



Final Technical Report
CAF2017-RR01-CMY-Neef

Climate Change Adaptation in Post-Disaster Recovery Processes: Flood-Affected Communities in Cambodia and Fiji

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Project Overview

Project Duration	: 1 September 2015 – 30 September 2019
Funding Awarded	: US\$ 45,000 for Year 1; US\$ 35,000 for Year 2; US\$ 40,000 for Year 3
Key organisations involved	: New Zealand The University of Auckland (Professor Andreas Neef; Dr. Chanrith Ngin; Dr. Jesse Hession Grayman; <i>Dr. Kellie McNeill, first two years only</i>)
Australia	
The University of Western Australia (Dr. Bryan Boruff; Dr. Natasha Pauli; <i>Dr. Julia Horsley, first two years only</i>)	
The University of Sydney (Dr. Eleanor Bruce; Dr. Floris van Ogtrop)	
Cambodia	
Ministry of Rural Development (Mr. Siphat Touch)	
Ministry of Environment (Dr. Vong Sok)	
Royal University of Phnom Penh (Dr. Nyda Chhinh; Dr. Kimlong Ly)	
Fiji	
The University of the South Pacific (Dr. Eberhard Weber; Ms. Renata Varea)	

Project Summary

By adopting an integrated and participatory action-research approach, this project explores how rural communities living in flood-prone river basins of Cambodia and Fiji respond to increasing variability of flood incidences and other natural hazards under the influence of climate change and other risk factors, such as hydro-electric power development, forest conversion and environmental degradation. Particular emphasis is placed on risk perceptions and adaptive strategies of individuals, families and social groups with regard to regular and catastrophic floods and how the livelihoods of vulnerable groups are affected by floods and other disasters. Our research approach integrates the food, water and energy security nexus with the rural livelihood framework. The objectives of the project are to (1) identify the spatial extent and dynamics of flood hazards as a result of multiple risk factors; (2) determine the various factors that can enhance resilience and adaptive capacities of flood-affected communities in a changing environment, and (3) provide examples of successful community-based flood management and climate change adaptation that can serve as best-practice models for other flood-affected communities in the Asia-Pacific region.

Keywords: Resilience; climate adaptation; participatory action research, post-disaster recovery, rural livelihoods

Project outputs and outcomes

Project outputs

- **A1** Three local research assistants/undergraduate students and one Master's student from the University of the South Pacific (Fiji) trained in innovative qualitative data collection techniques (field journals, talanoa-style research conversations, participatory hazard mapping)
- **A2** Eight local research assistants/undergraduate students and four Master's students from the Royal University of Phnom Penh (Cambodia) trained in mixed-method research, combining qualitative and quantitative data collection techniques (Q-sort method, participatory hazard mapping, household survey, open-ended and semi-structured interviews)
- **A3** Nine post-graduate students from the University of Auckland, New Zealand, two post-graduate students from the University of Western Australia and one post-graduate student trained in various fieldwork approaches in the study sites in Cambodia and Fiji
- **A4** One PhD student from Cambodia and one PhD student from Fiji recruited for the Development Studies programme at the University of Auckland, New Zealand
- **A5** Project website and database set up and maintained
- **B1** Hydrological models developed at catchment/sub-catchment level in both study sites
- **B2** Participatory hazard maps developed for all major study communities in both study sites
- **B3** Flood and drought forecasting models tested for the Ba River Catchment, Fiji
- **B4** Novel satellite imaging technologies employed for the study area in Prek Prasop district, Cambodia
- **C1** National workshop in Phnom Penh, Cambodia, to present project findings to national policy makers, international NGO representatives and academics
- **C2** Provincial workshop in Kratie Town, Cambodia, to present project findings to provincial and district officials, local NGO representatives and commune/village leaders
- **C3** National workshop in Suva, Fiji, to present project findings to national policy makers, international NGO representatives and academics
- **C4** District workshop in Ba Town, Fiji, to present project findings to local chiefs, village leaders, community members and small business owners
- **C5** Three peer-reviewed journal articles, eight conference presentations, eight invited talks, ten policy briefs, one documentary movie and eight media reports
- **C6** Seven Master's theses, one MA dissertation, one BSc dissertation, one BA (Honours) dissertation and one BSc (Honours) dissertation

Project outcomes:

- **A** Disaster risk awareness and preparedness enhanced for at least four communities in Prek Prasop district in Cambodia and at least four communities in the Ba River catchment in Fiji
- **B** Indirect impact on the current revisions of the National Disaster Management Act [NDMA] 1998 and the National Disaster Management Plan 1995 [NDMP] (one of the key actors in the revision process, Mr. Viliame Tuimanu, Senior Technical Officer of the National Disaster Management Office (NDMO), attended our dissemination workshop in Suva, Fiji, in September 2019
- **C** Indirect impact on future climate adaptation projects in Cambodia through the involvement of the Director of Research in the Ministry of Rural Development, Mr. Siphat Touch, in various phases of the APN project
- **D** Dr. Eberhard Weber (The University of the South Pacific) and Prof. Andreas Neef (The University of Auckland) have been invited as expert reviewers for the Intergovernmental Panel for Climate Change (IPCC) Working Group II of the Sixth Assessment Report

Key facts/figures

- Two PhD students, 20 postgraduate students and 13 undergraduate students from six universities involved in various fieldwork phases of the project
- More than 380 research participants in the Ba River Catchment, Fiji and over 350 research participants in Prek Prasop District and Kratie Town, Cambodia
- 27 hazard maps developed in a participatory process with mixed groups of research participants in four rural communities in Cambodia and four rural communities in Fiji
- Over 150 attendees to dissemination workshops across Cambodia and Fiji
- About 20 academic research outputs, 10 policy briefs (in English and Khmer/Fijian), one documentary movie and several media reports
- US\$ 149,629 in additional associated funding (not including in-kind contributions)

Potential for further work

Results from this project highlight the extent to which mitigation/adaptation strategies are already being practiced in rural Cambodia and Fiji. Yet, the variability in local climate patterns continues to hinder appropriate decision making in the agricultural sector as well as a broad range of livelihood activities. Linking perceived changes in the environment with climate records would allow for an enhanced understanding of shifts in historic environmental patterns and provide an opportunity to co-design local adaptation strategies and test their applicability in a natural experiment setting.

Another potential research area that has been identified by this project is ‘climate-induced migration’. Our project has identified various mobility patterns involved in climate adaptation strategies, ranging from (1) short-term labour mobility after floods and droughts to (2) relocation from coastal areas further inland to (3) longer-term in-country migration to (4) transnational climate-induced migration. Understanding the complexity of decision-making processes around climate-induced and climate-associated migration patterns will be important under accelerating climatic change.

Various research outputs from this project are still under preparation and are planned to be published in 2020. These include an edited book collection (under contract with Emerald Publishers, Bingley, UK) and a special feature in the International Journal of Disaster Risk Science (accepted by the editors).

Outline of Edited Book (in preparation; under contract with Emerald)

Title: Climate-Induced Disasters in the Asia-Pacific Region: Response, Recovery, Adaptation

Editors: Andreas Neef and Natasha Pauli

Chapters

Chapter 1. Climate-Induced Disasters in the Asia-Pacific Region – From Response and Recovery to Adaptation (Andreas Neef and Natasha Pauli)

Chapter 2. Linking Disaster Risk Reduction to Development: The Evolution of 'Building Back Better' in International Disaster Management Frameworks (Lucy Benge and Andreas Neef)

Chapter 3. Community Participation and NGO Responses to the April 2014 Floods in Solomon Islands (Carl Adams and Andreas Neef)

Chapter 4. The Politics of Humanitarian Intervention in Response to the March 2017 Flood in Piura, Peru (Hanyang Ge, Andreas Neef and Jesse Hession Grayman)

Chapter 5. Participatory GIS and Community-Based Adaptation to Climate Change and Environmental Hazard: A Cambodian Case Study (Mark Williams, Bryan Boruff and Natasha Pauli)

Chapter 6. Seasonal Livelihoods and Adaptation Strategies for an Uncertain Environmental Future: Results from Participatory Research in Kratie, Cambodia (Savuti Henningsen and Natasha Pauli)

Chapter 7. Embodying Resilience: Narrating Gendered Experiences and Knowledge Construction of Disasters in Fiji (Kahukura Bennett and Andreas Neef)

Chapter 8. Drawing Together Different Knowledges of Flooding under Changing Environmental Conditions: Case studies in Fiji (Natasha Pauli, Gracie Irvine and Bryan Boruff)

Chapter 9. Governing Mobility: Planned Relocation as Climate Adaptation Strategy in Fiji (Lucy Benge and Andreas Neef)

Chapter 10. Disaster Awareness and Preparedness among Southeast Asian Communities in Auckland, New Zealand (Jesse Hession Grayman, Chanrith Ngin, Andreas Neef, Nichapat Sanunsin, Caryn Yachinta, Thao Dao, Hannah McKnight, Camille Soriano, Ngan Pham and Sarah Najmilah)

Outline of Special Feature (in preparation; accepted by editors of International Journal of Disaster Risk Science)

Title: Multi-risk landscapes and climate change in Asia-Pacific: new concepts and applications

Editors: Eleanor Bruce, Floris van Ogtrop, Chanrith Ngin and Bryan Boruff

Planned Articles

Article 1. Community-based adaptation in multi-risk environments: Towards a new conceptual framework (Andreas Neef)

Article 2. Poor households' adaptation strategies in post-disaster recovery processes: findings from flood-affected communities in Kratie Province, Cambodia (Chanrith Ngin, Nyda Chhinh, Andreas Neef, A., Chanchaya Chhom, & Siphat Touch)

Article 3. Drawing together local and scientific knowledge on flood impacts, vulnerability and adaptation under changing environmental conditions: Case studies from Cambodia (Natasha Pauli, Savuti Henningsen, Mark Williams, Bryan Boruff, & Andreas Neef)

Article 4. Understanding perceptions of drought, flooding and adaptation along the Mekong River: a Q-sort analysis of climate effected communities in Kratie Province, Cambodia (Bryan Boruff, Andreas Neef, Sochanny Hak, Chanrith Ngin, & Siphat Touch)

Article 5. Monitoring spatiotemporal dynamics of coastal flood inundation for assessing vulnerability in multi-risk environments (Kevin Davies, J van Linge, Eleanor Bruce)

Article 6. Integrating hydrologic indices with household surveys to understand and adapt to multi-risk landscapes (Floris van Ogtrop)

Other publications in progress include:

Ngin, C., Chhom, C., Neef, A. Climate Change Impacts and Disaster Resilience among Small Businesses in Kratie Town, Kratie Province, Cambodia. Prepared for Special Issue on "Climate Change Impacts, Vulnerability and Adaptation: Asian Perspective", *Environmental Research*.

Publications

Journal Articles

- Cox, J., Varea, R., Finau, G., Tarai, J., Kant, R., Titifanue, J., & Neef, A. (2019). Disaster Preparedness and the Abeyance of Agency: Christian Responses to Tropical Cyclone Winston in Fiji. *Anthropological Forum*, DOI: 10.1080/00664677.2019.1647833.
- Anshuka, A., van Ogtrop, F. F., & Vervoort, R. W. (2019). Drought forecasting through statistical models using standardised precipitation index: a systematic review and meta-regression analysis. *Natural Hazards*, **97**, 955–977.
- Neef, A., Benge, L., Boruff, N., Pauli, N., Weber, E. and Varea, R. (2018). Climate Change Adaptation Strategies in Fiji: The Role of Social Norms and Cultural Values. *World Development* **107**, 125–137.

Conference Presentations

- Boruff, B., Neef, A., Hak, S., Siphat, T., and Ngin, C., (2019). Climate change impacts and adaptation strategies in rural Cambodia: perceptions from flood-affected communities in Kratie Province. Institute of Australian Geographers, Hobart, Tasmania, 9-13 July.
- Ngin, C. (2019). Climate Change Impacts and Disaster Resilience among Small Businesses in Kratie Town, Kratie Province, Cambodia. International Symposium on Climate Change Impacts, Vulnerability and Adaptation: Asian Perspective, Asian Institute of Technology, Bangkok, Thailand, 16-18 October 2019.
- Pauli, N., Irvine, G., Boruff, B., Bruce, E., van Ogtrop, F., Varea, R., Weber, E., & Neef, A. (2018). Drawing together different knowledges of flooding under changing environmental conditions: Case studies in Fiji. New Zealand Geographical Society and Institute of Australian Geographers Conference, Auckland, New Zealand, 11-14 July 2018.
- Anshuka, A., Vervoort, R.W. & van Ogtrop, F. F. (2018). Drought Modelling in Small Island Developing States: A Case Study in Fiji. Poster to be presented at the European Geosciences Union - General Assembly 2018, Vienna, Austria, 8-13 April 2018.
- Boruff, B., Bruce, E., Neef, A., Biggs, E. M., van Ogtrop, F. & Pauli, N. (2017). Applications of the 'Environmental Livelihood Security' framework: Three case studies from Asia-Pacific. Institute of Australian Geographers, Brisbane, Australia. 12-14 July 2017.
- Neef, A., Benge, L., Sochanny, H. et al. (2016). Integrating adaptation strategies into post-disaster recovery: Lessons from Asia-Pacific countries. Presented at the 6th International "Building Resilience" Conference at the University of Auckland, 7-9 September 2016.
- Benge, L., Neef, A. & Garrett-Walker, R. (2016). Disaster as 'Development Opportunity': An Analysis of Institutionalized Disaster Management in the Global South. Presented at the International Conference "Development in Question?" at Cornell University, Ithaca, USA, 6-8 October 2016.
- Boruff, B., Bruce, E., Neef, A., Biggs, E.M., Horsley, J., van Ogtrop, F., McNeill, K., Pauli, N., & Price, H. (2016). Application of the 'Environmental Livelihood Security' framework: Three case studies in vulnerable regions of Australia, Cambodia and Fiji. Presented at the Association of American Geographers 2016 Annual Meeting in San Francisco, USA, 29 March - 2 April 2016.
- Neef, A. & Hession Grayman, J. with Benge, L., Bronnimann, K., Hanna, D. and Parada Diaz, J. (2016). Post-Disaster Recovery after Cyclone Winston in Fiji. Session Organised at the Biennial Aotearoa – New Zealand Development Studies Conference in Wellington, New Zealand, 5-7 December 2016.

Invited Lectures and Seminar Talks

- Neef, A. (2019). Climate Adaptation Strategies in Post-Disaster Contexts: Lessons from Rural Communities in Cambodia and Fiji. Invited Lecture at the School of Business and Economics, Philipps-Universität Marburg, 23 May 2019.
- Pauli, N and Föllmer, J. (2019). Adaptation to environmental change in multi-hazard environments: Case studies from the Mekong River region and the South Pacific. Invited Keynote Presentation at the Geographical Association of Western Australia Annual Conference, Perth, Australia. 17 August 2019
- Boruff, B. and Neef, A. (2018). Climate change adaptation strategies in post-disaster contexts: lessons from rural communities in Cambodia and Fiji, Invited Presentation at the HASS Week Conference, University of Western Australia, Perth. 3 -10 Aug 2018.
- Boruff, B. (2017). Application of the 'Environmental Livelihood Security' framework: three case studies from Asia-Pacific, Development Studies Seminar, School of Social Sciences, University of Auckland. 12 June 2017.
- Boruff, B. (2017). Participatory mapping: an overview of techniques and applications, Lecture presented in the Masters of International Development, University of Auckland, 9 June 2017.
- Neef, A. (2017). Climate Adaptation Strategies in Post-Disaster Contexts: Lessons from Rural Communities in Cambodia and Fiji. Invited Lecture at the Institute of Tropical Agricultural Sciences, University of Hohenheim, Stuttgart, 15 December 2017.
- Neef, A. (2017). Climate Change Adaptation Strategies in Disaster-Affected Communities: Insights from Cambodia and Fiji. Invited Presentation, Research Seminar Series of the East-West Center, Honolulu, Hawai'i, 11 October 2017.
- Neef, A. with Boruff, B. (2017). Climate Change Adaptation Strategies in Disaster-Affected Communities: Lessons from Asia-Pacific Countries. Invited Presentation, Asian Disaster Preparedness Center, Bangkok, 18 July 2017.

Dissertations, Masters Theses, Masters Research Reports

- Abbott, D. (forthcoming). The Role of Transnationalism in Disaster Risk Reduction in Fiji and New Zealand (Masters Research Thesis, University of Auckland, New Zealand)
- Anshuka, A. (2019). Explorations in Forecasting Hydrological Indices: An Application in Fiji (Masters Research Thesis, University of Sydney, Australia)
- Henningsen, S. (2019). Temporal Dimensions of the Impacts of Environmental Change along the Lower Mekong River, Cambodia (Master's Research Thesis, University of Western Australia, Perth, Australia)
- Bennett, K. (2018). Embodying Resilience: Narrating Gendered Experiences and Knowledge Construction of Disasters in Fiji. (Masters Research Thesis, University of Auckland, New Zealand)
- Benge, L. (2017). Governing Mobility Across Messy Policy Space: Planned Relocation as a Strategy of Climate Change Adaptation from UNHCR to Fiji. (Masters Research Thesis, University of Auckland, New Zealand)
- Benipal, G. (2017). Observed and simulated impacts of land management practices on the hydrology of the Ba catchment (Fiji). MSc Research Report, University of Sydney, Australia.
- Irvine, G. (2017). Environmental Change Adaptation: Communities Facing Multiple Hazards in the Ba District, Viti Levu, Fiji. (BSc Dissertation, University College London, UK)
- Bronnimann, K. (2016). Losing Faith in development? The Role of Religion in a Post-Disaster Environment. (BA Honours Dissertation, University of Auckland, Auckland, New Zealand)

- Varea, R. (2018). Adapting Sustainable Drainage Systems to Stormwater Management in Flood-Affected Communities of Fiji: Case Studies of Nadi & Ba (Masters Research Thesis, University of the South Pacific, Fiji)
- Wieland, J. (2016). Towards an Uncertain Future with No-Regrets: Community Decision-Making in the Face of Multiple Risks in Fiji. (MA Dissertation, University of Auckland, Auckland, New Zealand)
- Williams, M. (2016). Participatory GIS and Community Based Adaptation to Climate Change and Environmental Hazards: A Cambodian case study. (Master's Research Thesis, University of Western Australia, Perth, Australia)
- Simpson, J. (2016). Assessing indicators of socio-ecological resilience in flood-prone coastal areas using remote sensing: a case study in the Ba catchment, Fiji. (BSc Honours Dissertation, University of Sydney, Australia)

Policy Briefs

- Michael, S. (2019). Adapting in Tough Times: Strategies and Barriers of Fijian Small Businesses in Building Disaster Resilience. *Climate Change Adaptation in Post-Disaster Recovery – Policy Brief 10 (in English and Fijian)*.
- Ake-Patolo, A., Cairns, L., Tui, S., & Seetoh, S. (2019). Religion: A Bane or a Boon in Post-Disaster Fiji? *Climate Change Adaptation in Post-Disaster Recovery – Policy Brief 9 (in English and Fijian)*.
- Adi, A., Stieler, E., & Titisari, C. N. (2019). Climate Adaptation Strategies in Fiji: The Role of Social Norms and Cultural Values. *Climate Change Adaptation in Post-Disaster Recovery – Policy Brief 8 (in English and Fijian)*.
- Brookbanks, A., Chand, A., & Thomas, E. (2019). Is Planned Relocation a Viable Solution to Climate Change Adaptation Policy in Fiji? *Climate Change Adaptation in Post-Disaster Recovery – Policy Brief 7 (in English and Fijian)*.
- Flannery, C., McKnight, H., & Case, C. (2019). Weathering the Storm: How iTaukei Fijian women experience vulnerability and resilience to disaster. *Climate Change Adaptation in Post-Disaster Recovery – Policy Brief 6 (in English and Fijian)*.
- Ngin, C. (2019). Impacts of Climate Change on Small Businesses in Kratie Town, Kratie Province, Cambodia. *Climate Change Adaptation in Post-Disaster Recovery – Policy Brief 5 (in English and Khmer)*.
- Boruff, B. (2019). Perceptions of Climate Change Impacts and Adaptation Strategies for an Uncertain Environmental Future: Results from Participatory Approaches in Prek Prasop District, Kratie Province, Cambodia. *Climate Change Adaptation in Post-Disaster Recovery – Policy Brief 4 (in English and Khmer)*.
- Pauli, N. and Henningsen, S. (2019). Seasonal Livelihoods and Adaptation Strategies for an Uncertain Environmental Future: Results from Participatory Approaches in Prek Prasop District, Kratie Province, Cambodia. *Climate Change Adaptation in Post-Disaster Recovery – Policy Brief 3 (in English and Khmer)*.
- Offner, S. and Vathanak Som, V. (2019). Climate Change Adaptation: Inside the Flood-prone Communities in Kratie Province, Cambodia. *Climate Change Adaptation in Post-Disaster Recovery – Policy Brief 2 (in English and Khmer)*.
- Ngin, C. and Touch, S. (2017). Community-Based Adaptation to Climate Change and Environmental Hazards: Results from Participatory Approaches in Prek Prasop District, Kratie Province, Cambodia. *Climate Change Adaptation in Post-Disaster Recovery – Policy Brief 1 (in English and Khmer)*.

