Griffith UNIVERSITY

2017-2018 Annual Report

EcoAdapt Research Project

The Benefits of Ecosystem-based Approaches for Climate Change in Least Developed Countries

Griffith Climate Change Response Program

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Project Overview

The EcoAdapt project is designed to address three primary research questions:

1. What constitutes an ecosystem-based approach to climate change adaptation?
2. In the Pacific context, under what circumstances are ecosystem based approaches an appropriate climate change adaptation response?
3. What information and decision making processes are required by stakeholders to evaluate adaptation options?

To address these questions, our research is organised around five themes, each of which has a set of secondary research questions that they are exploring (Appendix 1). The five themes are:

i. Coastal Process
ii. Risk Assessment of Adaptation Options
iii. Micro-economic Benefit-cost Analysis
iv. Policy & Social Analysis
v. Project Integration, Ecosystems and Climate Change Analysis

The geographic focus of our research is Tanna Island in the Tafea Province of Vanuatu (Figure 1). A second case study is underway in Samoa.

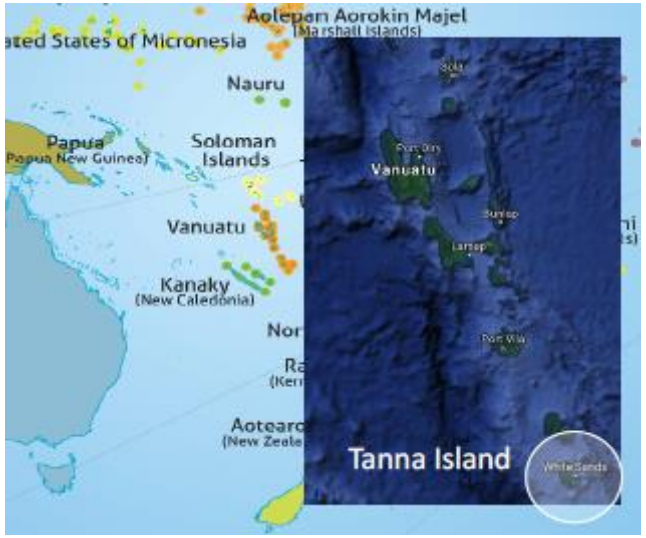


Figure 1 | Geographical focus of research — Tanna Island, Vanuatu

Director's Overview

As our EcoAdapt project comes to the end of its second year, it is timely to review progress made to date, lessons learnt, and also to reflect upon the challenges and opportunities that arise from the special and unique characteristics of this project, many of which relate to the multidisciplinary approach of our research.

We had set ourselves the bold task of investigating the issue of ecosystem-based adaptation in the coastal zone of small island developing states (SIDS) using a systems approach inclusive of ecological, micro-economic, social science and engineering perspectives. This requires a high level of coordination between disciplinary teams whose researchers have to both advance their specialised agendas while in parallel interact with their colleagues in the other project themes. Like Janus, the two-faced Roman God, our EcoAdapt researchers have to simultaneously look both 'inwards' and 'outwards' in order to ensure the overall project advances in a productive and timely manner.

Special methodological challenges also arise from taking a systems-based, multidisciplinary approach including the need to integrate qualitative and quantitative data, reconcile different theories and conceptual understandings, and achieve a genuine synthesis of results from multiple sources that generate new insights above and beyond what can be achieved from conventional disciplinary-based investigations alone.

At the same, we are mindful that the highest quality research emerges when investigators have their academic freedom protected to develop novel approaches and are able to pursue lines of inquiry accepting the possibility that these may deliver negative results and end up in dead ends or falling down rabbit holes.

Fortunately, Griffith University has an excellent track record in supporting multidisciplinary research, particularly when addressing practical problems of society and environment such as adaptation in the coastal zone of SIDS. The benefits of a multidisciplinary approach become apparent when we consider the new knowledge emerging from our research and the insights and lessons these provide for policy, decision making and community well-being.

