash is needed for items such as kerosene, sugar, flour and soap, although the principal identified expense (and the most problematic economic pressure) for a rural family is paying school fees.

For most Tangoan families, there are two principal factors shaping the ability of families to meet daily income demands. These are income generating activities themselves and capacity to manage ensuing financial capital. Most families on Tangoa rely to some degree on income from copra plantations and agricultural subsistence surplus for cash needs. Cocoa, vanilla and kava⁷ plantations, fishing and weaving for local markets, labour contracting and various local small business ventures supplement this to varying degrees. Most families engage with all of

⁶ Waddell and Connell (2007: 3) Describe this as a "condition where people are exposed to a bewildering range of new ideologies, lifestyles and goods...increasingly divorced from the needs and values of rural people". Weaver et al (2007, forthcoming) overviews issues surrounding this in a specific Vanuatu context.

⁷ A mildly tranquilizing, ceremonial drink made from the root of *Piper methysticum*.

these strategies to various degrees, however, copra is the mainstay of livelihoods in Tangoa. Copra has become an unreliable and low return activity however, due in part to volatile and unpredictable markets. This, coupled with money management practises at the family level often renders income insufficient. Women especially, identified budgeting and money management capacity building as a pressing need, as income is usually controlled by men and often spent on kava instead of saved for school fees. Insufficient income and money management is that few children (especially females) are able to access education past primary school. Of those that do, very few complete high school, and essentially none access higher education, thus perpetuating the generally perceived low capacity of the community to better their own situation.

In response to these factors, local people identified more lucrative and diverse income generating opportunities as a priority for. Youth largely refer this as increasing “employment” opportunities. Even of those that have attended high school, few who return home, or migrate to urban areas, are able to find “employment” other than copra cutting. However, little knowledge or awareness exists as to what these improved income strategies might be. In brainstorming exercises, participants overwhelmingly cited strategies based on initiatives already existing, such as more small business options and more copra, cocoa and vanilla plantations – strategies unlikely to (by themselves, at least) solve root problems identified. Accordingly, some Tangoans acknowledged the important role that ‘external actors’ can play in capacity building and in assisting financially, with the development of alternative initiatives.



Poster constructed by youth group. Photo: Warrick, 2006

Where income generating activities are able to meet household needs, there is rarely enough surplus cash to contribute to community projects identified as important such as fixing water pipes, building a youth hall, or establishing a clinic. Accordingly, projects such as this are largely perceived by the community as financially the responsibility of external actors – in this case, of the Rural Economic Development Initiative: the sole government programme specifically aimed at local rural development in the provinces and the only external actors Tangoan Islanders are immediately aware of. Tangoans also highlighted the shortcomings of this programme in producing tangible outcomes – attempts have been made to engage with the programme in the past with little success⁸

3.1.2 NEEDS AT THE COMMUNITY SCALE

At a broader community scale, needs and priorities related predominantly to community-scale infrastructural needs. Internal community social issues were recognized as important barriers to autonomously addressing these needs, and addressing social issues was identified as a need in itself. Externally facilitated education, awareness and skill building was identified as a necessary step in achieving infrastructural goals and addressing social issues.

Improving water security was the main infrastructural priority. River water is delivered to Tangoa via a gravity fed, polythene pipe running under the channel between the island and Santo mainland. Water quality is an increasing issue with increasing forest clearance and associated cattle farms. Water is held in a tank and distributed to each family area via smaller pipes and a tap. One family has a rainwater tank and others occasionally use smaller containers for rainwater collection. The need for a more efficient delivery system was identified as priority, as the pipe often breaks, water pressure is always low, and the tank cannot refill fast enough during peak use times. The need for improved medical facilities was also identified as a priority, as currently, the closest clinic is an hour walking. This, coupled with a lack of inexpensive transport means accessing medical supplies and services is extremely difficult, and ill-health is left largely untreated. This was a large concern amongst women, especially.

⁸ This was reinforced with interviews with relevant actors in both the local provincial and central government. Financial and human capacity is extremely low in this programme, resulting in a narrow range of projects attempted and a low incidence of suitable outcomes for local people.