Documentary Movie

Parada Diaz, J. (2017). Cyclone Winston blew my house away. Available online at: <https://vimeo.com/193014481>.

Media Reports about the Project

“Activities Worsen Climate Effects: Research Team Disseminates Findings with Local Communities” by Fiji Times (28 September 2019): <https://www.pressreader.com/fiji/the-fiji-times/20190928/282355451472271>

“Expert Reaction: Climate Change in Asia” by Asia Media Centre – New Zealand (9 September 2019): <https://www.asiamediacentre.org.nz/features/expert-reaction-climate-change-in-asia/>

“Climate Change Adaptation in Cambodia” by Natasha Pauli in University of Western Australia’s Institute of Agriculture, Newsletter August 2019.

“Research Snapshot: Post-Disaster Recovery Processes in Fiji” by Oceans Online (Issue 12, February 2017): <http://www.oceans.uwa.edu.au/community/oceans-online/research-snapshot-fiji>

“The aftermath of Cyclone Winston in Fiji” by Faculty of Arts, The University of Auckland, Online News (22 July 2016): <http://www.arts.auckland.ac.nz/en/about/news/2016/07/the-aftermath-of-cyclone-winston-in-fiji.html>

“University students to study flood affected village in Fiji” by Scoop Independent News (28 October 2015): <http://www.scoop.co.nz/stories/WO1510/S00077/university-students-to-study-flood-affected-village-in-fiji.htm>

“Fiji Television reported about the project” on Fiji One News (07 November 2015): <https://www.youtube.com/watch?v=ZcDOtoAUtRM&feature=youtu.be&t=10m45s>

“Fiji village toughs it out despite climate change” by Radio New Zealand (03/12/15): <http://www.radionz.co.nz/international/programmes/datelinepacific/audio/201781308/fiji-village-toughs-it-out-despite-climate-change>

Pull quote

“It’s been a real pleasure to be part of the research. I think often interdisciplinary research projects don’t really work out as truly interdisciplinary because of a lack of willingness to consider research problems from different perspectives. In our project the approach really worked due to the great team involved. Our collaborators at the Royal University of Phnom Penh, the Cambodian Ministry of Rural Development and the University of the South Pacific in Fiji have done a fantastic job in organising the research and the workshops. Observing the interactions at the dissemination workshops in Phnom Penh, Kratie, Suva and Ba, it was clear that the respectful and thoughtful approach that our collaborators have to the regular interactions with the communities as well as their commitment to the research contributed enormously to the success of the workshops and the research project in general. The communities involved have been very generous with their time and sharing knowledge, and attendees at the various workshops were very attentive and interested in the work discussed and in the interactions with the research team.”

Dr Natasha Pauli, University of Western Australia, Perth, Australia

Acknowledgments

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We are particularly grateful to the Asia-Pacific Network for Global Change Research (APN) for funding the project over several years and to the team at the APN Secretariat for supporting us throughout the project duration by answering our questions in a timely and professional manner and for providing excellent guidance for technical and financial reporting.

Finally, we would like to thank the following organisations that provided co-funding in cash and in kind:

- The University of Western Australia (UWA Research Collaboration Award & UWA Research Impact Grant)
- The University of Sydney (Sydney Southeast Asia Centre)
- The University of the South Pacific
- The University of Auckland (School of Graduate Studies & Faculty of Arts)
- Royal University of Phnom Penh
- Ministry of Rural Development, Cambodia
- Ministry of Environment, Cambodia
- PACE-Net Plus (Pacific-Europe Network for Science, Technology and Innovation)
- Australian Centre for International Agricultural Research (ACIAR)

1. Introduction

This project explored how rural communities living in flood-prone river basins of Cambodia and Fiji have responded to increasing variability of flood incidences and other natural hazards (e.g., droughts, storm events) under the influence of climate change and other risk factors, such as hydro-electric power development, forest conversion and environmental degradation. To this end, the research team adopted an integrated and participatory action-research approach with a mixed methodology. Particular emphasis was placed on risk perceptions and adaptive strategies of individuals, families and social groups with regard to regular and catastrophic floods and how the livelihoods of vulnerable groups have been affected by floods and other disasters. Our research approach integrated the food, water and energy security nexus with an adaptation of Agrawal and Perrin's (2008) climate adaptation framework.

The objectives of the project were to (1) identify the spatial extent and dynamics of flood hazards as a result of multiple risk factors; (2) determine the various factors that can enhance resilience and adaptive capacities of flood-affected communities in a changing environment, and (3) provide examples of successful community-based flood management and climate change adaptation that can serve as best-practice models for other flood-affected communities in the Asia-Pacific region.

2. Methodology

2.1 Study Sites in Cambodia and Fiji

2.1.1 Prek Prasop District, Kratie Province, Cambodia

Kratie province is closely connected with the Mekong River and Sesan River ecosystems with the livelihoods of communities in Kratie highly dependent on these fluctuating ecosystems. The communities surveyed reside in primarily lowland areas that are marked by cross-cutting water streams, water basins and natural lakes and ponds. Consequently, severe flooding is the primary climatic hazard in Kratie, occurring the most frequently and sustaining the highest levels of damage and costs. This vulnerability is magnified by poor infrastructure, lack of access to irrigation systems and a high dependence on agriculture. For example, 91% of the total population in Tamao Commune are considered to be permanent farmers. The impacts of these extreme flood events touch all corners of a community, from livelihood and food security to shelter, education and economic development.

The study site, Prek Prasop district, is located in the southwestern part of the province along Mekong River southward from the far end of Kratie town to the northern part of Tbong Khmum province and eastern part of Kampong Cham province. The district is composed of eight communes and 47 villages. It is covered mostly by forests (in the western part) and rivers (in the eastern part). The topological feature of this district can be described primarily as lowland areas that are marked by cross-cutting water streams and natural lakes and ponds. Similar to many other river areas in Cambodia, Prek Prasop's land area is characterised by its most fertile land as brought up by the river's water during rainy season in favour for agricultural activities. There are also a few small islands in the district that are subjected to be submerged by water in rainy season.

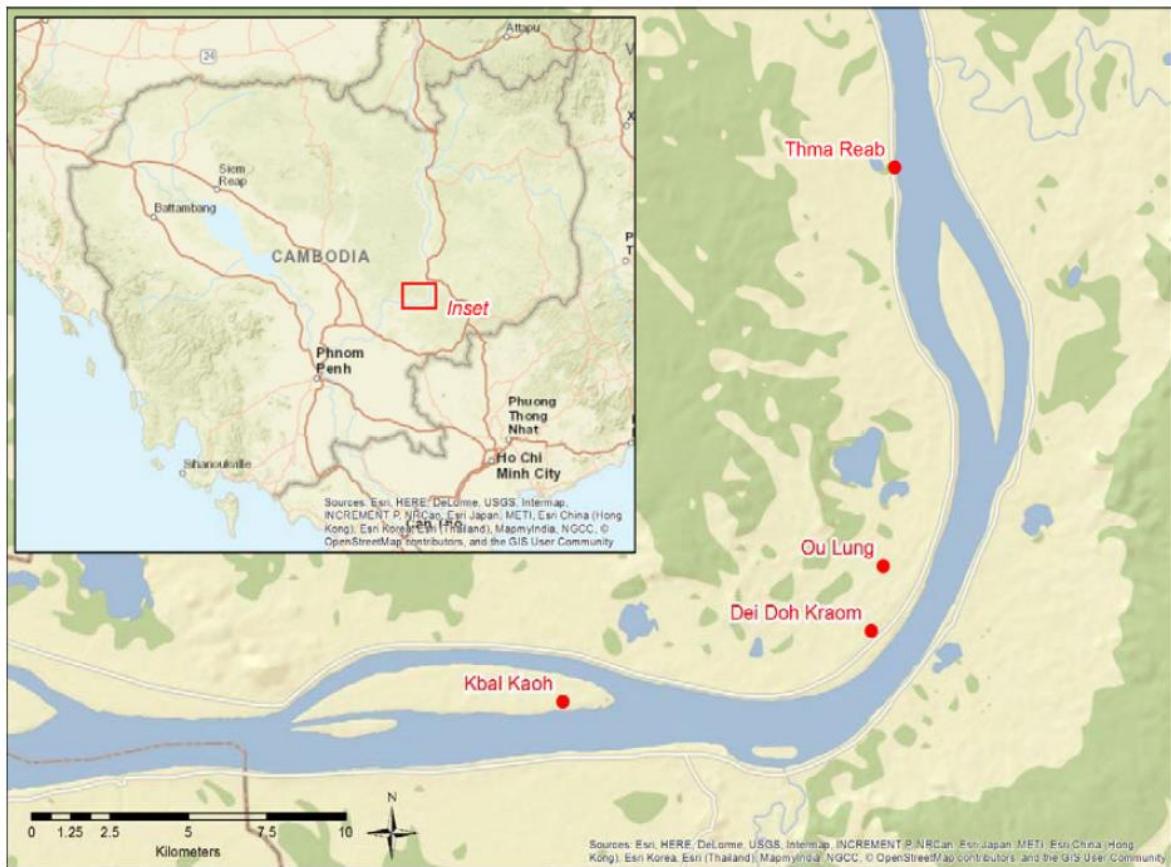


Figure 2.1. Map of the southern part of Prek Prasop district with the four villages that were the main focus of the research

There are approximately 15,345 families in Prek Prasop district, accounting for 68,719 people (of which 35,122 are female) (NCDD 2015). About 60% of the population are permanent farmers. Others are engaged in fishery, small business, forestry, animal raising, carpentry, handicraft, and day labouring. Out-migration is minimal, with 3,671 people migrating to work outside of the district in 2015 (NCDD 2015).

2.1.2 Ba River Catchment, Viti Levu, Fiji

The study area is the lower Ba River Catchment (Fig. 1), which was chosen for this research as it is one of the few areas that was severely affected by a series of flood events (the 2009 Flood, the 2012 Floods) that hit the Fiji Islands in recent years (Yila et al., 2013). The area was also struck by two major tropical cyclones, Cyclone Evan in 2012 and Cyclone Winston in 2016. We purposively selected three iTaukei (indigenous Fijian) communities in the lower Ba catchment whose history, culture and land relations are closely intertwined (Neef et al., 2018).

The oldest village, Votua, has remained in its current location for about 200 years. Despite limited information about exposure to hazards throughout history, it is likely that their adaptation processes had been successful prior to the flooding events in 2012. The second community is Nawaqarua, which has relocated several times due to riverbank erosion. This village has also received assistance from the Japan International Cooperation Agency (JICA) for a community-based disaster risk management (CBDRM) project between 2010 and 2013. The last community is Etatoko, which was relocated with

financial support from the government and international NGOs. The people of Etatoko once lived in the village of Wavuwavu, which was destroyed by the floods of 2012 (Neef et al., 2018).

Additional research was conducted in the upstream village of Naval, which is the only community on Viti Levu that still maintains the traditional vernacular *bure* architecture. The Ministry of iTaukei Affairs reported that 130 *bure* were located in Naval, most of which withstood the force of Tropical Cyclone Winston in 2016 (Miyaji et al., 2017).

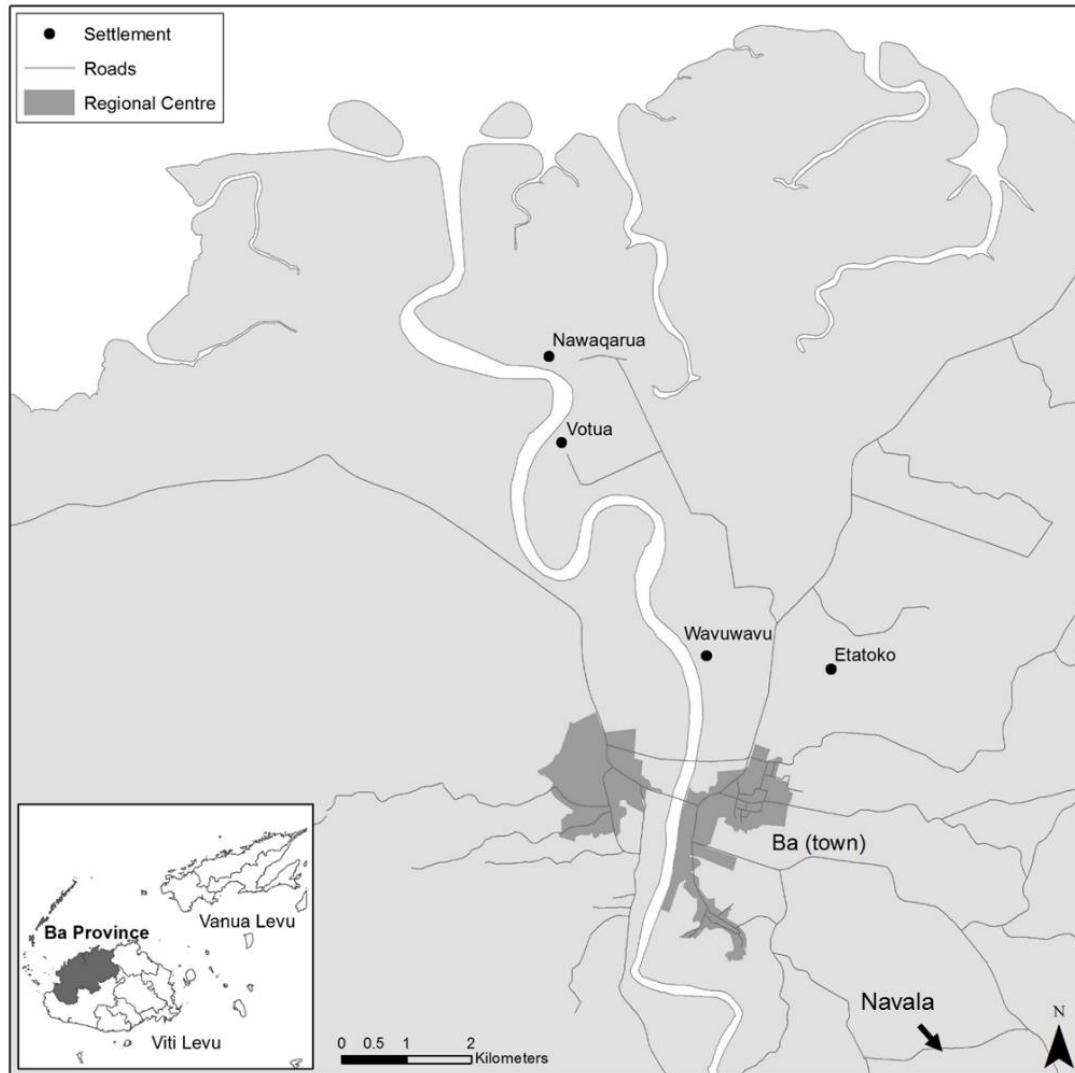


Figure 2.1. Map of the lower Ba River Catchment on Fiji's main island Viti Levu with main study villages

2.2 Methods for Data Collection and Analysis

The project employed an action-research approach, which means that the focus was not only on studying local communities' perspectives on and responses to flood disasters, but also on empowering local communities by building awareness, resilience and a viable socio-institutional environment that helps to mitigate the potentially disastrous effect of future flood events. Using an interdisciplinary research approach we combined qualitative, participatory and quantitative research methods. Qualitative data was primarily collected by talanoa-style research conversations, semi-structured interviews, in-depth

narrative interviews, life histories and focus group discussions. This approach was supported by various interactive and participatory methods, such as ranking exercises, Q-sort methodology, and participatory risk mapping to examine local governance of excess water as well as the perceived causes, preventive measures, impacts and local responses to flood and other climate-induced disasters at individual, family and community levels. Qualitative data was analysed by using computer-assisted qualitative data analysis software, e.g. ATLAS-ti and NVivo.

For the scientific assessment of flood risks, we collected various types of quantitative data, such as topographic and hydrological data, information on land use and farming systems, socio-economic conditions and local water management systems. Remote sensing (RS) techniques were employed to derive information such as soil characteristics and land and vegetation cover in the target basins. Remotely sensed data at multiple spatio-temporal scales were used to map landcover change in the Ba catchment between 2000 and 2018 (GeoEye-1, Sentinel-2, Landsat TM and MODIS). The RS-derived data was validated through field surveys. A Soil and Water Assessment Tool (SWAT) model was developed to establish the relationship between rainfall, runoff and erosion under different management practices. The result of the hydrological analysis was then integrated with other quantitative data for assessing the risks of flood disasters and other climate-associated hazards. The assessment employed a multi-criteria analysis approach and derived different indices for flood risks and other risk factors, in which biophysical and socio-economic conditions were considered.

Socio-ecological resilience within flood prone areas was also assessed using remotely sensed data to map incidences of slope failure following high precipitation and crop recovery periods post flood, drought and cyclone events. Possible adaptation and mitigation strategies with a primary focus on securing food, water and energy supplies were discussed with community members and other stakeholders. Results were reported back to the local communities as well as to district and provincial governments and NGOs in local feedback workshops to validate our research findings, share information and implement better flood protection and disaster risk reduction measures in the future.

2.3 Fieldwork Phases

In both study sites, the fieldwork involved several phases (see Tables 2.1 and 2.2).

Table 2.1 Fieldwork Phases in Cambodia

Period	Study sites	Activities, Methods & Research Participants
January 2016	Koh Tasuy, Prek Prasob and Tamao communes	In-depth discussions and informal interviews with village heads, teachers, elderly and female-headed households
June 2016	Thma Reab, Ou Long, Dei Doh Kraom and Kbal Kaoh villages	13 participatory hazard mapping and Q-sort sessions in small focus groups with a total number of 70 participants
August 2017	Eleven villages in four communes (Prek Prasob, Chroy Banteay, Tamao and Koh Tasuy)	Household survey with standardised questionnaires covering a total of 165 households
October- November 2018	Thma Reab, Ou Long, Dei Doh Kraom and Kbal Kaoh villages	Nine focus groups with male & female participants (7-18 participants per group), generating nine seasonal calendars; individual daily routine diaries
January-February 2019	Kratie Town	Semi-structured interviews with 32 small & micro business owners

Table 2.2 Fieldwork Phases in Fiji

Period	Study sites	Activities, Methods & Research Participants
November 2015	Votua, Nawaqarua and Navalā villages	Semi-structured interviews with a total of 55 households
July 2016	Votua, Etatoko and Navalā villages	Informal conversations, participant observation and ~ 100 individual journals with disaster narratives
November 2016	Votua, Nawaqarua, Etatoko and Navalā villages	14 participatory hazard mapping sessions; 32 talanoa-style research conversations
November 2018	Indo-Fijian settlements in the lower Ba catchment	38 semi-structured interviews at household level among Fijians of Indian descent
October 2018 - March 2019	Ba Town	Semi-structured interviews with 61 small & micro business owners

3. Results & Discussion

3.1 Susceptibility of the Study Sites in Cambodia and Fiji to Climate Variability and Climate-Induced Hazards

3.1.1 Climate Variability and Climate-Induced Hazards in Kratie Province, Cambodia

From 1996 to 2017 flooding in Kratie province adversely affected 558,984 people, damaging 1,715 houses and 164,896.50 ha of crops. Yet, more recently, the province – along with other areas of Cambodia – has also become more susceptible to dry spells and even severe droughts. A major drought occurred in 2016 due to the prolonged El Niño event that started in 2014. The drought was attributed as the cause for the non-occurrence of seasonal flooding in 2015 and the expected delay of the monsoon rains until late August 2016. Further, research has found that an increase in temperature of 1°C in night time temperatures will reduce rice grain yield by 10%. Another severe drought occurred in 2019, when the country had to increase its electricity imports from neighbouring Laos and Thailand. Many hydroelectric power stations around the country were not producing sufficient electricity, as the water levels in the reservoirs were too low.