A major finding of our research to date is that ecosystem-based adaptation (EbA) in practice is best understood as an 'approach' rather than an 'option'. Adaptation studies typically compare an EbA option, such as restoring a degraded mangrove, with a hard engineering options, such as building a concrete sea wall. Whereas, we argue that considering EbA as an approach means to first develop a comprehensive understanding of the socio-ecological system, identify all major risks to ecosystem integrity and community wellbeing, understand the underlying causal linkages that lead to these risks, and consider a broad sheet of adaptations strategies under a set of plausible scenarios. The aim being to identify options that are robust, cost-effective, socially acceptable, and culturally appropriate given possible future conditions. Critically, the effects of potential adaptation interventions must be considered on the socio-ecological system in toto rather than just at the site-level in isolation from the broader systemic connections.

We explored novel ways of consulting with the Tanna communities, which involved *in situ* activities. Discussions were held at the 'Nakamal' - the village meeting space, centred around a large banyan tree - where community members were free to assemble and ask questions of us. We also walked the land (and paddled the sea) with community members to discuss and witness first hand their environmental and development concerns. More structured interviews were also held with groups of women in the communities with the aid of a multilingual community member. We also conducted formal meetings with provincial government planners and other officials and stakeholder. Taking such a '360 degree' approach meant we

Director's Overview

(continued)

were able to gain insights into the local realities - including the growing pressures on their natural resources and economies - that the communities are experiencing and having to manage and respond to.

A good example of the positive outcomes that arose from the multidisciplinary approach of our research was the ways in which the ecosystem and climate change theme's analyses informed the micro-economic evaluations. We modelled the distribution and condition of the major ecosystem types of Tanna Island, including the fringing coral reefs, using high resolution satellite data, existing maps, and field observations.

Drawing upon a range of econometric techniques, we calculated the monetary value of the ecosystem service benefits generated from Tanna's ecosystems for the Tanna communities. The total annual monetary value of ecosystem service flows from all ecosystem type on Tanna was estimated at US$250.5M, a little over ⅓ of the annual GDP for all of Vanuatu. Ecosystem services are the benefits people derive from ecosystem services such as fish from coral reef consumed as part of the subsistence economy and freshwater from watersheds - which are not accounted for in conventional economic analyses.

Our socio-ecological framing meant we also took account of the kastom values the communities hold about their ecosystems, and the associated traditional knowledge and cultural practices. These can easily escape even the more progressive ecosystem service approach to economic evaluation as they are not amenable to being bought and sold on a market nor can they logically have their future value discounted. Kastom values are an important component of governance on Tanna Island and are therefore relevant when considering adaptation options and highlighting the circumstances where ecosystem-based adaptation might be particularly appropriate.

The local Tanna communities are, at the same time, living with the rapidly increasing influence of modernity, the pressures of increasing national and foreign infrastructure investment, and the emergence of a blended economy. With these changes come both new threats to the ecological and cultural integrity of Tanna, along with real prospects for much needed sustainable development.

Another of the innovative components of our research on Tanna is the use of multi-scale modelling to generate maps of three key coastal risks: inundation; erosion; and water quality. To our knowledge, for the first time in the south Pacific we are calibrating a regional ocean circulation model and using the outputs from these simulations to set the boundary conditions for a high resolution coastal processes model, both of which can be driven by current and future climate change projections. The high resolution coastal processes model is also able to make use of fine resolution drone imagery on the location and height of the fringing coral reefs and the effect these have on attenuating wave energy.

Our second case study is under development on the island of Savi'i, Samoa in partnership with the Ministry of Natural Resources and Environment. Samoa provides the opportunity to compare with Vanuatu how different levels of SIDS development affects ecosystem-based adaptation.

In addition to advancing knowledge on ecosystem-based adaptation in Pacific SIDS, the outcomes of our research have direct relevance for the Tafea Provincial Government and the people, communities and other stakeholders of Tanna. To further this end, we have signed an MOU with the Tafea Provincial Government to facilitate the transfer of knowledge and information to relevant government planners, Tanna communities and other stakeholders. We are also collaborating with other regional organisations working on Tanna - the Secretariat for the Regional Environment Programme and the sub-campus of the University of South Pacific - in our research and to contribute to local capacity building.

Professor Brendan Mackey
Director, EcoAdapt Project

Coastal Processes

The Coastal team has been working on the challenging task of establishing both an ocean circulation model for the south-west Pacific, and coastal process models for the coastal waters around Tanna Island. These models will provide input to the development of high level coastal erosion and inundation assessments in the coming year.