Poster constructed about the need for improved water infrastructure by women's group Photo: Warrick, 2006

Improved transport systems were also identified as a priority. Outrigger canoe is the sole mode of transport between island and mainland. Improved water transport is a need, as mainland access is difficult during rough seas such as following a cyclone. Transporting large loads of garden produce or house building materials is also problematic. Furthermore, unreliable and costly links to urban centres restrict opportunities to export copra and access urban markets for garden produce, fish and weaving.

There is widespread recognition that social issues such as population growth, land disputes, land availability, community governance, increasing individualism, and general community divisions increasingly impinge progress towards meeting community and family development need. These issues are common throughout rural Vanuatu and often operate in mutually reinforcing and complex ways. For example, decreasing land availability is a pressing issue for Tangoan Islanders, as mixed-cropping type agriculture forms the backbone of the subsistence economy as well being an important economic substitute for copra. Figure 3 illustrates the interconnecting issues contributing to this pressure. Increasing population growth, coupled with disputes over land ownership, eroding community governance structures, subsequent community divisions, and erosion of traditional resource management practises limit the availability of quality

gardening land in two respects. Firstly, fewer families have entitlement to land for gardening. Secondly, arability of existing land is compromised by shortened fallow periods. Over time, declining “soil quality” has restricted the range of crops that can be grown on existing land. This has significant implications for livelihood and food security especially, as well as for economic and cultural wellbeing. Some traditionally important staple root crops such as valued species of yam and taro no longer grow well, and the community is generally unable to grow economically valuable crops such as tomatoes, capsicums, beans and fruit trees. The role of external institutions was considered important here, principally to provide financial, human and educational support for improving current land use practises on existing land.

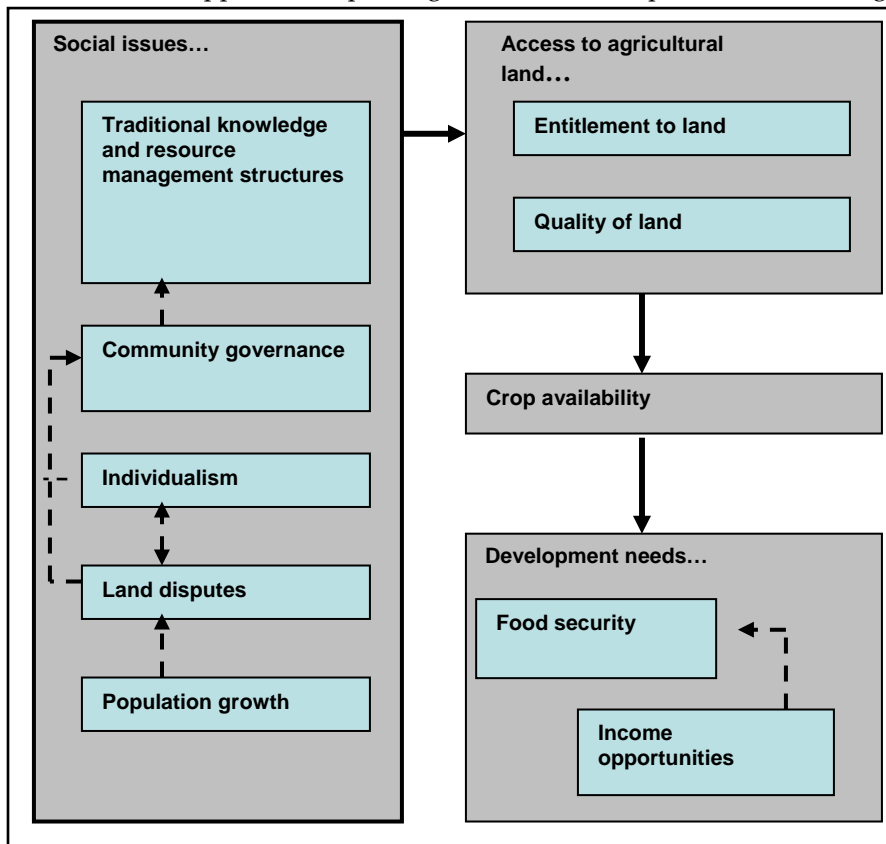


Figure 3. Relationships between social issues and food and income security in the Tangoa Island community.