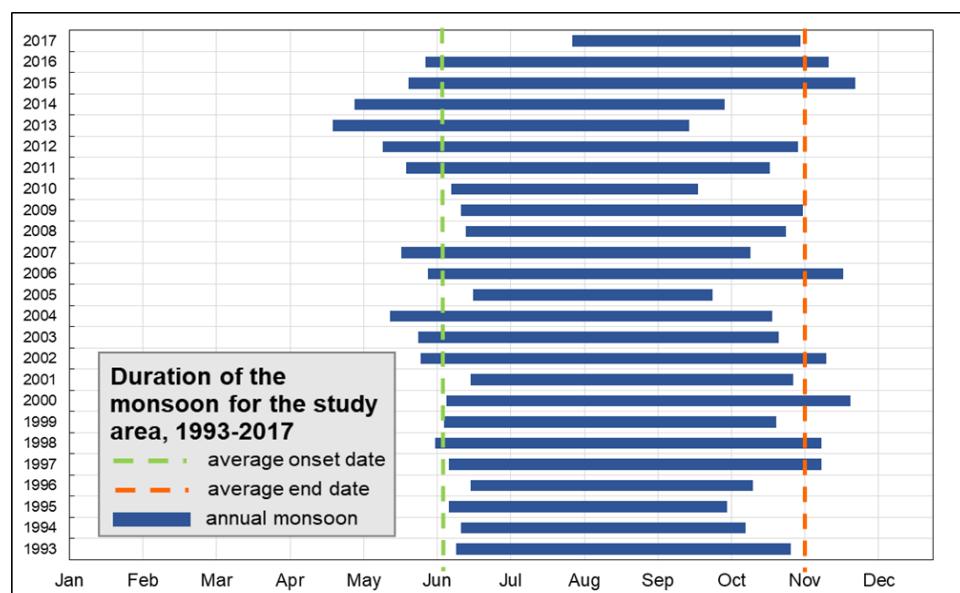


Figure 3.1. Gridded rainfall data from PERSIANN-CDR dataset, 1983-2017 (Source: NOAA)

Figure 3.1 above shows the increased variability in the length and duration of the rainy season in Kratie province. The data seems to confirm scientific forecasts that the frequency, intensity and pattern of hydro-meteorological events (monsoon rains, flooding, dry spells and the long dry season) along the Mekong may be affected by climate change and other forms of environmental change.

With the impacts of climate change increasing disproportionately to the development of adaptation and mitigation programmes in Cambodia, concerns for the future are undeniable. In response to these real and perceived threats, the Government of Cambodia has introduced a National Adaptation Program of Action, whereby the most active climate change adaptation projects have focused on water, agriculture and disaster risk management.

3.1.2 Climate Variability and Climate-Induced Hazards in the Ba Watershed, Fiji

The largest island in Fiji, Viti Levu, has experienced more frequent and more intense flooding in recent years due to increasing climate-induced hazards. Fiji's Ba province is particularly susceptible to climate-induced disasters such as floods, storm surges and cyclones, which pose unprecedented threats to local communities and the private sector.

The Ba River Catchment which is located in the northwestern corner of Viti Levu has experienced more than 130 climate-associated disasters over the last two decades. One of the worst disasters that affected the area was Tropical Cyclone (TC) Winston. TC Winston was a category-five cyclone that hit Fiji on the 20th of February 2016. It was one of the strongest cyclones ever recorded in the Southern Hemisphere. Forty-four people died and 120,000 people were displaced from their homes. Significant damage was done to homes and crops, with 60% of Fijians affected in some way by the storm.

3.2 Local Perceptions of Climatic Variability and Impacts in the Study Sites

3.2.1 Perceived Causes of Climate and Environmental Changes in Prek Prasop, Cambodia

Participatory hazard mapping, Q-sort exercises in focus groups and household surveys revealed that communities were more concerned with droughts than floods, since seasonal floods also have some benefits for their agricultural practices. Villagers identified deforestation as the chief cause of changes in the patterns of droughts and floods, particularly the hazard type and frequency (Figure 3.2). This conforms to a strong belief that forests can prevent or reduce floods. Other identified causes included natural/global change, agricultural irrigation and hydro-power dams.

Although the lived experience differs among the four villages, common perceptions were found across the study area (Figure 3.3). Drought was perceived to be of increasing concern and a particular risk to livelihoods. These conditions reflect a view that temperatures were increasing in general, alongside increased variability in rainfall. Community members viewed drought as a direct result of deforestation as well as unusual severe wind events.

Overall, communities perceived drought as more of a risk than floods; however, prolonged seasonal and out-of-season flooding also has impacts on livelihoods. Villager's viewed flooding as an important means for replenishing soil nutrients but worried that hydroelectricity projects in the upper Mekong basin may change annual flood regimes into the future.

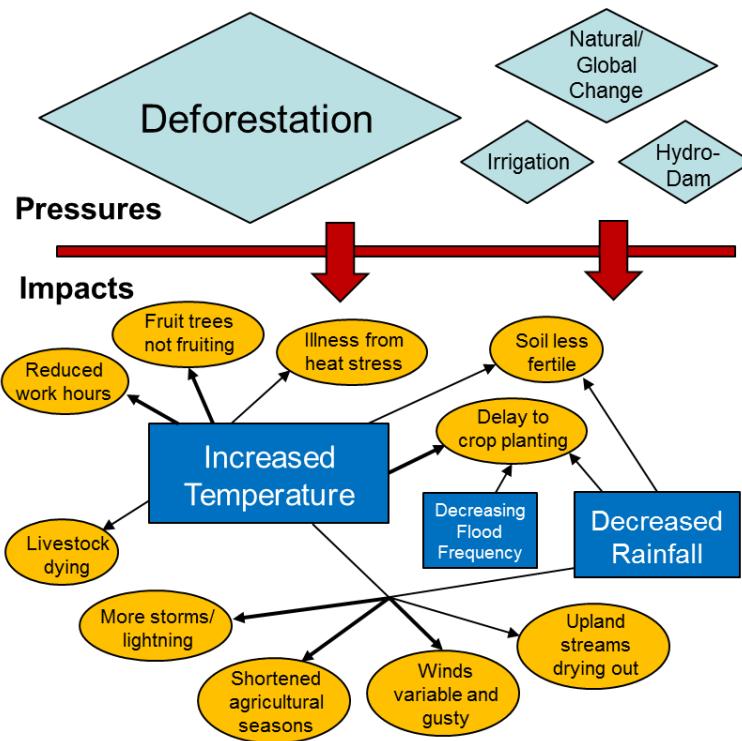


Figure 3.2. Illustration of focus group participants' perceptions. Perceptions of why hazard frequency and intensity has changed (light blue), how hazards have changed (dark blue) and how this has impacted communities (orange). Size of box and lines depicts number of identified by participants.

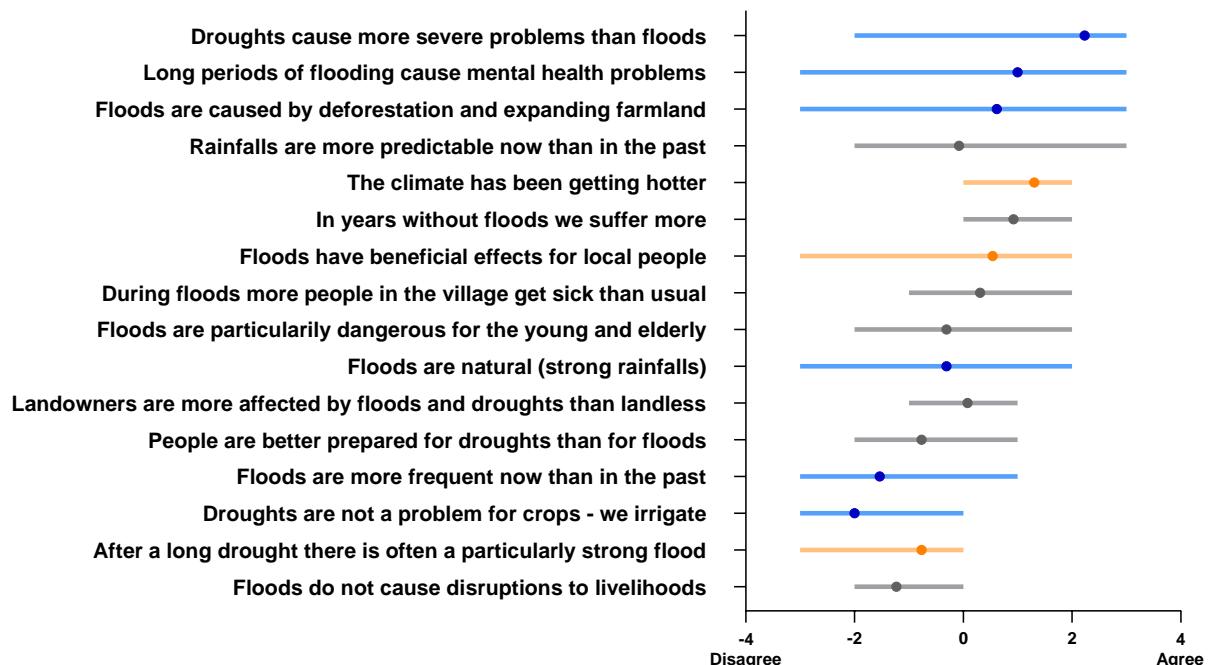


Figure 3.3. Perceived drivers for, and impacts from climate related hazards

Note: Figure shows range of responses from participants (bars) for each statement with circles representing the average response. Results in orange signify responses common across all communities. Results in blue represent views unique to a subset of communities.

The findings from the group-based studies in the four villages were further confirmed in our household survey conducted in eleven villages. Respondents reported that floods constituted the most frequent and severe disruption to people's livelihoods. Droughts were characterized as the second most severe hazard in terms of both occurrence and severity, followed by storms and lightning. This demonstrates the high degree of risk awareness among the district's communities. Villagers were both aware of the risks of natural hazards and the perceived effects of these hazards, as depicted in Figure 3.4. They confirmed that floods and droughts played significant roles in putting communities' livelihoods at risk, with the risk factors ranging from crop reduction to mental health problems. It is interesting to note that 28% of villagers surveyed recognized the potential benefits of flooding, specifically in terms of pest eradication and the replenishment of soil fertility.

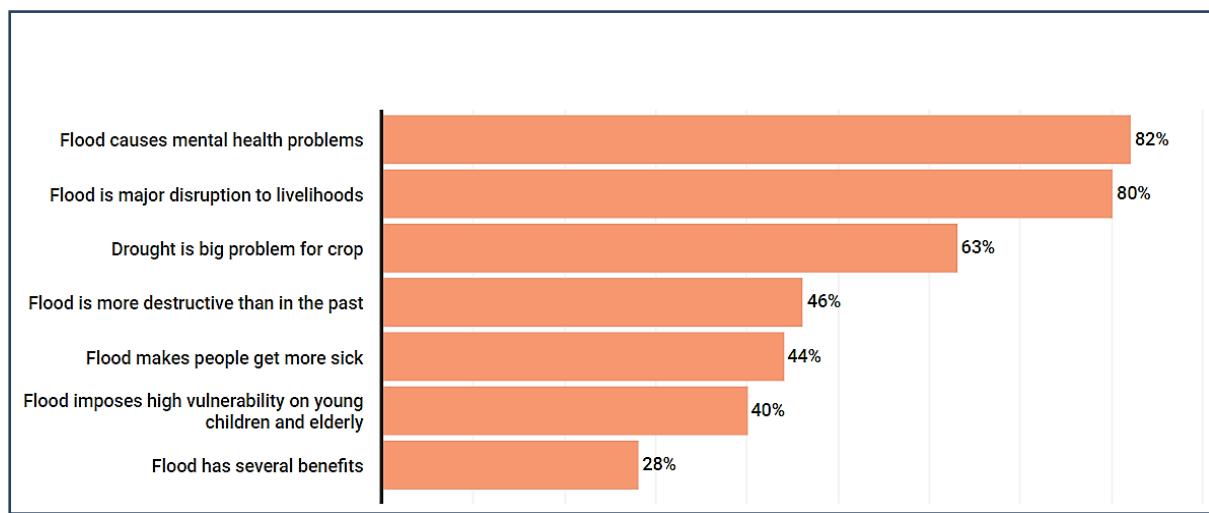


Figure 3.4. People's perception on hazards and associated impacts between 2013 and 2018 (in % of respondents who mentioned this in the household survey; n=165)

3.2.2 Perceptions of Flood Impacts, Climate Variability and Disaster Risk in the Ba River Catchment, Fiji

In participatory hazard mapping exercises during focus groups, men and women were able to clearly delineate the extent to which homes, gardens and agricultural land were inundated during 2012 floods. It was stated that small topographic variation could make a large difference in terms of impact. The full extent of flooding was greater than the maps could show on the eastern bank of the Ba River. Seaward impacts of flooding were also noted, e.g. it was stated that sedimentation in the river mouth and nearshore zone made diving for large crabs (*qari*) by men impossible and flushed *qari* from the mangroves which made it difficult for women to catch them. Altogether, the research found a very detailed local-scale knowledge, including home records of flood heights and times, widening of river, erosion of riverbanks and the path of river currents.

The map in Figure 3.5 represents an abstraction of local perspectives on flood water direction and river bank erosion. The community of Votua felt the impact of storm surge flooding as well as overland flooding in the 2012 floods. Riverbank erosion and river channel mobility were seen as a major concern by focus group participants.

Focus group participants had mixed views on sediment dredging undertaken to mitigate flooding. Some stated that it creates areas of higher and new land, while others maintained that the dredging mud can smother mangroves. Research participants had concern over construction and maintenance of riverbank

stabilisation and sea walls. There was a view among participants that while flooding can be damaging to local livelihoods, it also brings nutrients, fine sediments and moisture to fields. Most research participants had the perception that pattern of rainfall in the region is shifting.

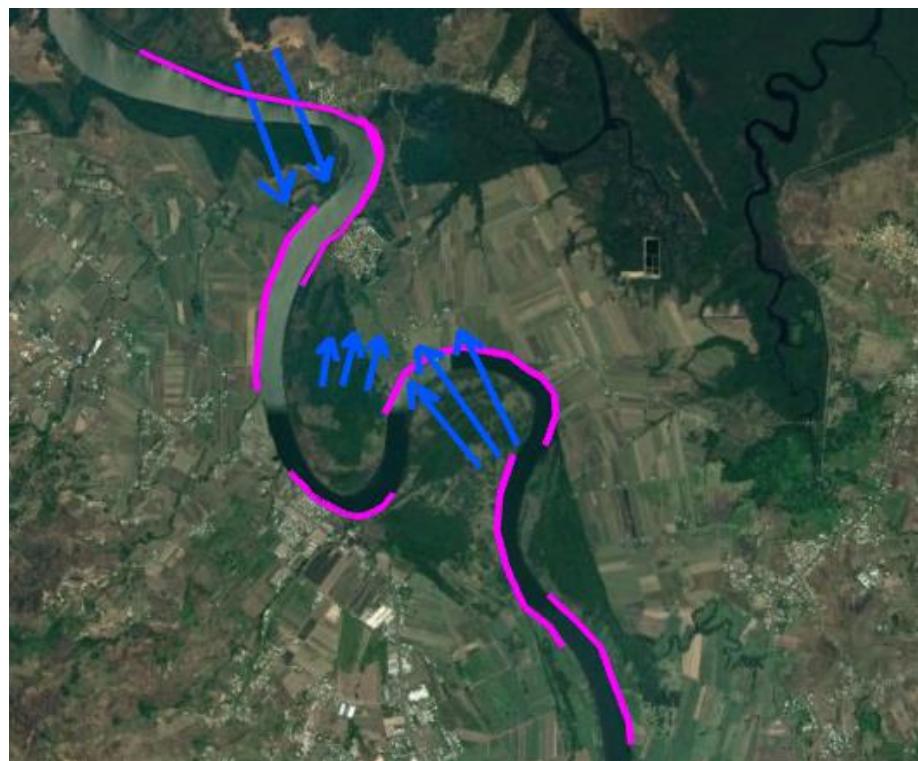


Figure 3.5. Abstraction of local perspectives on flood water direction (blue) and bank erosion (pink)

The experience of Tropical Cyclone Winston brought another important dimension of disaster perception to light, namely the role of religion (Photo 3.1). For iTaukei (indigenous) Fijian Christians, natural hazards bear symbolism of God's characteristics and the occurrence of them elicits the fear of God. More than a natural phenomenon, the destructiveness of Cyclone Winston was a reminder to the Fijian Christians that God is all-powerful. As Creator, he sits above all created things and is to be revered. This understanding conjures up an image of God being the ruler over the iTaukei Fijians and the *vanua* (land) and assumes that the iTaukei people are held accountable to God for the use of the land. An encounter with the deadly force of the cyclone is akin to meeting God face to face. In an instant, one is rendered powerless and made insignificant. From having fearful awe to bursting into praise, survivors of the cyclone responded in gratitude for being spared from death (see Photo 3.2).

Placing God at the centre of Fijian's narrative in relation to natural hazards has implications on the practice of disaster preparedness for the Fijian community as the values that they hold and the meaning that they attach to them prompt responses that either align with or ignore the need for risk mitigation strategies (Cox et al., 2019). Many research participants expressed the view that disaster preparedness includes spiritual preparedness, a theme which is not generally found in secular disaster policy. Our research finds that while secular aid organisations and state agencies often claim supremacy in the disaster space, faith-based organisations such as those who responded in Fiji also make important contributions to disaster recovery and provide significant local knowledge. More research is needed on the role of Christian and non-Christian faith-based organisations in providing both material and spiritual relief in post-disaster situations.



Photo 3.1. Church in Navala, upper Ba catchment

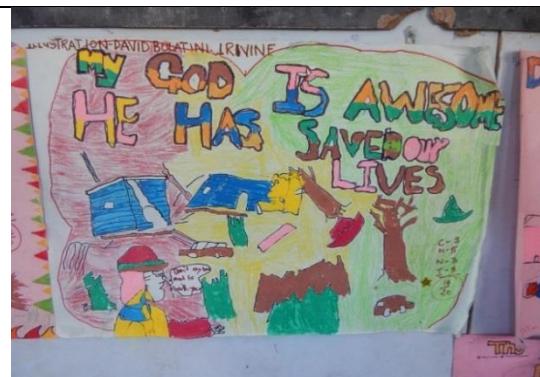


Photo 3.2. A student's drawing after TC Winston

3.3 Climate Adaptation Strategies at Community and Household Level in the Study Sites

3.3.1 Climate Adaptation Framework Employed in our Project

A number of frameworks have been developed to inform policymakers' views on the communities' and households' climate adaptation strategies. Effective climate change adaptation is commonly regarded as long-term changes that are a result of resources and innovation. By contrast, community-based approaches are often seen as short-term coping strategies that are purely driven by survival and not based on proper planning and foresight.