Dr Lee has overcome computational issues and has now established an operational ocean circulation model for the south-west Pacific Ocean. Boundary conditions can be extracted from this model's output to be used as input to the coastal process model. In April, Dr Andutta travelled to Belgium to work with the developers of the FVCOM model looking at the inclusion of wave forcing into the model. Model grids have been developed for the Port Resolution vicinity and the model is expected to be operational shortly.

The coastal team has evaluated the available ocean and coastal environmental data for Tanna Island. From this, it has become clear that the original assumptions regarding key parameters affecting the coast and the coastal team research plan needed to be revised.

For example, the team will no longer be implementing the QSurge decision-making tool as storm surge is not a significant impact on the island. New objectives have been set for the team to create levels of assessment based on information availability increasing with on-ground studies.

The first of these assessments provides a framework for the digital library of information. This first-pass coastal hazard assessment is based only on already published and accessible data, with limited extrapolation to the shoreline. Subsequent assessments will refine this, as new data is collected, and the models are made operational, calibrated and interconnected. The outcome from this staged assessment approach will be a framework for evaluating and justifying expenditure on data acquisition and modelling in remote island settings – what level of assessment gives the best return on investment.

Theme leader:

Professor Rodger Tomlinson
Director, Griffith Centre for Coastal Management

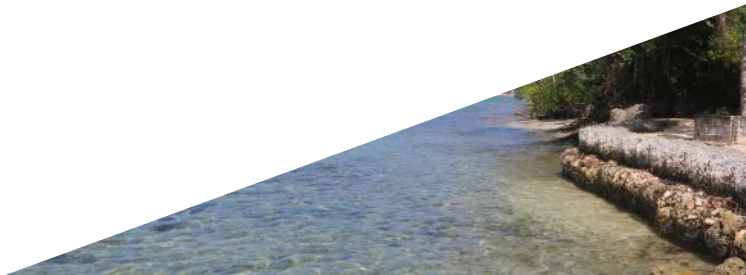
Theme members:

Dr Fernando Andutta, Dr Serena Lee
Griffith Centre for Coastal Management

Professor Charles Lemckert
University of Canberra

PhD researcher:

Gaelle Faivre



Risk Assessment of Adaptation Responses

Year 2 of the EcoAdapt project has seen the Risk assessment team conduct field work on Tanna Island and facilitate development of a shared conceptual model of the Social Ecological System for Ecosystem Based Adaptation within Small Island Developing States. The work has identified the relationships between key drivers of ecosystem condition and community wellbeing in particular; changing climate, institutional structures, urban development.

The research outputs from the team have been presented at a number of international conferences. In particular the team has identified serious limitations with traditional techniques for climate change risk assessment on the basis that they lack integration and are overly reductionist.

In the year ahead the risk assessment team will use the established social ecological systems models to integrated the research outputs from other EcoAdapt project themes and enable a truly integrated climate change risk assessment. This integrated risk assessment will be the basis for developing an improved understanding of ecosystem based adaptation on small island developing states through its application to our project case studies in Vanuatu and Samoa.

Theme leader:

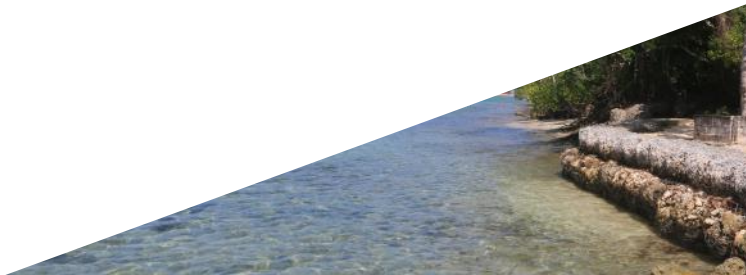
Professor Rodney Stewart
Griffith School of Engineering

Theme members:

Dr Oz Sahin

PhD researcher:

Mehdi Hafezi



Micro-economic Benefit-cost Analyses

The Micro-economics team has undertaken a meta-regression on a newly compiled dataset of 228 climate change adaptation (CCA) projects in the Pacific. The purpose of the meta-regression was to identify factors that exert statistically significant influences on the probability of a CCA project being successfully completed. This work marks a point of departure from previous studies in that each observation in our dataset contains categorised and coded information from individual CCA projects. Our analysis thus utilised project-specific data, which provide richer information at a much finer geographical scale than the country-level data employed in adaptation tracking studies undertaken to date.