Social issues themselves were categorized as ‘development needs’ by participants, due to an association between solving these and accessing assistance from external institutional actors. There is a leading perception that internal capacity is too low (in terms of education, skills and resources) to address problems in the absence of external institutional assistance.

3.2 THE NATURE OF VULNERABILITY IN TANGOA ISLAND

The nature of vulnerability to climate change in Tangoa Island is shaped largely by 'non-climate stresses' or factors not exclusive to climatic stress. These are largely social and economic stresses that determine exposure-sensitivity and shape adaptive capacity. Non-climate stresses are grounded in wider (spatial and temporal) issues such as increasing prevalence of 'western' or 'modern' values and systems, increasing demands for money with increasing integration into the capitalist economy, and population growth. These 'root causes' of the components of vulnerability are important to take account of, as they will influence adaptive capacity into the future. Tangoans believe themselves to be becoming less able to adapt to climatic stress than in the past because of changing social and economic community circumstances.

Vanuatu is particularly exposed to tropical cyclones. Cyclones were identified by Tangoan Islanders as the attribute of climate most pertinent to livelihoods and wellbeing in the community. Other types of exposure identified as problematic to a lesser degree were drought and heavy rain. Due to the emphasis placed on cyclones by local residents throughout the participatory research process, these will be the focus for explaining vulnerability in this paper⁹. Two distinct seasons influence the Vanuatu archipelago: a warm and wet season from November to April (cyclone season), and a cool and dry season from May to October. The number of cyclones per season and magnitude of these largely determine sensitivity and coping capacity. Tropical cyclones are "*likely* [to become] more intense, with larger peak wind speeds and more heavy precipitation..." (Alley et al, 2007:16). There is some evidence that the frequency of cyclones will increase also, although this is an area of much debate.

Cyclones Nigel and Eric both occurring in January of 1987, had a particularly severe impact due to their high magnitude and quick succession. Extreme damage was sustained to buildings, infrastructure, gardens, plantations and other assets from high winds, heavy rain and storm surge. The ensuing disruption to livelihoods and wellbeing was compounded as recovery efforts were nullified and already damaged, fragile systems were exposed for a second time. Overall, the most problematic aspect of this was the length of time until 'normal' livelihood systems could

⁹ It should be noted that, as exposure is an integral part of the vulnerability equation, the nature of vulnerability will not be identical for different exposure types. However, many of the broad characteristics of the community that comprise a condition of vulnerability will be similar across different exposures.

be resumed. Reduced income generation ability and food insecurity over a long period of time (up to two years for some families) were the most problematic stresses arising from this disruption to livelihoods.

Social networks were central to the adaptive capacity of the community in coping with these implications. Resources, shelter and labour were shared according to reciprocal social norms. However, institutional support in the form of relief aid (tinned fish, rice and building materials) was important directly following the cyclones, as the characteristics of exposure meant the capacity of internal relief networks and mechanisms was exceeded. Interestingly, some residents perceive the presence of institutional support to have increased vulnerability in the longer term by encouraging the reconstruction of buildings in a 'modern' as opposed to traditional style. This is the only time residents have received institutional support due to supply and demand side factors; resilience and adaptive capacity in Tangoa can largely be attributed to self sufficiency in coping with climatic stresses. However, it is important to recognise that many of the components and determinants of this self sufficiency are changing; care of pressures arising from a complex permutation of internal and external socio-economic pressures. It is likely that the current adaptive capacity will not be sufficient to withstand potential changes in magnitude of cyclones (and other aspects of variability and extremes) with climate change.

Cyclones Eric and Nigel highlighted the aspects of village life that are most significantly affected by exposure to a cyclone. The most important effects and ensuing implications (as identified by participants) generally fall into six categories, as summarised in Table 2 , along with the major contributing factors and the main adaptive strategies employed. The structure of Table 2 broadly reflects the way in which participants perceive climatic stress.