Community-based approaches can carry a number of misconceptions amongst policymakers, where:

- adaptation strategies are always desired, intended and beneficial for everyone in the community;
- adaptation strategies are used to address physical wellbeing only;
- changes to traditional lifestyle and culture are justified in order to adapt to climate change.

These simplistic assumptions fail to address the sociocultural factors that are fundamental in choosing appropriate adaptation strategies in a community. By considering the limitations of these perspectives, this study is based on Agrawal & Perrin's (2008) framework of five classes of climate adaptation practices which, unlike most other frameworks, allows to consider a community's or household's physical, cultural, and social needs in a holistic manner. According to this framework, climate change can result in socio-cultural, economic and physical risks that can be managed through applying five key adaptation strategies: mobility, storage, diversification, communal pooling, and market exchange (Figure 3.6).

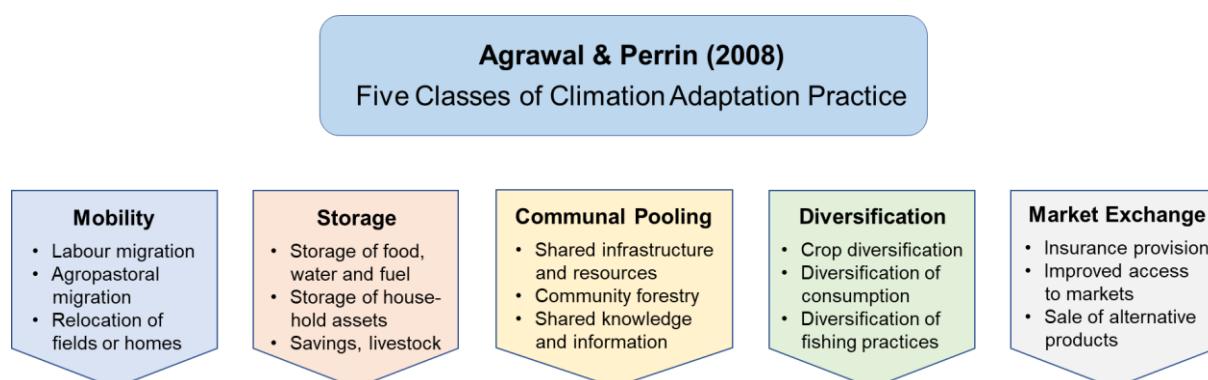


Figure 3.6. Authors' own based on Agrawal & Perrin's (2008) Climate Adaptation Framework

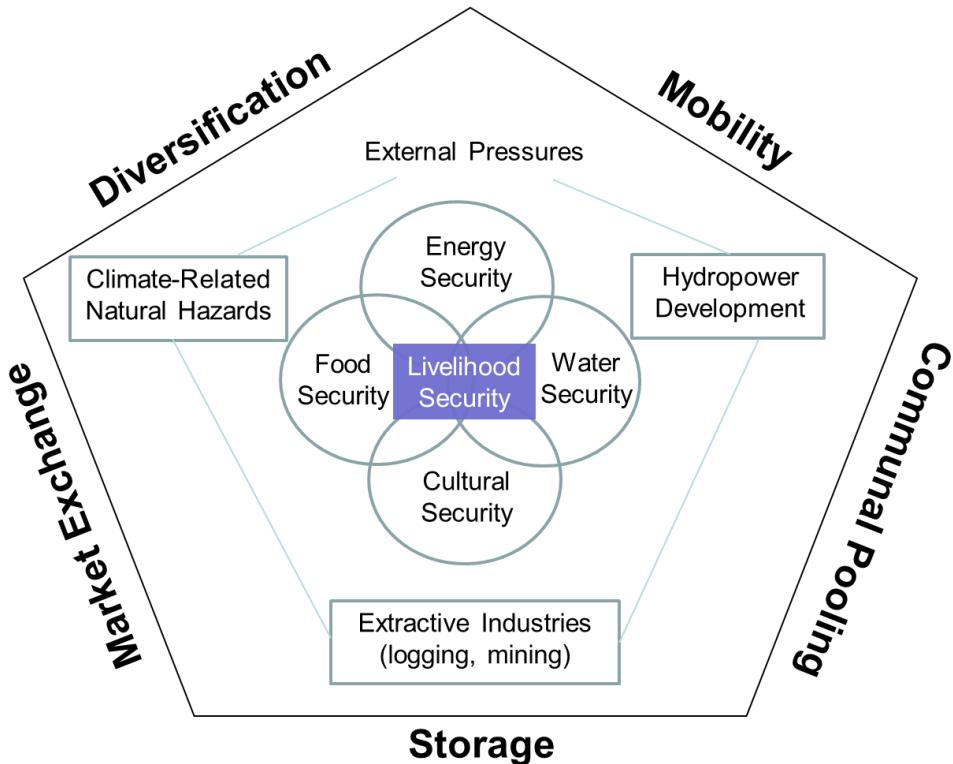


Figure 3.7. Integrating the Climate Adaptation Framework with a Livelihood Security Framework

3.3.2 Coping Mechanisms and Climate Adaptation Strategies in Prek Prasop District, Cambodia

Coping mechanisms for dealing with floods varied slightly from community to community. However, relocation of assets and storage of supplies (such as food, fodder, water and firewood) was a common coping mechanism across the study area. Villagers perceived their knowledge for dealing with floods sufficient, although a lack of knowledge for dealing with drought was a common sentiment in group discussions. Few communities have made significant changes to cropping systems aside from adoptions of dry and fast-growing rice varieties. Changes in crop selection from tobacco to sesame and maize have been driven primarily by health and market considerations. When possible, irrigation was used as a coping mechanism for drought however, not all farmers were able to adopt this strategy due to financial and/or geographic considerations.

In a number of communities, farmers were actively purchasing farm land in highland areas as an adaptation strategy and in several instances, villagers were forced to seek wage labour outside the community as a livelihood substitute. Views on relocation as a coping/adaptation mechanism varied from community to community with some villagers unwilling to move due to a deep sense of place. Others considered migration as a viable alternative; however, this view was primarily considered a means to a better standard of living.

The extent to which individuals could rely on support from other community members before, during and after an event varied from village to village. Community support was mainly in the form of volunteered labour with some participants identifying support in the form of food stuffs from neighbours and remittances as a coping mechanism. In most instances, villagers held high regard for

weather information communicated through TV and radio outlets with a common perception that environmental signals once used as signs of season change were no longer applicable. Whilst community members felt comfortable in their approaches to dealing with seasonal flooding as they have done for generations, there was a common sentiment that if climate variability and prolonged drought-like conditions persisted, further government intervention would be required.

Households in Prek Prasop district employed different adaptation strategies in response to the hazards encountered. The application of these strategies and extent to which households effectively maintained the processes directly corresponded to their means of livelihood. Those with superior livelihoods – measured through assets, activities securing certain living standards, activities providing alternative income means and other factors to facilitate access to assets – were able to better anticipate, cope with, resist and recover from the impacts of a natural hazard. Four primary classes of adaptation within the 165 households surveyed were established: storage, diversification, mobility, and communal pooling. The extent to which these adaptation strategies were successfully applied depended on the type of hazard experienced and the degree of livelihood capacity, materials and social assets. Figure 3.8 shows that households mentioned adaptation practices in all four adaptation classes more frequently for the case of flood events than for drought occurrences. This is an indicator that adaptation strategies to flood have been developed over a longer period of time, while droughts are a more recent phenomenon and people are still struggling to develop adequate adaptation strategies.

Traditional knowledge bears considerable weight in decision-making in the villages surveyed. Such knowledge was found to generate effective adaptation measures in many of the communities studied, primarily in the form of flood awareness knowledge and mitigation measures. Bamboo fences are used as flood mitigation, houses are raised to reduce exposure, and higher shelves are built in houses as preparedness measures. Bigger houses are built for stocking products and assets, and households often equip their boat as a form of flood preparation. Animals of value, such as cattle and poultry are evacuated to higher and safer areas, often along pre-established evacuation routes and into customary areas.

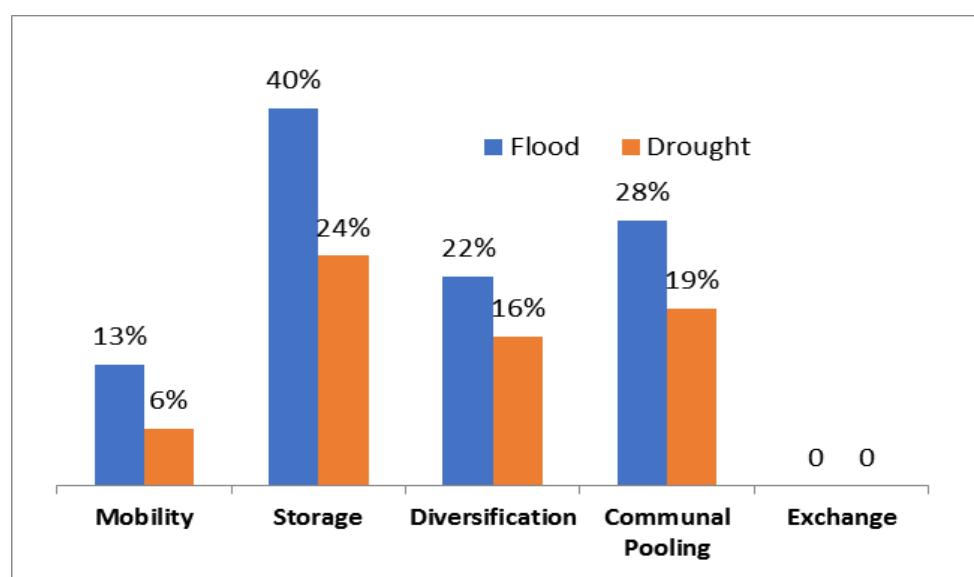


Figure 3.8. Four classes of adaptation strategies as practiced by surveyed households (% of respondents who mentioned these strategies in the interviews; n=165)

Seasonal calendars developed in focus groups at the community level showed how farmers spread out the harvesting of crops to adapt to less predictable rainfall patterns (Figure 3.9). The timing and variety of rice sown and transplanted is also adapted to the onset of monsoon rains. In some villages, a more diverse array of crops are grown, moving away from rice as the traditional staple crop.

	January	February	March	April	May	June	July	August	September	October	November	December
Major hydrometeorological events												
Rainfall			Little Rainfall	-----	Heavy Rainfall							
Flood						Flood						
Drought		Drought								Drought		
Important livelihood activities and vulnerabilities												
Dry season rice	Caring		Harvest	Drying					Preparation and Sowing			
Dry season maize	Caring		Harvest						Preparation and Sowing			
Wet season rice				Preparation, Sowing	Caring		Harvest	Drying				
Wet season maize				Prep., Sowing	Harvest							
Cassava	Drying			Preparation, Sowing		Caring			Harvest			
Soy	Caring		Harvest						Preparation			
Cashew		Fruit										
Mango		Fruit					Flower					
Off-season mango						Flower				Fruit		
Bamboo shoots				Best collection								
Fish		Regular fishing		Good fishing	Regular fishing		Best Fishing		Fishing			
Pig				Vulnerable to illness								
Livestock, cattle				Move to higher ground								

Figure 3.9. Seasonal calendar for Thma Raeb village, Prek Prasop district

In villages where seasonal flooding significantly and regularly affects homes and fields, our research showed that the daily activities carried out by women can differ greatly between seasons. During floods, children are commonly sent to stay somewhere safe on higher ground (with relatives or at the pagoda), while women stay at the primary residence, prepare food for themselves and their husbands, collect and transport fodder for livestock (which are also kept on higher ground, tended to by the men, who stay with the livestock), and take fish to market, commonly travelling by boat. With more frequent extreme flooding events predicted under climate change, there may be an increase in the length of time that families are physically separated and women remain in flooded villages, doing arduous work in difficult conditions and exposed to significant risks.

Table 3.1 shows that poorer households are more disadvantaged with regard to the adoption of effective coping mechanisms and adaptation strategies due to lack of resources, capital and social networks. Figure 3.10 provides a few examples of the four classes of adaptation practices that are particularly common in the villages in Prek Prasop district.

Table 3.1. Adaptation practices in response to flood by household (HH) group

Class of Adaptation Practice	Poor HHs	Medium HHs	Better-off HHs	Chi-square (p value)
Storage	79.63%	89.66%	94.34%	0.058*
Mobility	42.59%	72.41%	77.36%	0.000***
Diversification	44.44%	81.03%	81.13%	0.000***
Communal pooling	48.15%	63.79%	84.91%	0.000***

Mobility	Storage	
		
Building higher ground for farm animals as a flood refuge	Preservation of small fish as disaster food and for market sale	Storage of animal fodder above-ground
Communal pooling	Diversification	
		
Digging irrigation channels as drought adaptation	Building houses on stilts is a common strategy to adapt to frequent flooding	Off-season mango for risk diversification

Figure 3.10. Illustrative examples of the four classes of adaptation practice employed in communities of Prek Prasop district

3.3.3 Climate Adaptation Strategies in the Ba Catchment, Viti Levu, Fiji

This section explores the various strategies used by villages in the lower Ba Catchment to adapt to floods and examines how these strategies are chosen based on sociocultural factors and access to resources, power, and information. The findings are based on research carried out between 2015 and 2018 in three villages recovering from the impacts of flooding from 2012, namely Votua, Nawaqarua and Etatoko. The study found that all three iTaukei communities employed a range of flood adaptation strategies in line with Agrawal & Perrin's (2008) framework of five climate change adaptation practices.

These strategies were selected and applied at both the community and household levels in a variety of ways which reflect the sociocultural norms and values present in the communities. Each village expressed challenges in adaptation given availability of resources and access to power and information. However, these villages also identified opportunities as a means of adapting to relocation and changes to the local environment. Figure 3.11 provides a synthesis of the specific adaptation strategies identified in each of the three communities.

	VOTUA	NAWAQARUA	ETATOKO
Mobility	<ul style="list-style-type: none"> Inclined to relocate if the government provides land, housing, and jobs Lack of autonomy in the decision to relocate due to decision-making hierarchy held by elders Other limitations to mobility include housing needs, finances, and available job opportunities 	<ul style="list-style-type: none"> Relocating livestock fields to safer areas to secure food sources during floods Restrictions to relocate due to decision of elders, a strong connection to the land, and financial constraints 	<ul style="list-style-type: none"> Residents have relocated the village to a safer place with the help of external donors Relocation has resulted in feelings of dislocation from livelihoods, exposure to new hazards and a restriction to return permanently to the old location
Storage	<ul style="list-style-type: none"> Desire to build more community storage as only one participant could store household items in a permanent capacity Lack of financial capital and low inter household coordination as a key obstacle to building more storage space 	<ul style="list-style-type: none"> Higher capacity for public storage compared to Votua, particularly for water, food, and animals Communal hall and water storage tanks built by external organisations 	<ul style="list-style-type: none"> Consistent access to water from groundwater borehole and solar-powered pump financed by Australian Aid
Diversification	<ul style="list-style-type: none"> Diversify crop, land use, and fishing practices to maintain the necessary level of income and food Housing diversification where a two-storey house was built as a site for evacuation and storage 	<ul style="list-style-type: none"> Planting crops at higher ground and dredging river bed for fishing opportunities Planting flood-resilient crops and switching to fishing for smaller crabs Given seeds for flood-resilient crops from the government 	<ul style="list-style-type: none"> Practicing diverse agriculture in any available areas despite limited land and water resources
Communal Pooling	<ul style="list-style-type: none"> Sharing labour in reforestation and mangrove replanting for soil drainage Sharing infrastructure, knowledge, food and water amongst residents to enhance the ability to cope with climate hazards 	<ul style="list-style-type: none"> Two-story house built as a place for evacuation and storage Received help from the government to rebuild houses after Cyclone Evan in 2012 Sharing labour, assets, and knowledge amongst community members 	<ul style="list-style-type: none"> All houses that built from external funds are cyclone-resistant Limitations for newcomers who must build their own house, which are often less resilient than funded homes
Market Exchange	<ul style="list-style-type: none"> Fishing to earn money during the non-harvest period 	<ul style="list-style-type: none"> Households emphasise financial savings as a form of disaster insurance 	<ul style="list-style-type: none"> Little capacity for market exchange due to few resources and limited access to boats Reliant on rations supplied by external agencies

Figure 3.11. Adaptation strategies: Challenges and opportunities for each village

Figure 3.12 provides a few illustrative examples of the five classes of adaptation practices that are particularly common in indigenous (*iTaukei*) communities in the Ba River catchment. We found that community-based adaptation strategies, in particular, are based on a system of interlinking sociocultural values and norms. These norms shape the community's response to climate change, where they both contribute to effective adaptation strategies and constrain individuals' abilities to create their own strategies. Therefore, decisions need to be negotiated within the social structure and be approved by traditional leadership.

Mobility	Storage	Communal pooling
		
Resettled community of Etatoko, elevated above the flood plain of the Ba River	Storage of fermented root crops that can serve as post-disaster food	Cyclone-resilient traditional <i>bure</i> in Navala are built with communal labour
Diversification	Market exchange	
	 Catching mud crabs in mangroves is a lucrative activity for women; after the 2012 floods, the exchange and sale of <i>kuka</i> (small crabs) acted as a short-term coping mechanism	
Many families have built two-story houses as a strategy of flood adaptation	Catching mud crabs in mangroves is a lucrative activity for women; after the 2012 floods, the exchange and sale of <i>kuka</i> (small crabs) acted as a short-term coping mechanism	

Figure 3.12. Illustrative examples of the five classes of adaptation practice

Communities should be trusted to determine what sociocultural changes must occur in order to adapt. Livelihood changes will be inevitable and the loss of traditions is not always justified in climate change adaptation. Given the Fijian government's plan to relocate at-risk communities, policymakers must reflect on the potential risk that communities face in losing identity and connection to place. Local context determines why particular strategies are used and whether they are appropriate. A standardised, one-size-fits-all approach is not likely to work as each community has its own cultural and geographic features requiring strategies specifically catered to that context. Going forward, policymakers need to appreciate how communities use adaptation strategies for context-specific reasons, and that such strategies can be effective as long-term measures of community risk reduction and resilience.

Etatoko (formerly Wavuwavu) was one of the first Fijian villages to undergo a planned resettlement coordinated by the Fijian government. As a result, Etatoko should now be better adapted to the multiple risks of climate change. However, this relocation has made the people of Etatoko vulnerable in different ways. Whilst relatively safe from flooding, relocation has brought a new set of challenges that did not affect the village previously. This includes dislocation from where livelihoods are still derived, the increased burden of travel, and exposure to new hazards, such as drought and cyclones. When 28 household heads in Votua were asked about their adaptation strategies, only two suggested that they were planning for relocation and follow the example of Etatoko villagers. Nine household heads had previously considered relocating, but were held back by a range of factors. Another nine household heads mentioned relocation in the semi-structured interviews, but were in opposition to the idea, mainly due to their cultural and historical ties with the land and their livelihood needs. Eight of the households did not even mention relocation (Figure 3.13).