Through our analysis we find that, for a given level of funding, shorter projects, greater financial commitment from the host country, an explicit focus on climate adaptation from the outset, and a clear choice of adaptation approach all increase the probability of successful completion for an adaption project. Location-specific factors are also apparent.

Theme leaders:

Associate Professor Christopher Fleming
Griffith School of Business

Associate Professor Jim Smart
Griffith School of Environment

Theme members:

Dr Syezlin Hasan
Australian Rivers Institute

Andrew Buckwell
Australian Rivers Institute

Policy & Social Analysis

The Policy & Social Analysis team visited Tanna Island during 2017 to conduct community discussions and meet with government and tourism stakeholders in order to develop a better understanding of current issues and the kinds of climate adaptation strategies that can support both climate and development needs.

The team has also been actively engaging at global and national policy and science discussions and research activities. Team members participated in the Pacific Coastal Climate Change Symposium in Apia where Dr Nalau gave a keynote presentation based on the EcoAdapt research on defining ecosystem-based adaptation, and the kinds of challenges that are currently constraining EbA approaches in the Pacific.

Dr Nalau and Miss Schliephack also had the opportunity to meet with a number of key stakeholders from the Pacific region who were in attendance, including Samoan government representatives and discuss the EcoAdapt project.

The team also visited the Samoan island of Savai'i and conducted interviews with tourism operators about climate adaptation measures, development needs and decision-making processes on climate adaptation. The interviews and fieldwork have demonstrated the complexity of decision-making around which adaptation options are chosen and why.

For donors, EbA options are hard to invest in if there are doubts about how to measure their effectiveness, whereas communities want to see immediate results and tend to favour options, such as seawalls, that are perceived to provide urgent protection. In Samoa in particular, hard infrastructure investments are now seen as the standard response to coastal erosion although EbA options could provide more longer-term benefits.

The interviews have highlighted the importance of using robust science in project design phase, early engagement with the community, and setting in place monitoring and evaluation processes that can clearly demonstrate benefits.

Theme leader:

Professor Susanne Becken
Director, Griffith Institute for Tourism

Theme members:

Dr Johanna Nalau

PhD researcher:

Johanna Schliephack

Project Integration, Ecosystem & Climate Analysis

The Ecosystem & Climate Analysis team has been engaged in a number of model building activities over the past year.

Significant progress has been made in building a model of land cover change for Tanna Island which can capture the potential influences arising from future climate and land use change. This land cover change model is needed to help identify future risks for Tanna ecosystems and community wellbeing in relation to food security, water quality, and protection of kastom forest, all of which in turn have implications for the ecosystem integrity of the fringing coral reefs.

Key input data layers for this model are the existing national forest cover map and the new land cover map for Tanna Island developed by the tram from RapidEye satellite imagery. We are using spatial statistical techniques to correlate recent rates of land cover change with potential causal factors such as the road network and population growth.

These functions are then used to extrapolate land cover changes into the future under a range of plausible future scenario. Following the approaches developed for Tanna, the team is now undertaking climate change and land cover modelling for the Samoan islands of Savi'I and Efate.

The climate change modelling uses the WorldClim downscaled projections which at a 1 km resolution are sufficient to provide a first-pass assessment of potential terrestrial climate risks for the two largest Samoan islands.

Theme leader:

Professor Brendan Mackey
Director, Griffith Climate Change Response Program

Theme members:

Dan Ware
Griffith Centre for Coastal Management

Dr Willow Hallgren
Griffith Environmental Futures Institute

Professor Rod Connolly
Griffith School of Environment

Milestones & Research Progress

EcoAdapt's research is organised around five themes. As per our contractual arrangements, there is an agreed set of milestones for each theme.

Table 1 presents a summary of the milestones for each theme and the evidence that the milestone has been in fact achieved. Where the milestone deliverable is a publication, a digital or hard copy of this is available and will be gladly forwarded.

