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Walter Leal Filho *Editor*

Climate Change Adaptation in Pacific Countries

Fostering Resilience and Improving the Quality of Life

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Preface

The Pacific region is affected by climate change at different levels. According to the 5th Assessment Report by the Intergovernmental Panel on Climate Change (IPCC), current and future climate-related drivers of risk for small islands during the twenty-first century, include sea-level rise, tropical and extratropical cyclones, increasing air and sea surface temperatures, and changing rainfall patterns, among others.

The future risks associated with these drivers, according to the IPCC, include loss of adaptive capacity and damages to ecosystem services critical to lives and livelihoods in small islands. In addition, sea-level rise is mentioned as posing one of the most widely recognized climate change threats to low-lying coastal areas on islands and atolls. Furthermore, given the dependence of island communities on coral reef ecosystems for a range of services including coastal protection, subsistence fisheries, and tourism, there is high confidence that coral reef ecosystem degradation will negatively impact island communities and livelihoods. Given the inherent physical characteristics of small islands, AR5 reconfirms the high level of vulnerability of small islands to multiple stressors, both climate and non-climate. These elements illustrate the fact that in addition to the necessary measures in the field of environmental mitigation, adaptation approaches are urgently needed.

The above state of affairs illustrates the need for a better understanding of how climate change affects the Pacific region and for the identification of processes, methods, and tools which may help the countries in the region to adapt. There is also a perceived need to showcase successful examples of how to cope with the social, economic, and political problems posed by climate change in Pacific countries.

This book, which contains a set of papers presented at the Symposium on Climate Change Adaptation in the Pacific Region, held in Fiji in July 2016, serves the purpose of showcasing experiences from research, field projects, and best practice in climate change adaptation in Pacific countries, which may be useful or implemented in other countries and regions. A further aim of this book is to document and disseminate the wealth of experiences available today.

This book is divided into four parts:

Part I, titled "Implementing Climate Change Adaptation in Rural Areas and Communities," entails a set of papers showing how climate change is being handled in urban and rural areas.

Part II, titled "Climate Change Adaptation, Resilience and Hazards," describes a variety of initiatives showing how Pacific countries are handling many problems associated with climate change and many hazards associated with it.

Part III, titled "Information, Communication, Education and Training on Climate Change," describes some of the education and information initiatives taking place across the region.

Part IV, titled "Trends on Climate Change Adaptation," contains some papers outlining some of the operational aspects and their implications for policy-making.

We thank the authors for their willingness to share their knowledge, know-how and experiences, as well as many peer reviewers, who have helped us to ensure the quality of the manuscripts.

Enjoy your reading!

Hamburg, Germany
Winter/Spring 2017

Walter Leal Filho

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Implementing Climate Change Adaptation in Rural Areas and Communities

Chapter 1
Implementing Climate Change Adaptation Interventions in Remote Outer Islands of the Pacific Island Region

Gillian Cambers, Pasha Carruthers, Titilia Rabuatoka, Sanivalati Tubuna and Juliana Ungaro

Background

Climate change is one of the most serious threats to sustainable development in the Pacific Island countries, and indeed threatens the survival of atoll countries and communities. For the purposes of this paper climate change is defined as per the Intergovernmental Panel on Climate Change (IPCC) and includes changes in the climate due to anthropogenic emissions of greenhouse gases as well as climate variability (IPCC 2014).

The Pacific Island countries span a large area of the Pacific Ocean from around 15°N to 23°S of the equator and are immensely diverse in terms of their history, geography, climate, natural resource base and culture. Geologically they range from high volcanic islands to low lying atolls just a few metres above sea level. Many of the countries consist of archipelagos spread across several degrees of latitude and longitude, e.g. the Federated States of Micronesia (FSM) has 607 islands which extend from latitude 1°S to 14°N, and longitude 135°E to 166°E. The 14 Pacific Island countries are considered Small Island Developing States (SIDS), a group of countries that share similar sustainable development challenges including small populations, limited resources, remoteness, susceptibility to natural disasters, vulnerability to external shocks, dependence on international trade, and fragile environments. SIDS was first recognized as a distinct group of developing countries at the United Nations Conference on Environment and Development in June 1992. Table 1.1 illustrates some of the variability between the countries.