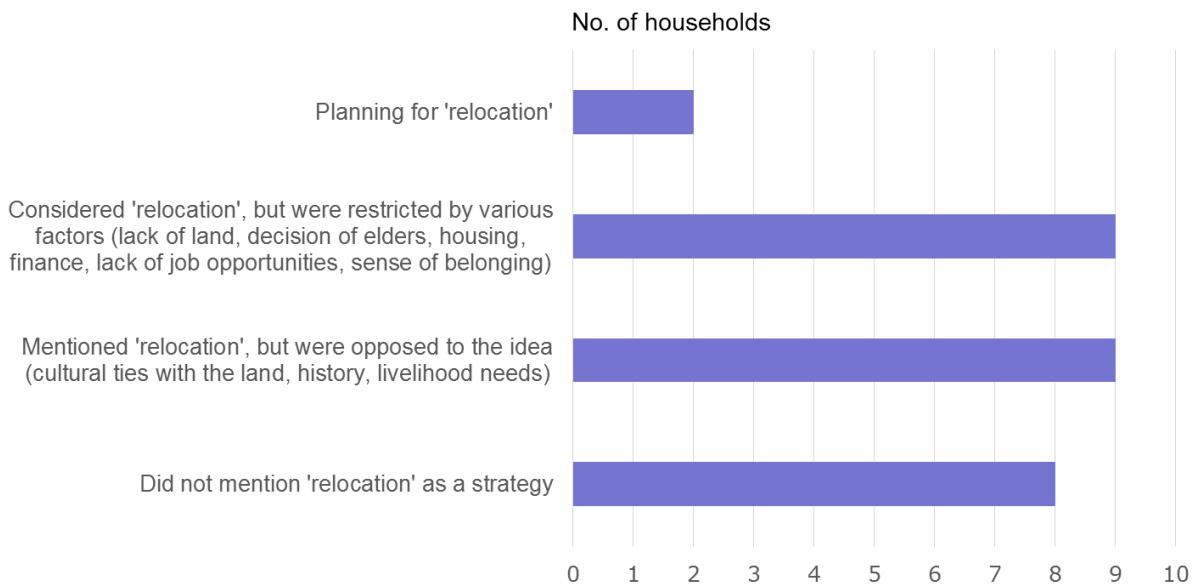


Figure 3.13. Attitudes towards 'relocation' as revealed in semi-structured interviews among 28 household heads in Votua community (November 2015)

When climate adaptation strategies – including climate-induced relocation – are implemented by external stakeholders without considering the local context, the lack of community involvement in making such decisions may make the communities more vulnerable to the impacts of climate change. Community social structures often change in response to relocation. This may trigger internal conflicts that disrupt the community's stability because the cultural and traditional values have not been properly considered in the decision-making process.

3.4 Landscape Level Research Approaches to Determine Climate-Related Hazard Risks

There was a general understanding amongst residents of the Ba catchment, Fiji, that climate change and land use change would affect flooding and drought within the catchment. Therefore, a number of landscape studies were undertaken to help communities understand or confirm their understanding of whether climate change and land use change will impact river flow. It was found that changing land use from trees to open grazing lands, which mirrors current land clearing in the catchment, will affect streamflow. In particular, average and high flows will increase as trees are replaced by pastures and low flows may decrease slightly. Therefore, flood severity and timing may be impacted. This generally agrees with what local communities' observations and understanding of the impacts of tree clearing on catchment hydrology.

In addition to the modelling, parts of the upper catchment areas were visited and large sections of erosion (100-200 meters long) were observed where clearing had occurred which had resulted in the transport of sediments downhill and into the tributaries of the Ba River. Local communities are aware of these changes. Importantly, these changes may change or are already changing flood patterns, which is causing concern amongst affected communities.

Another finding of this project is that drought is sometimes a bigger concern than flooding in communities, particularly in Cambodia. However, drought was also a problem in the Ba catchment and was mentioned by many communities, particularly the sugar cane farmers who are predominantly Fijians of Indian descent but also community residents of Nawaqarua, Votua, Etatoko and Navala. Recently drought has been declared in 2015, 2017, and 2018, with 2015 being particularly severe.

Based on the concerns of the communities, a drought forecasting tool was developed for the two main islands in Fiji. A number of drought indices were compared for Fiji and it was found that the Effective Drought Index worked best for Fiji. Based on community consultation, a one-month-ahead categorical drought forecast (extremely dry, very dry, dry, normal, wet, very wet, extremely wet) was developed and validated. A machine learning approach using Wavelet Artificial Neural Networks was found to be the best type of model. Figure 3.14 depicts the output from forecast model validation over the Ba catchment. The results show that the model has successfully predicted most of the categories, but that the model has underpredicted the more extreme wet categories and overpredicted the normal and drier categories. One other important observation is that the distribution of events is uneven across the categories, which suggests that the category boundaries should be reconsidered. Local knowledge is an important part of further refinement of the categories.

Forecast	observed						
	Extremely Wet	Very Wet	Moderately Wet	Normal	Moderately Dry	Severely Dry	Extremely Dry
Extremely Wet	2	0	0	0	0	0	0
Very Wet	0	0	0	1	0	0	0
Moderately Wet	1	0	1	0	0	0	0
Normal	0	1	0	38	2	0	0
Moderately Dry	0	0	0	0	2	0	0
Severely Dry	0	0	0	0	0	0	0
Extremely Dry	0	0	0	0	0	0	0

Figure 3.14. Output of model validation for one month ahead categorical forecasts. The green boxes show where the forecast matches observed conditions and the red boxes show where the forecast does not match observed conditions

Results of the remote sensing based changing detection highlighted the presence of landslide scars following the 2012 high precipitation events in deforested upland slopes concentrated in the western plantation area of the Ba catchment. These were associated with sediment deposits over agriculturally productive areas along tributaries of the Ba River (Figure 3.15).

MODIS time series analysis showed that there were measurable periods of disturbance to sugar cane crops following major flood events impacting areas below the maximum flood stage (Figure 3.16). Cyclones resulted in longer crop recovery periods and previous drought events influenced post flood crop recovery. Our findings suggest that it is important to incorporate complex cross-scale dynamics and interrelationships between human and natural components in understanding and effectively assessing resilience within these flood prone socio-ecological systems.

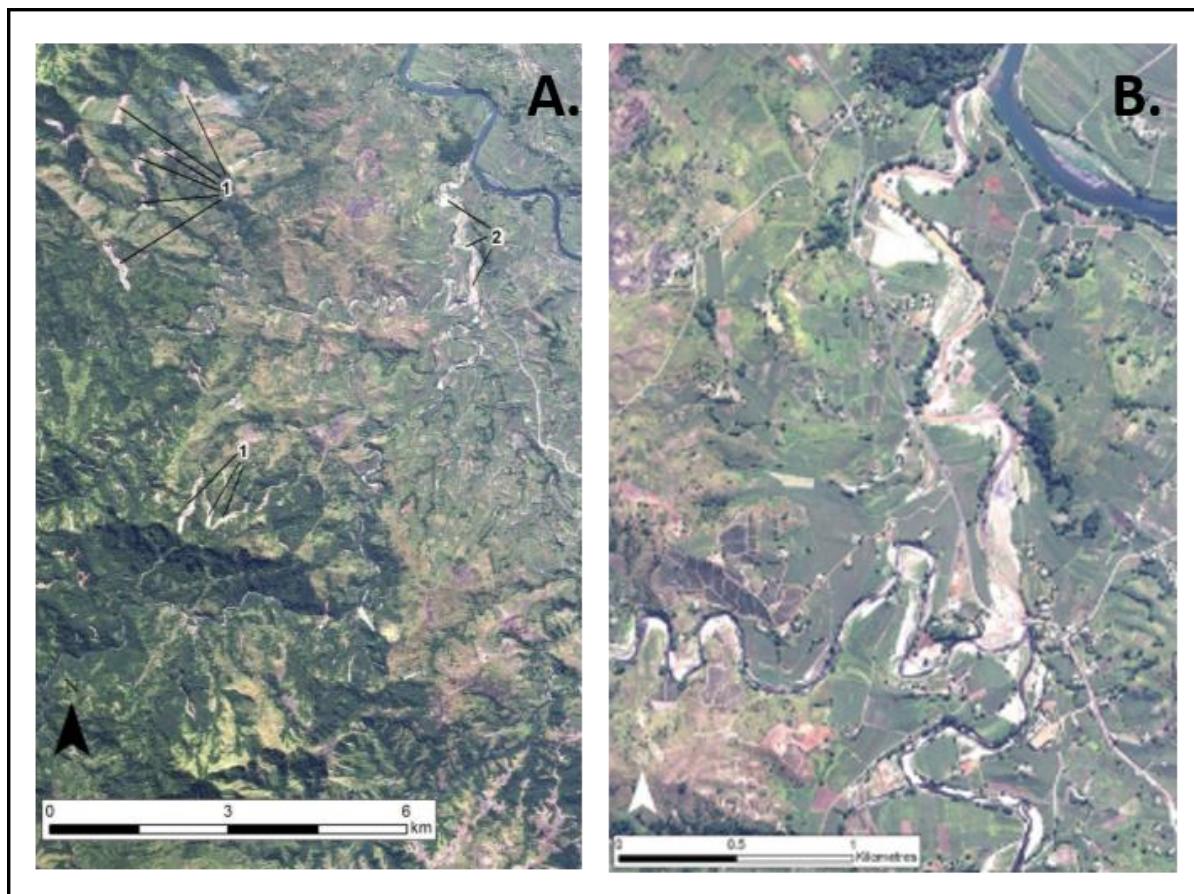


Figure 3.15. A. Landslide scars (1) and sediment deposition along Ba river tributary (2) detected post the 2012 extreme precipitation events using high resolution satellite data (GeoEye-1). B. Finer scale image showing patterns of sediment deposition on agricultural fields in the Ba catchment flood zone.

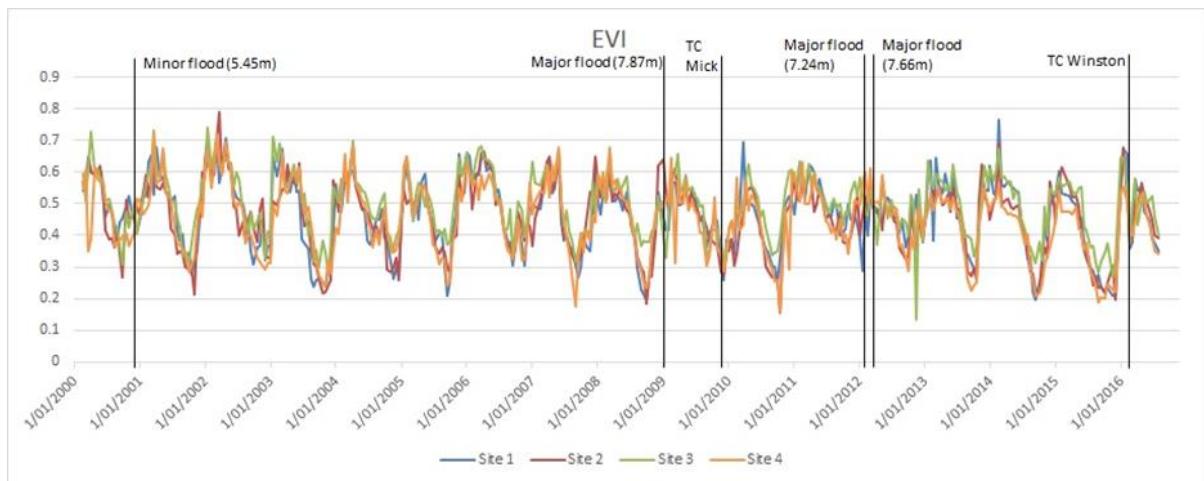


Figure 3.16. MODIS enhanced vegetation values for four sites within the Ba catchment. Annual peaks and troughs reflect seasonal growth and harvest patterns. Responses to disturbance events, including the 2012 floods and TC Winston, are evident.

4. Conclusions

In response to seasonal climate variability, communities in both study sites have developed a range of effective coping mechanisms and adaptation strategies. However, the occurrence of multiple risks poses increasing challenges to villagers' adaptive capacity. Attention needs to be paid to the various trade-offs between different adaptation strategies in multi-risk landscapes.

In the communities in Cambodia, local knowledge and scientific data agree that patterns in rainfall, flooding, dry spells and drought are becoming less predictable. Communities have developed complex, intricate adaptive responses to reduce the risk of crop damage and draw on a diverse range of produce and strategies to maintain their livelihoods. Additional measures taken to reduce reliance on rainfall include irrigation, excavation, tree plantations, and short maturity crops.

Repeated floods are changing the physical landscape and river channel of the lower Ba River on Fiji's major island Viti Levu. In Fijian communities, detailed local knowledge exists of bank erosion, river currents, floodwater pathways, landforms and flood heights. Communities adapt and respond as best as they can by using multiple strategies. Attention must be given to the experience of everyone in the community, particularly groups that may be more exposed and/or vulnerable during periods of floods and droughts such as women, the elderly, children, the landless and people with limited economic means.

Our study has also shown a high level of synergy between the flood extent identified in participatory mapping exercises and the satellite-derived flood data. The close alignment of the participant-drawn flood extent and the satellite data is consistent with previous research which found that there was a greater risk perception in areas of moderate or substantial flood hazards. This unveils that local people and scientists have the same comprehension about the physical extent of the hazard, although they might have different understandings about the causes of floods (as well as droughts and storm events) and coping/adaptation strategies.

5. Future Directions

As discussed under section "Potential for further work", future work could examine in more detail the potential of linking local knowledge with scientific knowledge, as landscape-level research based on high-resolution satellite imaging allows further refinement of highly localised data. Several members of the research team – including the PI – are involved in a project that examines climate-smart landscape adaptation through collaboratively harnessing geospatial information funded by the Australian Centre for International Agricultural Research (ACIAR). The project is focused on Fiji and Tonga, with a substantial overlap of the research sites in the Ba River Catchment with the APN project. Thereby, the data gathered over several research phases in the APN project can be made available to the ACIAR project.

Research findings in the field of 'climate-induced mobility and migration' have also informed a new research initiative that the PI, Prof Andreas Neef, is currently developing under the Worldwide Universities Network (WUN). A project proposal entitled "Climate-Induced Migration: Global Scope, Regional Impacts and National Policy Frameworks", comprising researchers from 14 global universities and two regional offices under the International Organization for Migration (IOM), is currently under review by the WUN Secretariat.

6. References

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7. Appendix

7.1 Workshops

Dissemination Workshop in Phnom Penh, Cambodia - Agenda



Royal University
of Phnom Penh

DISSEMINATION WORKSHOP ON

“Climate Change Adaptation in Post-Disaster Recovery Processes: Disaster-Affected Communities in Cambodia”

24 April 2019

Cambodia-Japan Cooperation Centre, Royal University of Phnom Penh

Time	Topic	Presenter
8.30-9.00	Registration	
9.00-9.10	Workshop Objectives	Prof Andreas Neef
9.10-9.20	Welcome/Opening Remarks by the Dean, Faculty of Development Studies, Royal University of Phnom Penh	Dr Sethik Rath Royal University of Phnom Penh
9.20-9.35	Climate Adaptation in Multi-Risk Environments: New Frameworks and Applications in Rural Communities of Southeast Asia	Prof Andreas Neef University of Auckland
9.35-9.50	Poor Households' Climate Change Adaptation in Post-Disaster Recovery Processes in Flood-Affected Communities in Kratie Province, Cambodia	Dr Chanrith Ngin University of Auckland
9.50-10.05	Evaluation of the Environmental Livelihood Security Framework: Case Study Applications	Dr Bryan Boruff University of Western Australia
10.05-10.35	Discussion	Moderator: Dr Floris van Ogtrop
10.35-10.50	Coffee Break	
10.50-11.05	Drawing Together Local and Scientific Knowledge on Flood Impacts, Vulnerability and Adaptation under Changing Environmental Conditions: A Case Study from Cambodia	Dr Natasha Pauli University of Western Australia
11.05-11.20	Remotely Sensed Assessments of Multi-Hazard Environments in Understanding Spatio-Temporal Dimensions of Vulnerability	Dr Eleanor Bruce University of Sydney
11.20-11.35	Climate Change Impacts and Adaptation Strategies in Kratie Province: Eliciting Perceptions from Flood-Affected Communities through Q-Sort Methodology	Dr Bryan Boruff University of Western Australia
11.35-12.05	Discussion	Moderator: Siphat Touch
12.05-14.00	Lunch (provided)	
14.00-14.15	The Intersection of Environmental Change with Seasonal Livelihoods and Daily Activities in Four Villages along the Lower Mekong River	Dr Natasha Pauli University of Western Australia
14.15-14.30	Impacts of Climate Change on Small Businesses in Kratie Town, Cambodia	Mr Chanchhaya Chhom Green Move Consulting
14.30-14.45	The Potential of Cubesats for High Resolution Inundation Mapping in Kratie Province	Dr Kevin Davies University of Sydney
14.45-15.15	Discussion	Moderator: Dr Chanrith Ngin
15.15-15.20	Wrap-up/Closing Remarks	Prof Andreas Neef

Funding Sources: Asia-Pacific Network for Global Change Research (APN-GCR) and University of Western Australia (UWA) Research Impact Grant

Funded by

 ASIA-PACIFIC NETWORK FOR
GLOBAL CHANGE RESEARCH

Dissemination Workshop in Phnom Penh, Cambodia – List of Participants



Royal University
of Phnom Penh

DISSEMINATION WORKSHOP ON

“Climate Change Adaptation in Post-Disaster Recovery Processes: Disaster-Affected Communities in Cambodia”

24 April 2019

Cambodia-Japan Cooperation Centre, Royal University of Phnom Penh

LIST OF PARTICIPANTS

No.	Name	Institution	Position
1	San Kimhong	Ministry of Environment	EIA Officer
2	Ratha Chhan	Ministry of Women Affairs	Deputy Director – Project Management
3	Lorn Trob	Emergency Coordination Center, National Committee For Disaster Management	Acting Director
4	Pheuk Sok	Asian Disaster Preparedness Center (ADPC)	Staff
5	Chanvibol Choeur	World Food Programme (WFP)	Staff
6	Francesca Puricelli	People in Need (PIN)	Staff
7	Mith Somountha	ActionAid	Program Officer
8	Sopheap Soeng	USAID	Gender Specialist
9	Sothira Seng	USAID	Project Management Specialist
10	Nop Polin	DanChurchAid	Staff
11	Frederico Barreras	People in Need (PIN)	Staff
12	Khem Sothea	Mekong River Commission (MRC)	Staff
13	Chap Nimol	RUPP	Staff
14	Heng Naret	FDS/RUPP	Staff
15	Chuop Sonivorth	RUPP	Student
16	Duong Chanmethachampang	FDS/RUPP	Staff
17	Sarouen Pheara	RUPP	Student
18	Kim Vantham	RUPP	Student
19	Chraing Mek	RUPP	Student
20	Pech Sophak	RUPP	Student
21	Rul Socheata	RUPP	Student
22	Ngov Penghuy	RUPP	Staff
23	Sopheak Chann	RUPP	Staff
24	Ly Kimlong	RUPP	Staff
25	Rann Rewy	RUPP	Student
26	Chhan Sreyrath	RUPP	Student

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Dissemination Workshop in Phnom Penh, Cambodia – List of Participants (cont'd)

No.	Name	Institution	Position
27	An Songha	RUPP	Student
28	Teng Chanthai	RUPP	Student
29	Ros Srey Rey	RUPP	Student
30	Loam Romnea	RUPP	Student
31	Siek Soeynouch	RUPP	Student
32	Met Juoy	RUPP	Student
33	Phon Sophea	RUPP	Student
34	Kong Davin	RUPP	Student
35	Nao Vannet	RUPP	Student
36	Reang Sophea	RUPP	Student
37	Cheng Chansereiynt	RUPP	Student
38	Morn Sreykhuoch	RUPP	Student
39	Phat Chandara	PDS/RUPP	Staff
40	Chhinh Nyda	RUPP	Staff
41	Sethik Rath	RUPP	Dean, Faculty of Development Studies
42	Chhom Chanchhaya	Green Move Consulting, RUPP	Advisor, Affiliated Researcher
43	Eleanor Bruce	University of Sydney	Associate Professor
44	Kevin Davies	University of Sydney	Lecturer
45	Bryan Boruff	University of Western Australia	Senior Lecturer
46	Natasha Pauli	University of Western Australia	Lecturer
47	Chanrith Ngan	University of Auckland	Researcher
48	Andreas Neef	University of Auckland	Professor
49	Siphat Touch	Ministry of Rural Development	Director

LIST OF PRESENTERS

No.	Name	Institution
1	Andreas Neef	University of Auckland, New Zealand
2	Chanrith Ngan	University of Auckland, New Zealand
3	Bryan Boruff	University of Western Australia, Australia
4	Natasha Pauli	University of Western Australia, Australia
5	Eleanor Bruce	University of Sydney, Australia
6	Kevin Davies	University of Sydney, Australia
7	Chanchhaya Chhom	Green Move Consulting, Cambodia