Table 1 | Milestones & Research Progress

TASK ID	DESCRIPTION	EVIDENCE MILESTONE HAS BEEN COMPLETED
1. COASTAL PROCESS		
1.3	Report on regional ocean model configuration, and integration with wave and coastal process models for site specific locations. This will include preliminary calibration based on available data	Completed internal documents
1.4	Preliminary report on development of digital library of climate change and extreme events impacts at site specific locations	Completed internal documents
1.5	Conference paper presented on regional ocean model set-up	Lee S, Lemckert C, and Tomlinson R, (2017) Eco-adaptation In The Southern Pacific Ocean And The Role Of Regional Ocean Modelling presented at 14th Annual Meeting of the Asia Oceania Geosciences Society, Singapore 6-11 August 2017 at meeting of the Asia Oceania Geosciences Society, Singapore 6 -11 August 2017
2. RISK ASSESSMENT OF ADAPTATION RESPONSES		
2.3	Conceptual System Dynamics and Bayesian Network models finalised based on the structural analysis and inputs from other team	Completed internal documents
2.4	Implementation of the Bayesian Network models developed for the three case study locations using the information obtained from the previous step and other teams' input	Completed internal documents

Milestones & Research Progress (continued)

TASK ID	DESCRIPTION	EVIDENCE THAT MILESTONE HAS BEEN COMPLETED
2. RISK ASSESSMENT OF ADAPTATION RESPONSES (CONTINUED)		
2.5	Journal paper submitted and conference paper presented on case study Bayesian Net model implementation	Hafezi M, Sahin O, Stewart R, Ware D, and Mackey B, (2017) Participatory dynamic modelling approach for adaptation planning needs focusing on Small Islands Developing States presented at 12th Conference on Sustainable Development of Energy, Water and Environment Systems – SDEWES Dubrovnik, Croatia
3. MICRO-ECONOMIC BENEFIT COSTS-ANALYSIS		
3.2	Meta-analysis completed of existing climate adaptation projects in the South Pacific	Hasan S, Fleming C, Smart J, Mackey B (2018) Factors influencing the outcomes of climate change adaptation projects in the Pacific Island Countries: A meta analysis presented at Pacific Ocean Pacific Climate Conference Wellington New Zealand 21-23 February 2018
3.3	Journal article submitted on results of meta-analysis	Hasan S, Fleming C, Smart J, Buckwell A, Mackey B (2018 submitted) Drivers of successful completion in climate change adaptation projects, Nature Climate Change
4. POLICY & SOCIAL ANALYSIS		
4.3	Stakeholder interviews and focus groups designed and conducted - focus on local communities and traditional knowledge	Nalau J, Becken S, Schliephack J, Parsons M, Brown C. (final draft 2018 to be submitted) Ecosystem-based Adaptation and Traditional Knowledge: a match made in heaven? Either World Development or Mitigation and Adaptation Strategies for Global Change
4.4	Interview analysis completed and discussed with key stakeholders. Traditional (and local) knowledge captured in user-friendly presentation/ communication material	Infographic developed to visually communicate interview analysis with case study communities
4.5	Journal article submitted or conference paper presented on first round of stakeholder analyses	Nalau J, Becken S, and Mackey B, (2018 in review) Ecosystem based adaptation a review of constraints, Environmental Science and Policy

Milestones & Research Progress (continued)

TASK ID	DESCRIPTION	EVIDENCE THAT MILESTONE HAS BEEN COMPLETED
5. PROJECT INTEGRATION, ECOSYSTEM & CLIMATE ANALYSIS		
5.3	Impact models completed for priority ecosystems	Completed internal documents
5.4	Latest downscaled future climate data assimilated into GIS and models	Mackey B, Ware D, Nalau J, Sahin O, Fleming C, Smart J, Connolly R, Hallgren W, and Buckwell A, Ecosystem and Socio-economic Resilience Analysis and Mapping (ESRAM) and associated work at multiple-scales in Vanuatu Griffith University for Secretariat for the Pacific Regional Environment Program Brisbane
6.3	Web-based portal operational to facilitate project data and information management, coordination, and communication with stakeholders	Portal is live at www2.griffith.edu.au/research/research-excellence/griffith-climate-change-response-program/ecoadapt-pacific
6.4	Year 2 project research symposium conducted	Conducted 17 May 2017 at Griffith University, Gold Coast campus
6.5	Year 2 project management report that reviews the year's activities, outcomes and issues arising	This document

The following sections provide some insight into the additional activities and outcomes for the five research themes.

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