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Table 1.1 Characteristics of the Pacific Island countries (Adapted from: Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation 2011)

Country	Land area (km^2)	Number of islands larger than 10 km^2	Exclusive economic zone area (million km^2)	Maximum height above sea level (m)	Population (2010 estimate except Vanuatu)	Languages	Government
Cook Islands	240	6	1.800	652	11,400	English, Maori	Self-governing country in free association with New Zealand
Federated States of Micronesia	702	7	2.978	791	111,364	English, Chuukese, Pohnpeian, Yapese, Kosraean, Ulithian, Carolinian	Independent with free association arrangements with USA until 2023
Fiji	18,333	37	1.300	1,323	844,420	English, Fijian, Hindi	Independent state
Kiribati	811	18	3,600	87	100,835	I-Kiribati, English	Democratic republic
Marshall Islands	181	6	2.131	3	54,439	Marshallese, English	Republic in free association with the USA until 2023
Nauru	21	1	0.320	70	9,976	Nauruan, English	Republic with parliamentary system
Niue	259	1	0.390	68	1,470	Niuean, English	Free association with New Zealand
Palau	488	4	0.629	214	20,518	Palauan, English	Republic in free association with USA
Papua New Guinea	462,243	20	3.120	4,697	6,744,955	Pidgin, English + more than 700 other languages	Independent state
Samoa	2,935	2	0.120	1,860	183,123	Samoa, English	Independent state
Solomon Islands	28,785	26	1.340	2,447	549,574	English, Pidgin + 87 other languages	Independent state
Tonga	649	10	0.700	1,030	103,365	Tongan, English	Independent kingdom
Tuvalu	26	0	1.300	5	11,149	Tuvaluan, English	Independent state
Vanuatu	12,281	30	0.664	1,700	234,023 (2009)	Bislama, French, English + 105 other languages	Republic

Yellow shaded countries are those discussed in this paper

People living in the Pacific Island countries are already experiencing changes and variability in their climate such as shifts in rainfall patterns, higher air and sea surface temperatures, changes in extreme events and rising sea levels (Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation 2011). For example in the Pacific Island countries, air temperatures rose between 0.08 and 0.20 °C per decade over the past 50 years; sea level rise varied across the Pacific and ranged between 3 and 12 mm year^{-1} over the period 1993–2009, which is higher than the global average; ocean acidification increased (with aragonite saturation values generally falling to around or below 4 since the mid-1990s).

These changes are affecting peoples' lives and livelihoods, as well as important industries, such as agriculture, fisheries and tourism. In recognition of the seriousness of the adverse effects of climate change, the Pacific Island countries and territories developed the Pacific Islands Framework for Action on Climate Change (PIFACC) 2006–2015 (SPREP 2006) to build their resilience to the risks and impacts of climate change. A new framework for the region is currently under development for the post-2016 period.

The PIFACC developed an action plan around the following principles:

- Implementing adaptation measures
- Governance and decision-making
- Improving our understanding of climate change
- Education, training and awareness
- Contributing to global greenhouse gas reduction
- Partnerships and cooperation

The PIFACC provided an overall framework for the many climate change activities, projects and programmes implemented by national governments, regional and international organisations, non-governmental organisations (NGOs) and civil society over the decade. A review of the PIFACC was presented at the Pacific Climate Change Roundtable in May 2015 (SPREP 2015).

For the purposes of this paper climate change adaptation is defined as "The process of adjustment in natural or human systems in response to actual or expected climatic stimuli or their climate and its effects, which moderates harm or exploits beneficial opportunities" (IPCC 2014). Over the period of the PIFACC there have been numerous climate change adaptation interventions ranging from community-based to multi-country initiatives and important outcomes have been achieved and lessons have been learnt.

This paper will focus particularly on some climate change adaptation activities and outcomes of the Global Climate Change Alliance: Pacific Small Island States (GCCA: PSIS) project over the period 2011–2015 (GCCA: PSIS 2015). These activities will be described and discussed through the lens of outer islands development.

The GCCA: PSIS project was funded by the European Union (EU) and implemented by the Pacific Community (SPC) in collaboration with the Secretariat of the Pacific Regional Environment Programme (SPREP). The overall objective of the GCCA: PSIS project was to support the governments of nine Pacific smaller island states, namely Cook Islands, FSM, Kiribati, Marshall Islands, Nauru, Niue, Palau, Tonga and Tuvalu, in their efforts to tackle the adverse effects of climate change.