Dissemination Workshop in Kratie, Cambodia - Agenda



Royal University
of Phnom Penh

DISSEMINATION WORKSHOP ON

“Climate Change Adaptation in Post-Disaster Recovery Processes: Disaster-Affected Communities in Cambodia”

26 April 2019

Provincial Department of Rural Development, Kratie Province

Time	Topic	Author/Presenter
8.30-9.00	Registration	
9.00-9.10	Workshop Objectives	Prof Andreas Neef
9.10-9.20	Welcome/Opening Remarks	HE Pen Lynath Deputy Governor, Kratie Province
9.20-9.35	Climate Adaptation in Multi-Risk Environments: New Frameworks and Applications in Rural Communities of Southeast Asia	Prof Andreas Neef University of Auckland
9.35-9.50	Poor Households' Climate Change Adaptation in Post-Disaster Recovery Processes in Flood-Affected Communities in Kratie Province, Cambodia	Dr Chanrith Ngin University of Auckland
9.50-10.05	Evaluation of the Environmental Livelihood Security Framework: Case study applications	Dr Bryan Boruff University of Western Australia
10.05-10.35	Discussion	Moderator: Siphat Touch, Ministry of Rural Development (MRD)
10.35-10.50	Coffee Break	
10.50-11.05	Drawing together local and scientific knowledge on flood impacts, vulnerability and adaptation under changing environmental conditions: Case studies from Cambodia	Dr Natasha Pauli University of Western Australia
11.05-11.20	Integrating social mapping with remotely sensed assessments of multi-hazard environments in understanding spatio-temporal dimensions of vulnerability	Dr Eleanor Bruce University of Sydney
11.20-11.35	Hydrological modelling, drought indices and local knowledge in early warning assessments	Dr Floris van Ogtrop University of Sydney
11.35-12.05	Discussion	Moderator: Siphat Touch (MRD)
12.05-14.00	Lunch (provided)	
14.00-14.15	The Relationship between Environmental Change and Gender in Respect to the Livelihoods of Communities along the Lower Mekong River Basin	Dr Natasha Pauli University of Western Australia
14.15-14.30	Impacts of Climate Change on Small Businesses in Kratie Town, Cambodia	Mr Chanchhaya Chhom Green Move Consulting
14.30-14.45	Monitoring floodwaters using fine temporal resolution Cubesat earth observation imagery	Dr Kevin Davies University of Sydney
14.45-15.15	Discussion	Moderator: Dr Chanrith Ngin
15.15-15.30	Coffee Break	
15.30-15.45	Wrap-up/Closing Remarks	Prof Andreas Neef

Funding Sources: Asia-Pacific Network for Global Change Research (APN-GCR) and University of Western Australia (UWA) Research Impact Grant

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Dissemination Workshop in Kratie Town, Cambodia – List of Participants



Royal University
of Phnom Penh

DISSEMINATION WORKSHOP ON

“Climate Change Adaptation in Post-Disaster Recovery Processes: Disaster-Affected Communities in Cambodia”

26 April 2019

Provincial Department of Rural Development, Kratie Province

LIST OF PARTICIPANTS

No.	Name	Institution	Position
1	Pen Lynath (M)	Kratie Province	Deputy Governor
2	Thun Bonith (F)	Provincial Department of Rural Development	Staff
3	Theng Sophea (M)	Provincial Department of Rural Development	Staff
4	Chan Bunrith (M)	Provincial Department of Rural Development	Deputy Office Chief
5	Suon Sokheng (M)	Ministry of Rural Development	Staff
6	Nuon Leangheng (M)	Koh Tasuy Commune	Chief
7	Chea Nath (M)	Kbal Village, Koh Tasuy Commune	Chief
8	Hong Phalla (M)	Technical Office, Provincial Department of Health	Chief
9	Sok Buntheoun (M)	Khmer Association For Development of Countryside Cambodia (KAFDOC)	Program Officer
10	Khy Channo (M)	Provincial Department of Agriculture	Staff
11	Thuok Vannara (M)	Provincial Department of Water Resources	Staff
12	Pho Chanmeng (M)	Provincial Department of Environment	Staff
13	Chea Thi (F)	Chroy Banteay Village, Chroy Banteay Commune	Chief
14	Seang Vanndy (M)	Khsach Tup Village	Chief
15	King Son (M)	Kampong Dor Village	Chief
16	Oeur Sareoun (M)	Krahorm Kor Krom Village	Chief
17	Lao Beth (M)	Ta Mao Krom Village	Chief
18	Suon Vannak (M)	Ta Mao Commune	Second Secretary
19	Mam Theoun (M)	Thmor Reap Village, Prek Prasop Commune	Chief
20	Pheng Chivin (M)	ChildFund	Program Officer
21	Nham Veasa (M)	Forests and Livelihood Organization (FLO)	Program Officer
22	Sean Nal (M)	Prek Prasop Commune	Second Secretary
23	Nou Sun (M)	Dey Dos Krom Village	Chief
24	Ou Tha (M)	Ta Mao Kandal Village	Chief
25	Nun Seang (M)	Ou Long Village	Chief
26	Kheang Sokunthy (F)	ChildFund	Development Officer
27	Khieu Len (M)	Kandal Koh Village	Chief
28	Sas Dara (M)	Kampuchea Women's Welfare Action (KWWA)	Program Officer
29	Son Sovann (M)	Northeastern Rural Development Organization (NRD)	Provincial Chief

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Dissemination Workshop in Kratie, Cambodia – List of Participants (cont'd)

No.	Name	Institution	Position
30	Nuon Chorvy (F)	Provincial Department of Rural Development	Staff
31	Thun Sary (M)	Provincial Department of Rural Development	Deputy Director
32	Chhan Sopheak (M)	Royal University of Phnom Penh (RUPP)	Lecturer
33	Chhom Chanchhaya (M)	Green Move Consulting, RUPP	Advisor, Affiliated Researcher
34	Eleanor Bruce (F)	University of Sydney	Associate Professor
35	Kevin Davies (M)	University of Sydney	Lecturer
36	Bryan Boruff (M)	University of Western Australia	Senior Lecturer
37	Natasha Pauli (F)	University of Western Australia	Lecturer
38	Chanrith Ngan (M)	University of Auckland	Researcher
39	Andreas Neef (M)	University of Auckland	Professor
40	Siphat Touch (M)	Ministry of Rural Development	Director

LIST OF PRESENTERS

No.	Name	Institution
1	Andreas Neef	University of Auckland, New Zealand
2	Chanrith Ngan	University of Auckland, New Zealand
3	Bryan Boruff	University of Western Australia, Australia
4	Natasha Pauli	University of Western Australia, Australia
5	Eleanor Bruce	University of Sydney, Australia
6	Kevin Davies	University of Sydney, Australia
7	Siphat Touch	Ministry of Rural Development, Cambodia
8	Chanchhaya Chhom	Green Move Consulting, Cambodia

Dissemination Workshops in Cambodia – Report by Dr. Natasha Pauli (UWA)

Researchers from the University of Auckland, the Royal University of Phnom Penh, the University of Western Australia (UWA) and the University of Sydney organised two workshops on climate change adaptation in disaster-prone areas along the Mekong River in Cambodia.

Three years of research findings and policy implications were discussed with a broad group of stakeholders in the country's capital Phnom Penh and the town of Kratie, including village leaders, commune chiefs, representatives from government and NGOs, academics and students. The workshop in Phnom Penh was hosted by the Royal University of Phnom Penh and held at the Cambodia-Japan Cooperation Centre on 24 April 2019. Among the participants were representatives from the Ministry of Environment, Ministry of Women Affairs, Ministry of Rural Development, the Emergency Coordination Center under the National Committee for Disaster Management, the World Food Programme, the Asian Disaster Preparedness Center, the Mekong River Commission, USAID and several local NGOs.

“The research workshop in Phnom Penh generated lively discussions among participants and highlighted a pressing need for greater access to geospatial data and training in the application of remote sensing methods for disaster preparedness,” said Dr Bryan Boruff from UWA.

In Kratie, where the workshop was hosted by the Provincial Department of Rural Development on 26 April 2019, the local participants emphasised that the research team had “captured well their reality”, and they were very pleased to see the results of the research returned to communities and local authorities. The workshop was officially opened by Kratie’s Provincial Deputy Governor, Mr Pen Lynath. Among the participants were representatives of the various provincial departments, the commune and village leaders of Phrek Prasob district and staff of several local NGOs.

Two of the presentations were based on dissertations completed by Master of Environmental Science students Savuti Henningsen and Mark Williams from the University of Western Australia. Both students were hosted by the rural communities that were the focus of the research, alongside small teams of students from the Royal University of Phnom Penh who acted as research assistants, facilitators and translators.

“Both Savuti and Mark were outstanding students who really immersed themselves in their research. Mark spent time with the communities working on participatory hazard mapping, and recording local adaptations to floods and droughts. Savuti compiled seasonal calendars of agricultural livelihoods and weather events, as well as interviewing women about their daily routines in times of flood and drought,” said Dr Natasha Pauli (UWA). “Our wonderful Cambodian collaborators translated their work into policy briefs and presentations, delivered in Khmer, which were provided as a tangible output of the research,” she added.

The research project has been funded by the Asia Pacific Network for Global Change Research, and is led by Professor Andreas Neef at the University of Auckland. A Research Impact Grant from the University of Western Australia, awarded to Dr Natasha Pauli and Dr Bryan Boruff, made a significant contribution towards the cost of running the two workshops.



Participants of the dissemination workshop at RUPP's Cambodia-Japan Cooperation Centre



Professor Andreas Neef from the University of Auckland introduces the workshop objectives



Dr Natasha Pauli (UWA) presents the findings of Mark Williams at the Phnom Penh workshop



Members of the research team pose in front of the workshop banner



Deputy Provincial Governor, Mr Pen Lynath, giving his opening address to the participants in Kratie



Mr Siphat Touch, Director of the Ministry of Rural Development's Research Office, as moderator



Professor Neef gives an overview of the research findings at the workshop in Kratie



Policy briefs were intensively examined and discussed in the Kratie workshops

Dissemination Workshop in Suva, Fiji - Agenda



DISSEMINATION WORKSHOP ON

“Climate Change Adaptation in Post-Disaster Recovery Processes: Disaster-Affected Communities in Fiji”

Thursday, 12 September 2019

Holiday Inn, Suva, Fiji

Time	Topic	Presenter
8.30-9.00	Registration	
9.00-9.20	Official Opening (Chief Guest: Deputy Vice Chancellor Research, Innovation and International - USP)	Prof Derrick Armstrong University of the South Pacific
9.20-9.30	Welcome & Introduction to APN Project “Climate Change Adaptation in Post-Disaster Recovery Processes”	Prof Andreas Neef University of Auckland
9.30-9.50	Assessing Indicators of Socio-Ecological Resilience in Flood-Prone Coastal Areas of the Ba Catchment Using Remote Sensing	Dr Eleanor Bruce University of Sydney
9.50-10.10	Climate Adaptation in Multi-Risk Environments: New Frameworks and Applications in Rural Communities of the Pacific Region	Prof Andreas Neef University of Auckland
10.10-10.30	Evaluation of the Environmental Livelihood Security Framework: Case Study of Fiji	Dr Natasha Pauli University of Western Australia
10.30-10.50	Discussion	Moderator: Dr Floris van Ogtrop
10.50-11.20	<i>Coffee/Tea Break (provided)</i>	
11.20-11.40	Factors of Building Disaster Resilience: An Exploratory Case Study of Small Businesses in Ba Province, Fiji	Mr Sivendra Michael University of Auckland
11.40-12.00	Drawing together Different Knowledges of Multiple Hazards under Changing Environmental Conditions: Case Studies in Fiji	Dr Natasha Pauli University of Western Australia
12.00-12.30	Learning about Links between Climate, Land and Water, Fiji	Dr Floris van Ogtrop University of Sydney
12.30-13.00	Discussion	Moderator: Dr Eleanor Bruce
13.00-14.00	<i>Lunch (provided)</i>	
14.00-14.20	Introduction to ACIAR Project “Climate-Smart Landscapes for Promoting Sustainability of Pacific Island Agricultural Systems”	Dr Eleanor Bruce University of Sydney
14.20-14.45	An Open-Source Mobile Geospatial Platform for Promoting Climate-Smart Livelihood-Landscape Systems in Fiji & Tonga	Dr Natasha Pauli University of Western Australia
14.45-15.10	Monitoring the Impacts of Climate Shocks on Ecosystem Services in the Ba Mangrove System	Dr Eleanor Bruce University of Sydney
15.10-15.30	Discussion	Moderator: Sivendra Michael
15.30-15.45	Wrap-up/Closing Remarks	Prof Andreas Neef

Funding Source: Asia-Pacific Network for Global Change Research (APN); Australian Centre for International Agricultural Research (ACIAR); University of Auckland – Faculty of Arts

Funded by



Dissemination Workshop in Suva, Fiji – List of Participants

    Dissemination Workshop				
Climate Change Adaptation in Post-Disaster Recovery Processes: Disaster-Affected Communities in Fiji				
HOLIDAY INN, SUVA, FIJI				
12 SEPTEMBER 2019				
PARTICIPANT LIST				
1.	Komal Kumar	Alliance for Future Generations - Fiji	Assistant Coordinator	karishma.komal92@gmail.com
2.	Davila Taleimaimaleya	Alliance for Future Generations - Fiji	Executive Committee Member	davila.taleimaimaleya@gmail.com
3.	Kunal Singh	USP	Teaching Assistant/Masters Candidate	singh_ku@usp.ac.fj
4.	Filipe Veisa	USP/PaCE-SD	Post Graduate Officer	veisa_f@usp.ac.fj
5.	Noa Seru	USAID Climate Ready project	Senior Policy and Finance Advisor	nseru@pacificclimateready.org
6.	Andrew Mcelroy	UNDRR	Head of Pacific Office	mcelroy@un.org
7.	Nikola Komailevuka	Pacific Islands Forum Secretariat	Office of Secretary General	nikolak@forumsec.org
8.	Anshuka Anshuka	University of the South Pacific	Tutor/Research Assistant	anshuka92@gmail.com
9.	Krishnan Narasimhan	United Nations Capital Development Fund	Deputy Program Manager	krishnan.narasimhan@uncdf.org
10.	Mikaele Livai Tamani	iTaukei Trust Fund Board (TTFB)	Project Coordinator - Active Citizen Fiji	livai@itaukeitrustfund.com.fj
11.	Dr. Amerita Ravuvu	Fiji National University	Professional Staff	amerita.ravuvu@fnu.ac.fj
12.	Shayal Kumar	Ministry of Economy	Climate Change Adaptation Officer	shayal.kumar01@economy.gov.fj
13.	Dr. Gade Waqa	Fiji Institute of Pacific Health Research, Fiji National University	Professional Staff	gade.waqa@fnu.ac.fj

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Dissemination Workshop in Suva, Fiji – List of Participants (cont'd)

14	Reginald Singh	Pacific Financial Inclusion Programme	Research Officer	reginald.singh@undp.org
15	Waisea Vosa	Fiji Business Disaster Resilience Council	Coordinator	waisea.vosa@gmail.com
16	Nacanieli Speighth	Development Agency	Policy Officer	nacanieli.bolo@fco.gov.uk
17	Praneel Pritesh	UNDP PFIP	Financial Inclusion Specialist (Fiji)	praneel.pritesh@undp.org
18	Ilisapeci Vakacegu	Ministry of Economy - Climate Change & International Cooperation Division	Climate Change Officer - Adaptation	ilisapeci.vakacegu@economy.gov.fj
19	Professor Mathew Allen	University of South Pacific	Director of Development Studies	mathew.allen@usp.ac.fj
20	Maria Nailevu	DIVA network & community	Community member	marianailevu05@gmail.com
21	Shivani Lata	IOM	Adaption Officer	shivanilata483@gmail.com
22	Vineil Narayan	Ministry of Economy	Climate Finance Specialist	vineil.narayan@economy.gov.fj
23	Viliama Tuimanu	National Disaster Management Office	Senior Policy Officer	viliame.tuimanu@govnet.gov.fj

PROJECT TEAM

	NAME	ORGANISATION	ROLE	CONTACT DETAILS
1.	Professor Andreas Neef	University of Auckland	Professor in Development Studies / APN Project Leader	a.neef@auckland.ac.nz
2.	Dr Eleanor Bruce	University of Sydney	Associate Professor School of Geosciences	eleanor.brace@sydney.edu.au
3.	Dr Natasha Pauli	University of Western Australia	Lecturer, School of Agriculture and Environment	natasha.pauli@uwa.edu.au
4.	Dr Floris van Ogtrop	University of Sydney	Senior Lecturer, School of Environment Sciences	floris.vanogtrop@sydney.edu.au
5.	Sivendra Michael	University of Auckland	PhD Student	smic013@aucklanduni.ac.nz
6.	Renata Varea	USP	Research Associate	renata.varea@usp.ac.fj

Dissemination Workshop in Ba Town, Fiji - Agenda



DISSEMINATION WORKSHOP ON

“Climate Change Adaptation in Post-Disaster Recovery Processes: Disaster-Affected Communities in Fiji”

Friday, 13 September 2019

Ba Women’s Forum Development Training Center, Ba Town, Fiji

Time	Topic	Presenter
9.00-9.30	Registration	
9.30-10.10	Traditional Opening	Tui Votua
10.10-10.30	Welcome & Introduction to APN Project “Climate Change Adaptation in Post-Disaster Recovery Processes”	Prof Andreas Neef University of Auckland
10.30-10.50	Indicators of Socio-Ecological Resilience in Flood-Prone Coastal Areas of the Ba Catchment	Dr Eleanor Bruce University of Sydney
10.50-11.20	<i>Coffee/Tea Break (provided)</i>	
11.20-11.40	Climate Adaptation Strategies among Rural Communities of the Ba Catchment	Prof Andreas Neef University of Auckland
11.40-12.00	Combining Scientific and Local Knowledge for Managing Risk: Case Studies in Fiji	Dr Natasha Pauli University of Western Australia
12.00-12.20	Learning about Links between Climate, Land and Water, Fiji	Dr Floris van Ogtrop University of Sydney
12.20-12.40	Discussion	Moderator: Sivendra Michael
12.40-13.30	<i>Lunch (provided)</i>	
13.30-13.45	Introduction to ACIAR Project “Climate-Smart Landscapes for Promoting Sustainability of Pacific Island Agricultural Systems”	Dr Eleanor Bruce University of Sydney
13.45-14.00	An Open-Source Mobile Geospatial Platform for Promoting Climate-Smart Livelihood-Landscape Systems in Fiji & Tonga	Dr Natasha Pauli University of Western Australia
14.00-14.15	Understanding the Impacts of Climate Shocks on Local Beneficiaries of Ecosystem Services in the Ba Catchment	Renata Varea University of the South Pacific
14.15-14.30	Monitoring the Impacts of Climate Shocks on Ecosystem Services in the Ba Mangrove System	Dr Eleanor Bruce University of Sydney
14.30-15.00	Discussion	Moderator: Renata Varea
15.00-15.10	Wrap-up/Closing Remarks	Prof Andreas Neef
15.10-15.30	<i>Vaka Vinaka (Afternoon Tea)</i>	

Funding Source: Asia-Pacific Network for Global Change Research (APN); Australian Centre for International Agricultural Research (ACIAR); University of Auckland – Faculty of Arts



Dissemination Workshop in Ba Town, Fiji – List of Participants



Dissemination Workshop

Climate Change Adaptation in Post-Disaster Recovery Processes: Disaster-Affected Communities in Fiji