Table 2: Components and determinants of vulnerability to tropical cyclones and adaptive capacity in the Tangoa Island community			
Effects	Implications	Significant Contributing Factors	Current Adaptive Strategies
Decreased income generation ability	<ul style="list-style-type: none"> • Difficult to pay school fees • Difficult to purchase household items • Difficult to repair infrastructure and houses • Difficult to pay medical bills 	<ul style="list-style-type: none"> • Reliance on copra 	<ul style="list-style-type: none"> • 'Livelihood switching' or concentration on other activities like contract labouring and fishing
Food insecurity	<ul style="list-style-type: none"> • Less diverse and nutritious diet • Increased demand for money to purchase food 	<ul style="list-style-type: none"> • Decline in quality agricultural land 	<ul style="list-style-type: none"> • Reliance on purchased food • Reliance on uncultivated 'back-up' crops • Social networks
Water insecurity	<ul style="list-style-type: none"> • Health problems • Increased demand for money for repairs 	<ul style="list-style-type: none"> • Contamination of historic back-up supply (well) • Infrastructure unreliable, insufficient and in disrepair 	<ul style="list-style-type: none"> • Rainwater collection • Ad hoc repairs • Social networks
Increased disease incidence	<ul style="list-style-type: none"> • Increased demand for money for medicine • Longer term health problems from untreated illnesses 	<ul style="list-style-type: none"> • Limited access to medical facilities • Debris not rapidly cleared, increased mosquito breeding 	<ul style="list-style-type: none"> • Traditional 'Kastom' medicine use
Damage to Housing	<ul style="list-style-type: none"> • Increased demand for money for repairs (for some) • Insufficient or sustained lack of shelter 	<ul style="list-style-type: none"> • Decline in traditional housing 	<ul style="list-style-type: none"> • Maintain traditional-style buildings • Prepare by planting construction species in sheltered areas • Secure rooves • Social networks
Coastal erosion	<ul style="list-style-type: none"> • Damage to plantations • Loss of subsistence areas 	<ul style="list-style-type: none"> • Clearance of coastal vegetation 	<ul style="list-style-type: none"> • Replanting in some areas

The economic impact of cyclones is perhaps the most significant component of vulnerability due to the flow-on effects on aspects of food security, water security, health, and education in the short and longer term. Impacts and implications in these areas largely encompass greater

financial demands – demands that are difficult to meet, given decreased ability to generate income following a cyclone. Widespread economic reliance on copra production largely underwrites this. All families rely on copra to some degree – those who do not own a plantation themselves will work as hired labour for those that do.

The majority of copra plantations are located in a low-lying, narrow coastal strip on the mainland of Santo, increasing exposure to high winds and storm surge. Copra crops are susceptible to wind damage, which has been perpetuated by clearance of dune and coastal trees and vegetation. Depending on the magnitude and frequency of cyclone occurrence, a plantation can be unproductive for up to two years, thus vastly reducing income opportunity. Although families generally have the ability to shift emphasis onto another income generating activity such as fishing, more gardening, or contract labouring, opportunities are limited and incomes are regarded as too piecemeal to rely on in the absence of copra for extended periods of time. Also, a rapid increase in fisherman, for example, can flood local markets, thereby compounding the problem.

There are a number of social issues that underwrite the components of vulnerability outlined in Table 2. These social issues are largely the same as those identified as at the root of development needs, outlined in 3.1.2 above. For example, Figure 3 illustrated the social issues contributing to land quality and access. Figure 4 places these in the context of exposure to a cyclone, illustrating the links between land availability, the ability to generate income, and food security.