The project approach was to assist the nine countries design and implement practical on-the-ground climate change adaptation demonstration projects in conjunction with mainstreaming climate change into line ministries and national development plans. The rationale was that this would help countries move from an *ad hoc* project-by-project approach towards a programmatic approach underpinning an entire sector. The nine countries chose their own sectors based on their national priorities and plans.

Six of the nine countries chose to focus their demonstration projects in outer islands. National partners felt that outer islands had been relatively disregarded in the past with most of the projects being centred in the main island of an archipelago. Thus outer islands, where the need was often greater, had been somewhat neglected.

This paper discusses several on-the-ground climate change adaptation interventions that were implemented in outer island communities in different countries through the GCCA: PSIS project and to analyse the challenges and how they were addressed. The purpose of this paper is to show to development partners working in the Pacific and to the research community that climate change adaptation interventions can be successfully implemented in outer island communities provided the constraints are fully recognised and accommodated in the conceptualisation and planning stages.

Methodology

The methodology for designing and implementing the demonstration projects consisted of a multi-step process. At the start of the project climate change profiles were prepared for each country; these included the physical, historical and socio-economic background for each country, the national and sector planning policies, the most up-to-date climate change projections for the country, and climate change adaptation interventions undertaken in the previous five years. These country profiles were used to analyse gaps and needs. This was followed by a consultation phase during which countries used their strategic and development planning policies, plans and budgets to identify a specific sector for the project focus. Project concept notes were prepared and reviewed, followed by further consultations during which national stakeholders designed the elements of their demonstration project. Finally project design documents were prepared describing the activities, and including logframes, budgets, risk matrices and exit strategies. This entire process took on average 12–18 months.

Once the project design document was approved, implementation began. Typically this included recruitment of project staff; procurement of equipment, goods and services; implementation of the intervention; and ongoing monitoring and evaluation cumulating in the capture and exchange of lessons learnt. On average this phase took two or more years.

One of the major limitations of this paper is that there has been insufficient time to monitor the impact of the interventions, as implementation in most countries continued right up to the project end date. A further 3–5 years are required before the impact of the interventions can be fully assessed. This is a major challenge experienced by many development projects in the Pacific and elsewhere, in that implementation usually continues right up to the end of the project, and in many cases beyond, thereby requiring the need for project extensions. Despite this lack of objective and thorough impact analysis, it is still useful to discuss the interventions in terms of the lessons learnt and what were perceived as best practices during the implementation.

Implementing Climate Change Adaptation Activities in Pacific Outer Islands

Five case studies covering six different countries will be described to illustrate the challenges involved and how they were met in delivering project activities to outer islands.

Managing Marine Resources in the Northern Group of the Cook Islands

The Cook Islands is made up of 15 islands lying between 8°S and 23°S in the south Pacific Ocean and divided into a southern group and a northern group. The GCCA: PSIS climate change adaptation project focused particularly on the Manihiki atoll in the northern group. Up until the beginning of the 21st century there used to be a vibrant pearl farming industry in the Manihiki Lagoon (Ponia et al. 2000), however, following a severe cyclone in 1997 and outbreaks of pearl oyster disease relating to intense El Niño and La Niña events, export production of pearls fell from a peak of US$ 9 million in 2000 to US$ 3 million in 2003 (Ponia 2010; Diggles and Hine 2001). The decline was also related to poor farming practices.

The project sought to strengthen real time environmental monitoring, including water quality so as to provide information that will assist pearl farmers improve their farming practices, and avoid disease outbreaks and stress to the oysters due to present environmental conditions and future projected conditions under climate change.

One of the planned activities was to establish an automatic water quality monitoring buoy in the lagoon to provide real time information to the pearl farmers. While this was achieved to a limited extent it was not as successful as hoped. One of the reasons was the remoteness of Manihiki, which lies 1,200 km from the main island, Rarotonga, and is served by an infrequent and somewhat irregular shipping schedule and a small 8-seater plane which only flies the 4 h trip once every two weeks. Added to which Cook Islands, with a population of around 15,000 people, does not have the skills in-country for maintaining and servicing such equipment. Routine maintenance, such as calibration of sensors, involves the equipment being sent off-island with resultant long delays and breaks in data records.

An alternative approach was adopted which proved to be more successful and this involved stationing a marine biologist from the Cook Islands Ministry of Marine Resources full-time on Manihiki to work with the communities and pearl farmers to regularly monitor water quality with mobile probes and to advise on practical ways to improve farming practices on a day-to-day basis. Monitoring results are regularly posted on community noticeboards and water quality alerts are sent out to the farmers via emails and text messages on mobile phones e.g. when water temperatures are high and the oyster shells should not be disturbed.