BA WOMENS FORUM, BA, FIJI

13 SEPTEMBER 2019

PARTICIPANT LIST

	NAME	VILLAGE	ROLE	CONTACT DETAILS
1.	Anaseini Nai	Votua	Women's Leader (CEC)	840 7893
2.	Aseri Tuva	Votua	Women in Fisheries Programme	840 7893
3.	Makitalei'ia Ratuvou	Votua	Village Member	840 7893
4.	Litiana Tawai	Nawaqarua	Women in Fisheries	279 1205
5.	Karalaini Vu	Nawaqarua	Youth	297 2011
6.	Voniani Nasay	Nawaqarua	Village Member	297 2112
7.	Kirisitiana Rau	Votua	Youth	-
8.	Dionisia Dame	Nawaqarua	Women's Rep	933 2372
9.	Naomi Neisau	Natutu	Village Member	-
10.	Kalesi Buka	Natutu	Community Health Worker	229 6334
11.	Eseta Buka	Nawaqarua	Youth	-
12.	Silina Tuvou	Nawaqarua	Women's Rep	931 7231 / 927 8438
13.	Tevita Seru	Nawaqarua	Youth	738 6842
14.	Merewalesi Lesu	Nawaqarua	Women's Rep	738 6842
15.	Emali Viti Caucau	Votua	Women's Committee Member	945 5572
16.	Emali Nawalu	Votua	Youth Committee Member	277 4895
17.	Samisoni Ratukula	Votua	Youth	296 3384
18.	Asenaca Naio Tuwai	Natutu	Community Health Worker	994 5479
19.	Filomena Seru	Natutu	Women's Committee Member	878 5496
20.	Livai Qoqa	Votua	Fisheries	960 7040
21.	Atilaite Bula	Nawaqarua	Village Member	951 1965
22.	Arieta Lala	Nawaqarua	Youth Member	217 3118

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Dissemination Workshop in Ba Town, Fiji – List of Participants (cont'd)

	NAME	VILLAGE	ROLE	CONTACT DETAILS
23.	Maikeli Tuwai	Natutu	Village Member	279 2095
24.	Alipate Matuku	Natutu	Village Member	-
25.	Kiamenieli Tuwai	Natutu	Village Spokesperson	-
26.	Viliame Senileba	Natutu	Village Member	-
27.	Vatinio Ratu	Nawaqarua	Village Member	-
28.	Nuisaele Raibe	Natutu	Youth	-
29.	Luke Waqalevu	Nawaqarua	Village Member	-
30.	Sitiveni	Nawaqarua	Turaga Ni Koro	279 3502
31.	Aisake Raibe	Votua	Village Member	201 7196
32.	Iferemi Tuicake	Votua	Village Member	-
33.	Alusio Waisile	Votua	Youth	214 5493
34.	Opeti Waqa	Votua	Youth	-
35.	Madika Rabonu	Natutu	Turaga Ni Mataqali	902 5317
36.	Pio Tuwai	Votua	Village Member	836 6763
37.	Epeli Saukuiru	Votua	Village Member	203 8649
38.	Eliseo Koli	Votua	Village Member	-
39.	Pio Naueli	Votua	Village Member	-
40.	Ratu Vatenio	Votua	Turaga Ni Mataqali	274 9547
41.	Meli Naqimi	Nawaqarua	Youth Leader	861 9595
42.	Paulo Tabacece	Votua	Church Leader	297 2025
43.	Seremaia Namaloi	Votua	Village Member	848 9468
44.	Simione Navara	Votua	Turaga Ni Koro	960 7040
45.	Livai Qaqa	Votua	Youth	-
46.	Aborosio Nalesu	Nawaqarua	Youth	-
47.	Katarina Waisale	Votua	Village Member	-
48.	Mereani Naqiri	Votua	Village Member	-
49.	Makereta Ranadi	Votua	Women's Rep	-
50.	Tuidoka Tokasa	Votua	Village Member	-
51.	Sala Koto	Votua	Women's Committee Member	-
52.	Rimirani Dugu	Votua	Village Member	-

Dissemination Workshop in Ba Town, Fiji – List of Participants (cont'd)

	NAME	VILLAGE	ROLE	CONTACT DETAILS
53.	Laitia Lokuila	Votua	Village Member	-
54.	Gabereli Naborisi	Votua	Youth Committee President	830 6757
55.	Paulini Tuwai	Natutu	Women Committee Secretary	297 0174
56.	Stino Caucau	Votua	Village Spokesperson	907 9291

PROJECT TEAM

	NAME	ORGANISATION	ROLE	CONTACT DETAILS
1.	Professor Andreas Neef	University of Auckland	Professor in Development Studies / APN Project Leader	a.neef@auckland.ac.nz
2.	Dr Eleanor Bruce	University of Sydney	Associate Professor, School of Geosciences	eleanor.brace@sydney.edu.au
3.	Dr Natasha Pauli	University of Western Australia	Lecturer, School of Agriculture and Environment	natasha.pauli@uwa.edu.au
4.	Dr Floris van Ogtrop	University of Sydney	Senior Lecturer, School of Environment Sciences	floris.vanoq trop@sydney.edu.au
5.	Sivendra Michael	University of Auckland	PhD Student	smic013@aucklanduni.ac.nz
6.	Renata Varea	USP	Research Associate	renata.varea@usp.ac.fi

Dissemination Workshops in Fiji – Report by Prof. Andreas Neef (AKL)

A research team from the University of Auckland, University of Western Australia, University of Sydney and the University of the South Pacific (USP) organised two dissemination workshops in Fiji's capital Suva and in Ba Town. The workshops concluded three years of research into local climate adaptation strategies funded by the Asia-Pacific Network for Global Change Research. Local media – Fiji Times and Fijian Broadcast Corporation – reported extensively on the events.

The workshop in Suva, held at the Holiday Inn on 12 September 2019, was attended by more than 20 representatives of various government agencies and UN organisations, Members of Parliament, academics and NGO staff. In his opening address, USP's Deputy Vice Chancellor Research, Innovation and International, Professor Derrick Armstrong, expressed his sincere appreciation of the project's achievements:

“We are grateful for the work the research team has conducted over the past few years, which has built new research capacities, particularly among emerging researchers and postgraduate students in the participating universities. We do hope that the findings will support policy making with regard to climate adaptation and will continue to raise national and international attention to the vulnerabilities but also the capacities of local communities in Fiji when it comes to adapting to rapidly accelerating climatic changes.”

The researchers presented results from various fieldwork phases in the Ba River catchment, emphasising the resilience and adaptive capacity of local communities. The fieldwork had been supported by several undergraduate and postgraduate students from the Universities of Auckland, Western Australia, Sydney and the South Pacific. Sivendra Michael, a PhD student in the University of Auckland's Development Studies programme, shared findings from his study examining factors of building disaster resilience among small businesses in Ba Town.

The dissemination workshop in Ba was held at the Ba Women's Forum Development Training Center on 13 September 2019 and attended by 57 participants from three communities in the lower Ba catchment, Votua, Nawaqarua and Natutu. The workshop was formally opened with a traditional welcome ceremony and *sevusevu*, including a prayer.

The project leader, Professor Andreas Neef from the University of Auckland, acknowledged in his opening statement that these communities do not only face climate-related hazards, such as cyclones, floods and droughts, but also other risks stemming from upstream deforestation and iron-sand mining in the Ba River delta. The combination of these risks puts increasing pressure on the local mangrove ecosystem and the livelihoods and ecological services that are derived from it.

The researchers combined scientific methods with local knowledge to identify the most viable adaptation strategies. In *talanoa* sessions, community members and researchers discussed how the research could be used to convince government officials and mining corporations about the immense value that the Ba delta's vast mangrove area has for biodiversity, carbon sequestration, disaster risk management and the local economy.

The research team will continue its research in the Ba river delta under a project on climate-smart landscapes and livelihoods funded by the Australian Centre for International Agricultural Research. Community leaders expressed their gratitude to the research team for the trustful and productive work over several years and for making an effort to disseminate findings that are useful for improving local resilience and adaptive capacity.



USP's Deputy Vice Chancellor, Prof Derrick Armstrong, delivering his opening address



Dr Floris van Ogtrop from the University of Sydney discusses methods for flood & drought forecasting



Sivendra Michael presents his findings on disaster resilience among small businesses in Ba Town



Participants of the workshop at the Holiday Inn Suva pose for a group photo



Sevusevu as part of the traditional opening ceremony of the dissemination workshop in Ba



Local chiefs and workshop organisers are garlanded at the opening ceremony



Dr Eleanor Bruce, University of Sydney, presents her work on mangroves in the Ba River delta



Women share their stories and experiences during the *talanoa* sessions



All presentations are translated into the Fijian language by local interpreters



Participants of the dissemination workshop in Ba pose for a group photo before lunch

Local News Report about Dissemination Workshop in Ba Town

NATIONALNEWS

www.fijitimes.com



'Activities worsen climate effects'

Research team disseminates findings with local communities

By LUKE RAWALAI

UPSTREAM deforestation and iron-sand mining in the Ba River delta has aggravated the effects of climate change within communities in the area.

This was established by research teams from the University of Auckland, University of Western Australia, University of Sydney and the University of the South Pacific, which recently organised a dissemination workshop for three communities in the lower Ba catchment, Votua, Nawakarua and Natatu recently.

The research teams also identified the need for more community-led climate adaptation research in Fiji.

Project leader, Professor Andreas Neef from the University of Auckland said these communities did not only face climate-related hazards such as cyclones, floods and droughts, but also other risks stemming from upstream deforestation and sand mining in the Ba River delta.

"The combination of these risks puts increasing pressure on the local mangrove ecosystem and the livelihoods and ecological services that are derived from it,"

said Prof Neef.

"The researchers combined scientific methods with local knowledge to identify the most viable adaptation strategies.

"In *talanoa* sessions, community members and researchers discussed how the research could be used to convince government officials and mining corporations about the immense value that the Ba delta's vast mangrove area had for biodiversity, carbon sequestration, disaster risk management and the local economy."

Community leaders expressed their gratitude to the research team for the trustful and productive work over several years and for making an effort to disseminate findings that are useful for improving local resilience and adaptive capacity.

Meanwhile, the research teams will continue its study in the Ba River delta under a project on climate-smart landscapes and livelihoods funded by the Australian Centre for International Agricultural Research.

The workshop was attended by 57 participants — concluding four years of research into local climate adaptation strategies funded by the Asia-Pacific Network for Global Change Research.



Participants of the recent dissemination workshop held in Ba which discussed on climate change research issues. Picture: SUPPLIED

Source: Fiji Times, 28 September 2019

7.2 Funding sources outside the APN

University of Western Australia: **AUD 16,000 (US\$ 12,640)** from the UWA Research Collaboration Award to support project activities under the APN project (fieldwork in Cambodia and Fiji, writing retreat in New Zealand)

University of Western Australia: **AUD 7,900 (US\$ 6,241)** from the UWA Research Impact Grant “Integrating local and scientific knowledge for climate change adaptation in disaster-prone communities along the Mekong River, Cambodia” (financial support for the dissemination workshops in Phnom Penh and Kratie, Cambodia)

University of Sydney: **AUD 15,000 (US\$ 11,850)** from the Sydney Southeast Asia Centre to support a writing workshop in Phnom Penh, Cambodia, entitled “Climate adaptation in disaster-prone environments of Southeast Asia” that will lead to a special journal edition

University of the South Pacific, Fiji: **FJD 71,319 (US\$ 35,696)** for a graduate scholarship for Ms. Renata Varea (two-year MSc thesis project)

The University of Auckland: **NZD 78,000 (US\$ 57,371)** for a PhD scholarship for Mr. Sivendra Michael to conduct research into the disaster resilience of small & medium-sized enterprises in the Ba watershed

The University of Auckland: ~ **NZD 14,000 (US\$ 10,298)** for one roundtrip Auckland to Nadi (Fiji), one roundtrip Auckland to Honolulu (Hawaii), one roundtrip Auckland to Bangkok (Thailand), one roundtrip Auckland to Wellington (New Zealand), registration fees “Building Resilience Conference” in Auckland; summer scholarship for Ms. Lucy Benge to conduct field research in Cambodia in January 2016 and analyse data from 2015 fieldwork in Fiji

PACE-Net Plus (Pacific-Europe Network for Science, Technology and Innovation): ~ **Euro 9,000 (US\$ 10,003)** seed-funding to identify geospatial information for assessing environmental livelihood security in the South Pacific

Australian Centre for International Agricultural Research (ACIAR): ~ **AUD 7,000 (US\$ 5,530)** for one roundtrip Auckland to Nadi (Fiji), one roundtrip Auckland to Suva (Fiji), one roundtrip Sydney to Suva (Fiji), car rental in Fiji during dissemination workshop

7.3 List of Young Scientists, Postgraduate Students and Research Assistants

A. PhD and Master's students (with thesis/dissertation/research projects)

Name, gender, affiliation	Status at time of the APN project	Involvement in project activity	Current email address
Hak Sochanny (F) AKL	PhD student	Fieldwork in Cambodia (June 2016)	hsochanny@gmail.com
Sivendra Michael (M) AKL	PhD student	Fieldwork in Fiji (Sept 2018 – March 2019)	smic013@aucklanduni.ac.nz
Chhom Chanchhaya (M) RUPP	Master's student	Fieldwork in Cambodia (several phases)	chhaya22.cc@gmail.com
Renata Varea (F) USP	Master's student	Fieldwork in Fiji (several phases)	varea.renata@gmail.com
Lucy Benge (F) AKL	Master's student	Fieldwork in Cambodia (Jan 2016) and Fiji (June 2016)	lucyalicebenge@gmail.com
Kahukura Bennett (F) AKL	Master's student	Fieldwork in Fiji (Nov-Dec 2016)	kahukurabennett@gmail.com
David Abbott (M) AKL	Master's student	Fieldwork in Fiji (June 2019)	dabb958@aucklanduni.ac.nz
Joanne Wieland (F) AKL	Master's student	Fieldwork in Fiji (June 2016)	joanne.r.wieland@gmail.com
Juan Parada Diaz (M) AKL	Master's student	Fieldwork in Fiji (June 2016)	jpar470@aucklanduni.ac.nz
Mark Williams (M) UWA	Master's student	Fieldwork in Cambodia (June 2016)	markawilliams@gmail.com
Savuti Henningsen (F) UWA	Master's student	Fieldwork in Cambodia (Oct-Nov 2016)	savutih@gmail.com
Anshuka Anshuka (F) USyd	Master's student	Fieldwork in Fiji (Nov 2018)	anshuka92@gmail.com

B. BA/BSc (Honours Students), BSc students (with individual dissertations)

Name, gender, affiliation	Status at time of the APN project	Involvement in project activity	Current email address
Gracie Irvine (F) UCL/UWA	BSc student	Fieldwork in Fiji (Nov-Dec 2016)	GracieIrvine@hotmail.co.uk
Kayt Bronnimann (F) AKL	BA(Honours) student	Fieldwork in Fiji (June 2016)	kayt.bronnimanna@gmail.com
Patricia Tupou (F) AKL	BA(Honours) student	Fieldwork in Fiji (June 2016)	trishtupou01@gmail.com
Devon Hanna (F) AKL	BA(Honours) student	Fieldwork in Fiji (June 2016)	dhan091@aucklanduni.ac.nz

C. Research assistants (without individual thesis/dissertation project)

Name, gender, affiliation	Status at time of the APN project	Involvement in project activity	Current email address
Sa Kimleng (M) RUPP	Master's student	Fieldwork in Cambodia (several phases)	sakimleng@yahoo.com
Yuk Sengponleur (M) RUPP	Master's student	Fieldwork in Cambodia (several phases)	ponleur@gmail.com
Nhem Sareth (M) RUPP	Master's student	Fieldwork in Cambodia (several phases)	nhemsareth@gmail.com
Alejandro Acosta Carrizosa (M) AKL	Master's student	Fieldwork in Fiji (Nov 2015)	suramerica2003@gmail.com
Erin Thomas (F) AKL	Master's student	Fieldwork in Fiji (Nov 2018)	etho548@aucklanduni.ac.nz
Archana Chand (F) AKL	Master's student	Fieldwork in Fiji (Nov 2018)	acha985@aucklanduni.ac.nz
Jeffrey Sabour (M) AKL	BA(Honours student)	Fieldwork in Fiji (Nov 2015)	jsmi570@aucklanduni.ac.nz
Robert Varea (M) USP	BSc student	Fieldwork in Fiji (Nov-Dec 2016)	n/a
Talicia Kava Nauvi (F) USP	BSc student	Fieldwork in Fiji (June 2016, Nov-Dec 2016)	n/a
Venina Bukasasa (F) USP	BSc student	Fieldwork in Fiji (June 2016)	n/a
Vat Namon (F)	Bachelor's student	Fieldwork in Cambodia (August 2017)	vatnamon@gmail.com
Pok Kaknikar (F)	Bachelor's student	Fieldwork in Cambodia (August 2017)	pok.kaknikar@gmail.com
Hak Thidameas (F)	Bachelor's student	Fieldwork in Cambodia (several phases)	thidameas.hak@gmail.com
Rin Usar (M)	Bachelor's student	Fieldwork in Cambodia (August 2017)	usr.rin@gmail.com
Toem Sophat (M)	Bachelor's student	Fieldwork in Cambodia (August 2017)	toemsophat.nrmd@gmail.com
Srieng Leangchheng (F)	Bachelor's student	Fieldwork in Cambodia (August 2017)	leangchhengsrieng@gmail.com
Roeung Vanthet (M) RUPP	Bachelor's student	Fieldwork in Cambodia (August 2017)	vanthet.roeung@gmail.com
Eom Nakhem (M) RUPP	Bachelor's student	Fieldwork in Cambodia (August 2017)	nakhem.eom@gmail.com
Nao Vannet (M) RUPP	Bachelor's student	Fieldwork in Cambodia (Jan - Feb 2019)	vannet.nao2017@gmail.com

D. Selected Statements of Young Scientists/PhD Students/Research Students



Sochanny Hak, PhD Student,
The University of Auckland

“I participated in the APN project in the very early stage of the fieldwork whereby I provided support in facilitating focus group discussions. I have greatly benefited from the APN project on two levels. At the personal level, I had the chance to interact with the team members, organising fieldwork activities, and facilitating team reflections on the fieldwork. This experience has helped me to prepare for my PhD research project which I commenced a year after I participated in the APN project. At the professional level, I gained important knowledge and experience in organising Q-sort discussion and participatory mapping which enabled me to include some of the tools in the group discussions in my PhD research project on land grabbing. I gained great insight from applying this tool in the field during my fieldwork participation and this benefited me in preparing my fieldwork. I appreciate the opportunity that I was given to participate in the project which helped me to advance my knowledge of research methods and fieldwork facilitation. I am now in my third year of the PhD programme at the University of Auckland.”



Sivendra Michael, PhD Student,
The University of Auckland

“My involvement in the APN research project began in 2015, when I was offered the opportunity to conduct fieldwork in Ba, a province that is part of my identity and one that my parents called home 23 years ago. At first, I knew that this was not going to be an easy journey as I had felt unconnected to the communities in Ba, after having worked for large organisations for a little over 5 years. During the fieldwork in 2015 and later in 2018 when I started interviewing small business owners affected by flood disasters in Ba Town, I developed an appreciation of qualitative research approaches and how critical it was for local people’s stories to be shared. Second, I gathered a deeper understanding of how people were still struggling to cope with the aftermath of disasters. My life was shaped completely by the experiences from the field, which also enhanced my research and communication skills. I dedicate my journey as a researcher to the APN project and wish to thank all the team members for embracing me as their own. Currently, I am a third-year PhD student in the Development Studies programme of the University of Auckland.”



Mark Williams, MSc Graduate, The University of
Western Australia

“Being involved with this project was very rewarding. I was involved at the ground level trying to answer real and difficult problems that the community is facing. This gives me a strong sense of value in the work. The experience has explicitly shaped my future pathway.

I am now working in the Emergency Management space within Western Australia at the state level, providing geospatial support for potential and unfolding emergencies. We tackle issues of hazard, exposure, vulnerability, and impact, as well as climate change, on a daily basis. The experience gained in the APN project has given me a strong base to further extend and shape my career in this field.”