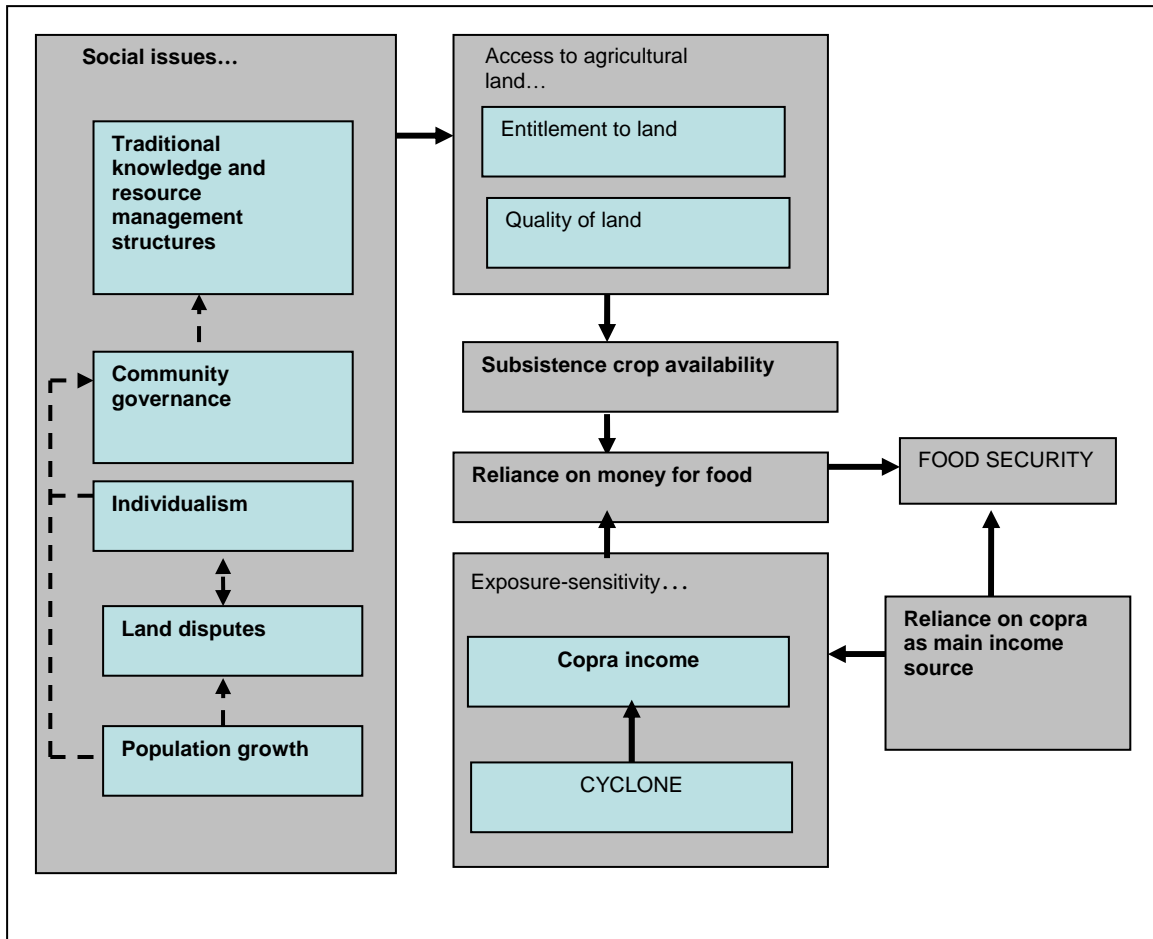


Figure 4. Components and determinants of vulnerability to food security in the Tangoa Island community

A declining ability to access quality subsistence crops, results in declining self sufficiency and increasing reliance on money for food. The ability to access food therefore increasingly relies on the ability to generate sufficient income – something that is often significantly compromised by a cyclone. An important aspect of adaptive capacity in this respect, and with respect to most aspects of vulnerability, is social networks and systems based on reciprocity. The sharing of resources, food, shelter and labour is fundamental to coping capacity. However, residents pointed to evidence that the nature of this traditional social system is changing with increasing prevalence of monetary systems, decline of traditional value systems among youth and community divisions stemming largely from land disputes. Although what is referred to as the ‘moral economy’ in the literature (Adger, 2003), still operates, increasing individualism is increasingly prevalent.

The ability to access fresh water is an important implication of cyclone exposure. Water infrastructure is fragile and unreliable irrespective of climate stress, and invariably sustains damage. Adaptive capacity therefore depends on the ability to collect clean rainwater. In the past, Tangoa Island was better able to cope by utilizing a more reliable, back-up groundwater supply from a village well. However, in the past two decades, increasing population has not been matched with improved waste management systems, resulting in contamination of the underground freshwater lens.

Increases in malaria, skin and eye infections, dysentery and other water and vector born disease are more prevalent following a cyclone. These diseases are largely left untreated, as medical facilities are virtually inaccessible. Adaptive capacity in this respect is determined by traditional “kastom¹⁰” medicine – the prevalence and quality of which is declining due to eroding traditional knowledge, especially among youth.