This simpler type of technology combined with a more personal approach is providing some positive results e.g. one pearl farmer noted that receiving the information not to handle the shells between January and April 2016 because of the high sea surface temperatures helped her plan to spend that period in Rarotonga and focus on pearl marketing.

Providing Clean Drinking Water to Outer Island Communities in Kiribati

In Kiribati, which consists of 33 scattered low-lying islands, mainly atolls, dispersed over 3.5 million km^2 in the central Pacific Ocean, national stakeholders selected climate change adaptation and health as the focus for its climate change adaptation project. Changing rainfall patterns as a result of climate change and population pressures are leading to the contamination of the freshwater lens in the islands and this is the main source of drinking water. As a consequence Kiribati has one of the highest rates of childhood mortality from diarrhoea in the Pacific (WHO and UNICEF 2015).

In the main centre of population, South Tarawa, a low-cost method for water disinfection, named SODIS (Solar Disinfection), was trialled through the GCCA: PSIS project and is currently being rolled out in the outer islands where it is particularly appropriate. Solar water disinfection involves placing contaminated water in plastic PET (polyethylene terephthalate) 1.5 l bottles on a reflective surface in direct sunlight for 6 h, after which the water is drinkable. It is particularly effective in reducing rates of diarrhoea (Ungaro 2016), and results in considerable cost savings—up to AU$ 300 per household per year—as residents no longer have to boil water. This approach was initially trialled in one of the poorest communities in Bairiki, the capital of South Tarawa. After it was shown to be successful, from both a social and scientific perspective, SODIS was launched nationally in March 2015.

With the help of trained community water champions, SODIS was introduced in Bairiki over a six month period starting in October 2014 and continuing through to March 2015. Figure 1.1 shows that there was a substantial drop in the number of reported diarrhoeal cases after the introduction of SODIS.

Since then SODIS has been rolled out in three outer islands, by the Ministry of Health and Medical Services and the Kiribati Adaptation Programme—Phase III (funded by the World Bank) which has integrated SODIS into their planned project interventions. This also illustrates the importance of partnerships for sustainability of project activities beyond donor timeframes.

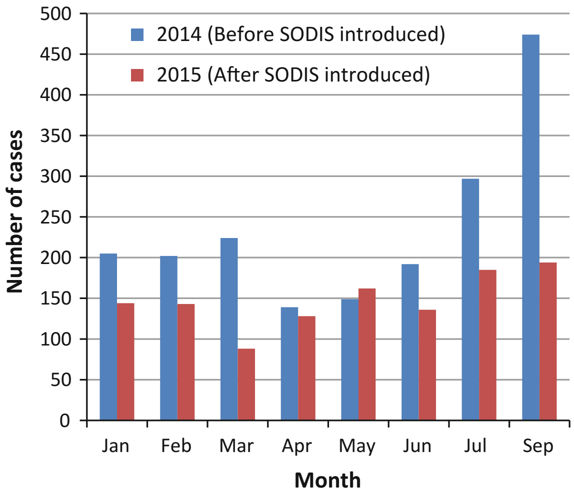

Fig. 1.1 Number of cases of diarrhoea *before* and *after* the introduction of SODIS (*Data source* Bairiki Health Clinic, Kiribati, 2015)

Enhancing Water Security in the Outer Islands of FSM and Palau

Palau is located in the northwest tropical Pacific, 800 km east of the Philippines and has over 500 islands, most of which are the small, uninhabited Rock Islands. Only nine islands are currently inhabited and these are divided into 16 states. FSM lies to the northeast of Palau, and as already described, has over 600 islands divided into four states, and around 65 islands are populated.

In both countries the GCCA: PSIS project focused on enhancing water security in outer islands: five outer islands in Palau and one in FSM. Many of the smaller islands in particular are dependent on rainwater harvesting; and some have small freshwater lenses from which water can be pumped, although often the groundwater is contaminated and cannot be used for drinking.

One of the major challenges with implementing projects in such outer islands is the absence of protected landing sites. The islands are usually surrounded by coral reefs with very small gaps through the reef, which in many cases can only be accessed using small open dinghies. This was the case in Fais Island in Yap State of FSM, where 46 large (5,000 l) plastic water tanks had to be unloaded from a freighter one by one onto a small dinghy which was then navigated through a gap in the reef and eventually unloaded by hand onto the beach, see Fig. 1.2. Obviously such hazardous unloading requires calm sea conditions and very skilled operators.