Anshuka Anshuka, MSc Graduate, The University of Sydney

“This project gave me an opportunity to better understand the inherent conditions which make Pacific island countries more vulnerable to disasters in comparison to other nations. Vulnerability in Pacific island countries is a result of economic, political, social and environmental complexities leading to increased hazard risks. This gave me prospects to translate my drought forecasting work to the needs of people at the grassroots level.

Presently, I am undertaking doctorate studies at the University of New South Wales in Australia where I will be looking at increasing resilience from urban disasters in Pacific neighbourhoods which is directly in line with the APN project. I also wish to apply a qualitative approach from the skills gained through the APN project to develop a flood risk management framework for Fiji.



Renata Varea, MA Graduate, The University of the South Pacific

“Throughout the entirety of this project I learnt a lot of new skills and to grow within the various fields of research and project work. Working in this project has helped me gain knowledge around planning work for projects and the importance of this in research. I have gained experience in working with rural communities and being able to appreciate the importance of local knowledge and the value of perspectives from grassroots people. This project has aided me in my MA in Geography and provided invaluable mentorship throughout my journey and for this I am truly grateful. Through this project I was introduced to academics from various universities in New Zealand and Australia and through these networks I have been able to further my passion for research work.

I am currently employed as a Research Associate at the University of the South Pacific under another project. Without this project I would not have been exposed to interdisciplinary research and many wonderful academics who have guided me and helped me pave a better career in research and teaching.”



David Abbott, MA student, The University of Auckland

“Through the APN project, I have been afforded a valuable opportunity to cultivate various personal and academic skillsets that have significantly contributed towards research for my MA in Development Studies. Most important for me, has been experiencing the organisational and planning abilities required to engage in academic research at both a local and international level, as well as navigating the differing cultural sensitivities that come with that. Additionally, with this being my first large-scale independent research venture, the experiences with the APN project have also taught me the rewards that come from perseverance and flexibility in the face of unforeseen academic challenges.

I am presently completing my MA thesis in Development Studies. My research seeks ways in which transnational Pacific Island communities can be better understood in order to generate more effective disaster awareness and preparedness initiatives. I am also employed part-time as a research assistant with Auckland Emergency Management (Auckland Council) and engage with Pasifika communities in order to help develop a more culturally appropriate disaster awareness programme in Auckland.”



Lucy Benge, MA Graduate,
The University of Auckland

“In 2015 I joined the APN project as a summer research scholar which explored community methods of adapting to climate-induced disasters in Fiji and Cambodia. This project took me to Cambodia for three weeks where I worked with a group of students from the Royal University of Phnom Penh to carry out initial interviews with families in Kratie province who had been repeatedly impacted by flooding.

In 2016 this project also provided me the ability to carry out my own research in Fiji for my Master’s thesis on climate-induced migration. In October 2016, I was given the opportunity to present a research paper at the 2016 ‘Development in Question’ conference at Cornell University. Presenting at Cornell was altogether one of the most valuable and memorable experiences.

The opportunities provided by the APN project helped to provide the inspiration that has led me to what I now do in my work as Capability and Public Awareness Advisor with Auckland Emergency Management.”



Savuti Henningsen, MSc Graduate,
The University of Western Australia

“Personally, I gained a great deal of knowledge and skills throughout the entirety of my involvement with the APN project. In my prior studies I had never been exposed to the logistics and planning that goes into research and fieldwork and this project allowed me to get first-hand experience. I also feel that this project enhanced my communication skills, as well as my cultural awareness. This project also aided in my obtaining an MSc in Environmental Science from UWA with Distinction for which I am truly grateful.

Currently, mid 2019, this project has directly lead to my current employment. At present, I am involved in teaching and demonstrating six units across the University of Western Australia and Murdoch University in Perth. Without this project I would not be in any way qualified for the current positions that I am involved in and I would not have had the privilege of meeting many of the academics who now employ me.”



Juan Parada Diaz (pictured right), MA Graduate, The University of Auckland

“The experience of living in a couple of Fijian villages for two weeks gave me a very personal insight into the daily life and culture of the Fijian people. It was a really rewarding and enriching opportunity to talk to them directly about their experience with Cyclone Winston and the process of rebuilding their houses and livelihoods. It highlighted the importance of community and collaboration, a process that in their case is closely related to the religious beliefs they share. I had the chance to film a lot of it and discover so much more during the process of editing the documentary.

Doing this documentary as part of my Master’s in Screen Production has also helped in my current work as news editor for a New Zealand TV channel.”

E. Selected Statements of Research Assistants

 <p>Vat Namon, BA Graduate, Royal University of Phnom Penh</p>	<p>“Frankly, I have learnt so many things in the project activities. The knowledge I have gained from the project has led me to a new version of myself. There were plenty of things that I had to learn to prepare and get ready for the fieldwork activities, including logistics, management planning, administration process and so forth. The fieldwork built my communication skills through interactions with local people and other participants from different cultures. This helped me better understand people from different backgrounds. After the fieldwork, I learnt how to analyse data and write a report. Also, from the project, I could see a change in my ability to handle workloads.</p> <p>I have been working as a financial analyst with an international NGO called GRET Cambodia since January 2019. As a fresh graduate with little work experience, it was hard for me to seek a decent job. But my involvement in the APN project provided me with a good opportunity to learn how to get work done and be more mature in doing tasks and figuring out my potential. This helped me get the job.”</p>
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 <p>Eom Nakhem, BA Graduate, Royal University of Phnom Penh</p>	<p>“I was very glad to be a part of this project. It was such a valuable opportunity for me to apply the theories I have learned from class to real society, especially the research skills. The research experience in this project shaped my career and made me gain deep research knowledge. Besides academic benefits, cultural exchange was also a wonderful experience for me to learn how to interact with those from different cultures. After my involvement with this APN project, I worked as a research assistant with a researcher from Chiang Mai University, Thailand. This was due to my research experience in the project.</p> <p>Currently, I am working as a contract officer with the Department of Policy at the Ministry of Education, Youth, and Sport. Working here, I still keep doing research and improving my research skills although in the field of education. I can say that without participation in this project, I would not have built a strong research foundation. Importantly, I would not have been qualified for the current employment if I did not get involved in this learning experience.”</p>
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 <p>Hak Thidameas (second from left), BA Graduate, Royal University of Phnom Penh</p>	<p>“Through the fieldwork in the APN project in Cambodia, I have gained plenty of experiences, most importantly the planning of the research. I am planning to apply for a Master’s study, thus the experiences that I have gained from the project will be crucial for me, especially regarding how to properly do research.</p> <p>I am currently working for a government agency that works to improve the environment and sustainable development. This work would have been hard for me without gaining my advanced understanding of environmental and development aspects from the APN project that I truly appreciate and am grateful for.”</p>
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Pok Kaknikar, BA Graduate,
Royal University of Phnom Penh

“Personally, I have learnt a lot during this project. The knowledge I have gained from the project is related to my current job. There were many things I have learnt before, during and after the fieldwork, including time management, administration, and logistic preparation. In addition, I have improved my communication skills with villagers, group work skills, and knowledge about the fieldwork process. Finally, I have learnt to write a report for the project.

Now, I am working as an administrator at the Faculty of Development Studies at the Royal University of Phnom Penh and also as a part-time assistant in a research project at the Faculty. This APN project has led me to my current job because during the project I have learnt the administration process and communication skills. Without this project, I would not have been able to work in my current jobs.



Archana Chand, MA student,
The University of Auckland

“My involvement in the APN project was brief but the experience was thoroughly enriching, providing an opportunity to put into practice research skills learnt in class. Together with Professor Andreas Neef and his team, I conducted six interviews during the fieldwork in rural Ba province of Fiji. Prior to studying at the University of Auckland, in my eight years of career as an economist for the Reserve Bank of Fiji, I never once had the opportunity to participate in a field research that sought direct feedback from affected individuals. The personal intricacies of such consultations are usually nullified in the secondary statistics that I am accustomed to working with in my professional career. Personally, the exposure created awareness for the need to amalgamate qualitative research and quantitative economic analysis in order to create meaningful policies in the country. Upon completion of my studies in November and returning to my employment, I wish to impart this very insight.”



Erin Thomas, MA student,
The University of Auckland

“I learned a lot on the APN fieldwork in Ba, Fiji in November 2018. Although I had some experience in development research, this was my first time involved with research on climate change. I learned a lot about conducting interviews in a different language, using mixed methods and GIS, and navigating the everyday realities of working in the field. The project helped set me up for the fieldwork of my master's thesis where I felt much more confident in my interview and cross-cultural communication skills. Because of this project, I have many more research tools to draw from.

Currently, I am working on my Master's thesis and plan to finish in July 2020. By getting involved with climate change research in the Pacific, this project has also allowed me to secure a full-time position with the International Center for Advocates Against Discrimination, an international NGO, upon completion of my master's programme. I am so grateful for the opportunity to participate in this fieldwork and everything I learned from the academics on the trip.”

F. Other Student Statements

Joanne Wieland, participated in three-week fieldwork in Fiji in July 2016 and completed a MA dissertation

“I felt very privileged to be able to travel to Fiji to speak with people about the effects of climate change on their everyday life. People were so willing to share their life with us, to share their experience of Cyclone Winston, and other natural disasters. Through these discussions we were able to hear about the risks that people perceived and hear of the numerous ways they are adapting in order to fight against the increased risk of cyclones and floods. The people we met epitomize resilience, there is a lot to be learnt from them.”

Devon Hanna, participated in three-week fieldwork in Fiji in July 2016 and completed a BA(Honours) dissertation

“Having the chance to engage in real on-the-ground research whilst still doing a Bachelor of Arts Honours was an amazing opportunity. Not only was it an eye-opening experience to be able to see the tangible effects of climate change on people's everyday livelihoods, but it meant that all of the discussions that we have had in class really came to life in front of us.”

Kayt Bronnimann, participated in three-week fieldwork in Fiji in July 2016 and completed a BA(Honours) dissertation

“I was so grateful to have had the chance to meet the people of Fiji and hear their stories. Everyone was so welcoming and open, willing to share their experiences and include us in their daily lives. What struck me most was the strong sense of community — and we were made to feel a part of this community, too.”

Patricia Tupou, participated in three-week fieldwork in Fiji in July 2016 and completed a BA(Honours) dissertation

“As a student of Pacific descent, it is important to me to extend postgraduate study outside of the classroom. Going to Fiji meant that I was able to reflect on what I have learnt through our coursework, in a way that brought the tensions within development theory to life. As a Tongan I have strong familial and cultural ties to Fiji, so it was great to be able to spend time in Fiji thinking about how my culture ties into the issues of climate change and migration.”

Alejandro Acosta Carrizosa, participated in two-week fieldwork in Fiji in November 2015

“I am very happy that I was part of that project and thankful for all the opportunities that it provided me, particularly in terms of fieldwork experience in a foreign cultural context.”

7.4 Glossary of Terms / Acronyms / Abbreviations

ACIAR	Australian Centre for International Agricultural Research
AKL	The University of Auckland, New Zealand
APN	Asia-Pacific Network for Global Change Research
GIS	Geographic Information System
HH	Household
iTaukei	Indigenous Fijians
IPCC	Intergovernmental Panel for Climate Change
MODIS	Moderate-Resolution Imaging Spectroradiometer
NCDD	National Committee for Decentralisation and Deconcentration (Cambodia)
NDMA	National Disaster Management Act (Fiji)
NDMO	National Disaster Management Office (Fiji)
NDMP	National Disaster Management Plan (Fiji)
NGO	Non-Governmental Organisation
NOAA	National Oceanic and Atmospheric Administration (United States)
Q-Sort	A specific research technique that combines qualitative and quantitative elements
RS	Remote Sensing
RUPP	Royal University of Phnom Penh
SWAT	Soil and Water Assessment Tool
Talanoa	Pacific research methodology that involves informal communication and storytelling
TC	Tropical Cyclone
USP	The University of the South Pacific
USyd	The University of Sydney
UWA	The University of Western Australia
WUN	Worldwide Universities Network

7.5 Selected Conference Abstracts

Abstract for Institute of Australian Geographers Conference, Hobart, Tasmania, 9-13 July 2019.

Title: Climate change impacts and adaptation strategies in rural Cambodia: perceptions from flood-affected communities in Kratie Province

Authors: Bryan Boruff, Andreas Neef, Sochanny Hak, Siphat Touch, Chanrith Ngin

Abstract: Most studies and development interventions considered climate change adaptation and post-disaster recovery processes as two separate issues. Yet there is increasing evidence that post-disaster recovery can only be successful and sustainable when it not only restores the pre-disaster livelihood situation, but evokes long-term efforts to enhance adaptive capacities to cope with future hazards and environmental risks. As such we aim to determine the factors that enhance or constrain resilience and adaptive capacities for several Cambodian communities impacted by annual flooding and growing environmental risks.

Here we present results from Q-sort activities conducted in four agriculturally based communes situated along the Mei Kong River, Kratie Province. Two separate Q-sort activities were conducted in small group settings to: i) understand perceptions of, and impacts from, climatic changes and related hazards, and ii) associated coping and adaptation strategies. *Consensus* statements show that whilst the interplay between drought and flooding is causing increased impacts from these two hazards, floods are still perceived to provide benefits to local people. *Distinguishing* statements however, highlight how the perceived causes of environmental change are nuanced and coping strategies used by each must be interpreted within the wider context of the community's livelihood risks, vulnerability and resilience.

Abstract for Institute of Australian Geographers Conference, Brisbane, Australia, 12-14 July 2017.

Title: Applications of the 'Environmental Livelihood Security' framework: Three case studies from Asia-Pacific

Authors: Bryan Boruff, Eleanor Bruce, Andreas Neef, Eloise Biggs, Floris van Ogtrop Natasha Pauli

Abstract: The United Nations' Sustainable Development Goals call for the efficient use of resources in an effort to promote sustainable consumption and production. Central to this objective is the water-energy-food (wef) nexus and the efficient use of these resources for enhancing wellbeing and quality of life. However, the nexus concept is often criticized as 'an economic project' or 'engineering exercise' in scarcity management whereby humans are removed from the equation. The importance of understanding the relationship between quality of life, livelihoods and the water-food-energy nexus is well recognised however, there are a paucity of approaches that define the inter-linkages between natural resource supply and human demand on the environment. Environmental Livelihood Security (ELS) is a new approach that integrates the water-energy-food nexus with the sustainable livelihoods framework providing a holistic method for understanding the relationship between wef resources and the livelihoods they sustain.

Originally conceived as an approach for guiding sustainable development in Southeast Asia and Oceania, ELS has remained conceptual in nature. This paper illustrates the application of the ELS framework to three case studies: the Western Australian Wheatbelt, the Ba watershed in Fiji, and the Prek Prasob District of Cambodia. Through a series of in-depth community studies, participatory mapping exercises, and expert workshops the respective water-energy-food systems of each were described. The relationship between nexus resources and livelihoods were then identified as well as a range of pressures influencing the coupled systems. The results provide an illustration of how the ELS concept can be applied as a baseline for understanding human use systems, as a tool for identifying the impacts of resource scarcity on livelihoods and an approach for monitor progress in meeting development targets.

Abstract for New Zealand Geographical Society and Institute of Australian Geographers Conference, Auckland, New Zealand, 11-14 July 2018.

Title: Drawing together different knowledges of flooding under changing environmental conditions: Case studies in Fiji

Authors: Natasha Pauli, Gracie Irvine, Bryan Boruff, Eleanor Bruce, Floris van Ogtrop, Renata Varea, Eberhard Weber, Andreas Neef

Abstract: People living in locations that regularly experience floods may hold detailed knowledge of flood flows, duration and intensity. Local knowledge can augment hydrological models, and identify land uses, livelihoods and settlements that are most affected by flooding. Models of hydrological flows and flood patterns can provide information on future scenarios under environmental change that are yet to be experienced. Drawing on both sets of knowledge can identify areas of complementarity and discord, which can aid development of locally appropriate adaptation strategies. In this research, we present a multidisciplinary, mixed methods approach to understanding past and future flood patterns along the Ba River in Ba Province, Fiji. Participatory mapping techniques were used to discuss and visualise environmental hazards, impacts and adaptation strategies in four communities, alongside hydrological modelling. Understanding local responses to floods is crucial, as modelling suggests extreme events may become more frequent in the future for the Ba watershed.

Abstract for Annual Meeting of American Association of Geographers, San Francisco, USA, 29 March - 2 April 2016.

Title: Application of the 'Environmental Livelihood Security' Framework: Three case studies in vulnerable regions of Australia, Cambodia and Fiji

Authors: Bryan Boruff, Eleanor Bruce, Andreas Neef, Ellie Biggs, Julia Horsley, Floris van Ogtrop, Kellie McNeill, Natasha Pauli, Heather Price

Abstract: The United Nations' Sustainable Development Goals call for the efficient use of resources in an effort to promote sustainable consumption and production. Central to this objective is the water-food-energy nexus and the role efficient use of these resources play in increasing quality of life. The importance of understanding the relationship between quality of life, livelihoods and the water-food-energy nexus is well recognised, yet until recently there has been a paucity of approaches that define the inter-linkages between natural resource supply and human demand on the environment at various scales. Environmental Livelihood Security (ELS) is a new approach that integrates the water-energy-food nexus with the sustainable livelihoods framework providing a holistic method for measuring progress in achieving sustainable development outcomes across multi-scale systems. Originally conceived as an approach for guiding sustainable development in Southeast Asia and Oceania, until now ELS has remained conceptual in nature. This paper illustrates the application of the ELS framework to three case studies: the Western Australian Wheatbelt, the Ba watershed in Fiji, and the Prek Prasob District of Cambodia. Through a series of workshops with experts and in-depth community studies, the respective water-food-energy systems were described. The relationship between nexus resources and livelihoods were then identified as well as a range of pressures influencing the coupled system. The results provide a preliminary illustration of how the ELS concept can be applied as a baseline for monitoring progress in meeting development targets for enhancing both the efficiency and equity of development outcomes.

Abstract for the International Conference “Development in Question: Challenges for the 21st Century”, Ithaca, USA, 6-8 October 2016.

Title: Disaster as ‘Development Opportunity’: An Analysis of Institutionalized Disaster Management in the Global South

Authors: Lucy Benge, Andreas Neef and Reuben Garrett-Walker

Abstract: Disasters are increasingly framed as unique opportunities to ‘build back better’, to make communities more ‘resilient’ and to address pre-existing ‘vulnerabilities’. This requires the linking of short-term relief efforts with long-term development objectives, thus perpetuating a particular idea of ‘progress’ and ‘safety’ defined by development professionals and disaster experts. At the same time, disaster risk reduction strategies emphasize active community participation, local knowledge inclusion and ownership of the mitigation and recovery process. This creates tension between attempts to standardize disaster management strategies while valuing diverse needs, interests and knowledge. Efforts to create a global ‘disaster-resilient culture’ are at odds with diverse, culturally situated understandings of risk, opportunity and development. The shift toward understanding disaster as ‘development opportunity’ has implications for how and when disaster is acted upon. This requires an examination of whether the post-disaster context is the right space for implementing long-term social change. Through a critical discourse analysis of three United Nations disaster mitigation frameworks from 1994 to 2015, we examine, first, how disaster has been constructed as an ‘opportunity for change’ and how the direction of change has been determined by structures of power, particular kinds of knowledge and dominant development paradigms. We then present examples from recovery processes among disaster-affected communities in Thailand, Indonesia and Fiji to illustrate how attempts of government agencies, NGOs, corporations and donor organizations to ‘build back better’ run the risk of perpetuating particular technocratic ideals of ‘improvement’ while creating new vulnerabilities among the ‘target groups’. We conclude that disaster recovery efforts should avoid co-opting ‘local’ ideas into dominant development ideologies and imposing universal standards of resilience and risk reduction, looking instead at how normative ideas of ‘better’ can be challenged and reconstructed through the introduction of alternative concepts of ‘human security’, ‘change’ and ‘progress’.