The physical location of the village itself has advantages and disadvantages. Physically, Tangoa Island is a fairly high, raised coral island, meaning the village itself is fairly resilient to storm surge. Furthermore, settlement is located on the more protected channel side of the island, as opposed to the seaward side. However, lack of dense vegetation around the village makes it susceptible to wind and rain damage. An important determinant of adaptive capacity in this respect is building style. Houses and buildings constructed in a traditional style and using traditional materials are generally considered to be more resilient than those constructed from corrugated iron and concrete. This is principally because repairing a traditional house is free of cost, while repairing a ‘blockhouse’ requires money and a trip to town. Furthermore, traditional style roofs can be effectively secured with coconut fronds, significantly reducing wind damage.

¹⁰ Local pigin word for custom



Modern style house. Photo: Warrick, 2006

Other adaptive strategies include intentionally planting relevant species in sheltered places in preparation for cyclone season. However, only roughly 50% of buildings are constructed traditionally, due to perceptions of blockhouses as a sign of wealth, and declining knowledge of traditional construction methods.



Traditional style house. Photo: Warrick, 2006

Tangoa Island's relatively high self sufficiency has contributed to its adaptive capacity. The absence of institutional relief support may have contributed to this as the community has been forced to be self reliant in times of stress. Social networks and stable subsistence systems have

played a central role in resilience. The nature of these systems is changing however, due to a suite of social factors, and Tangoan Islanders generally regard their ability to cope with climatic stress to be declining with time. Adaptive capacity in its current form therefore may not be sufficient in the future, given current social trends and likely increases in cyclone intensity and (perhaps) frequency (Alley et al, 2007).

4 CONCLUSIONS

The groundwork is thus established for enabling an adaptive decision-making process to proceed. Some preliminary observations can be made from this. It is evident that some vulnerability components can be directly addressed by development, others indirectly, some, not at all. Addressing some of the root causes at the intersection of development need and vulnerability to climate change is infeasible given the core priorities and focus of the ICMSD model and Vanuatu Carbon Credits Project. 'Development' as required by the model (i.e to offset deforestation drivers), cannot be expected to in itself, re-kindle traditional knowledge or repair community divisions, for example. The potential for adaptation exists however, in increasing community adaptive capacity, or the ability to cope with current and future exposure-sensitivities, by treating the symptoms of root causes.

The participatory assessment revealed two overarching opportunities for, or approaches to, reducing vulnerability via adaptive decision-making in the Tangoa Island community. These are developing more diverse and stable means of generating income, thereby reducing reliance on copra, and providing alternative and improved community infrastructures, specifically regarding water, health, and transport facilities. Initiatives can address vulnerability in multi-faceted ways. For example, alternative, more resilient and sustainable agricultural systems could be designed to improve and diversify income generation whilst addressing food security, by employing cropping systems for improving the quality of existing land. Similarly, developing an improved and sustainable island waste management system could enhance water security by preventing contamination of groundwater supplies. These are examples of the ways in which development initiatives, for the ultimate purpose of discouraging deforestation, can also assist

the community in preparing for, coping with, and recovering from, the impacts of climate change.

The Tangoa Island community case study illustrates the pertinence of taking a community-based, vulnerability approach to delivering adaptation in the context of a multi-component project with multiple and competing priorities. A holistic and intricate understanding of the components and determinants of vulnerability and how these relate to wider socio-economic, cultural and environmental conditions is enabled in a way that other approaches to adaptation may not enable. It is evident that a holistic understanding of the causes and symptoms of direct and indirect climatic stress is fundamental to guide decisions on how best to use carbon finance to optimize co-benefits.

This approach facilitates adaptation outcomes from mitigation focussed projects. In this respect, carbon finance offers a potential funding source for adaptation, supplementary to current donor focussed adaptation funding structures. This is potentially valuable in the case of Vanuatu, where adaptation efforts, particularly initiatives to mainstream adaptation into national level development planning, lack widespread outcomes on the ground. Instigation of synergistic projects under an ICMSD framework could supplement current adaptation delivery in Vanuatu and is relevant to number of other vulnerable developing countries.

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