Similar situations were encountered in Palau where water tanks were delivered to the outlying island states of Sonsorol and Hatohobei, more than 500 km south of the main port in Koror, and involving up to three days at sea each way. For these islands similar unloading challenges exist, compounded by irregular shipping schedules and few windows of opportunity each year when sea conditions are favourable.

Fig. 1.2 Unloading water tanks in Fais Island, Yap State, FSM, April 2015

Such factors add significantly to the cost and duration of a planned climate change adaptation intervention in an outer island. In FSM and Palau, however, some economies of scale were achieved by combining the shipment of tanks from their point of manufacture to the main port in each country.

Protecting Low-Lying Atolls in the Marshall Islands

Coastal erosion is a serious issue in many Pacific islands, e.g. there has been a landward retreat between 5 and 50 m on the eastern coast of Kosrae in FSM (Gombos et al. 2014). Pacific atolls have historically undergone coastal changes (Webb and Kensch 2010) as the small sandy islands shift their position on the reef in response to the waves and currents—often resulting in erosion on one side of the island and accretion on the other. However, there is growing observational evidence in many of the populated Pacific atolls of increasing coastal erosion, which is being attributed, in part, to rising sea levels (Ramsay 2011).

Such changes are affecting lives and livelihoods of the islanders living in these distant atolls, for example in Ailinglaplap Atoll in the Marshall Islands, Woja Island was in danger of being cut into two parts, and conditions were so serious that students from one part of the island had to wait on the tide each day to cross to the other part of the island and as a result they sometimes missed school.

As part of the GCCA: PSIS project a 70 m causeway was constructed to strengthen the narrow strip of land joining the two parts of Woja Island. This involved coastal and marine studies as well as extensive feasibility and design work. One of the contributing factors making this project feasible was that armour stone for the rock causeway existed in abundance on the reef flat having broken off the outer edge of the reef platform during large wave events and then thrown up onto the reef flats. Over time the rocks had been reduced to smaller sized boulders suitable for the armour stone. The existence of this natural rock for the armour stone meant that the cost was within the project budget; otherwise the cost of shipping in armour stone would have been prohibitive.

Information about coastal changes and climate change is often poorly understood in the Pacific Islands and especially in remote outer islands. This is largely due to the fact that information on technical aspects of climate change is written in English and technical terms are often hard for people to understand in their native language, and even more so in a foreign language. To begin to overcome this impediment, the Office of Environmental Planning and Policy Coordination (OEPPC) in the Marshall Islands, with support from the GCCA: PSIS project, prepared a Climate Change Glossary giving the Marshallese and English descriptions for technical climate change and environmental terms (OEPPC 2015). This glossary is being trialled by some Marshallese teachers in 2016 and it is hoped it will help the Marshallese people better understand the challenges posed by climate change and the adaptation options available.

Augmenting Food Security in the Islands of Tuvalu

Tuvalu, in the southern Pacific Ocean, consists of four raised atolls and five raised reef islands, all less than 5 m in elevation. Especially in the outer islands there is a subsistence economy with farming and fishing being the major sources of employment. However, over recent decades there has been a decline in subsistence agriculture and increasing dependence on imported foods such as rice and flour. This has been linked to increasing incidence of non-communicable diseases such as diabetes (WHO 2013).

There has been wide research on agroforestry in the Pacific (e.g. Wilkinson and Elvitch 2000). Agroforestry practices consist of integrating understory crops with tree crops as shown in the schematic in Fig. 1.3. This technique, although widely used in several Pacific countries in the past, has in Tuvalu declined over the past few recent decades.

Through the GCCA: PSIS project, traditional agroforestry farming practices were revived and combined with new technology, specifically the use of innovative "climate-ready" crops and trees (sourced from the SPC Pacific Centre for Crops and Trees), which had been bred for enhanced resilience to climate change. These new and old farming technologies were demonstrated in both the main and one outer island of Tuvalu on underutilized land. Coconut plantations were thinned, senile trees removed, and a variety of "climate-ready" crops and trees planted to maximize land use and promote additional production beyond subsistence needs. Farmers and landowners developed the demonstration sites and at the same time were trained in agroforestry design, compost making, plant grafting and breeding techniques, through hands-on technical training and local language communication materials.

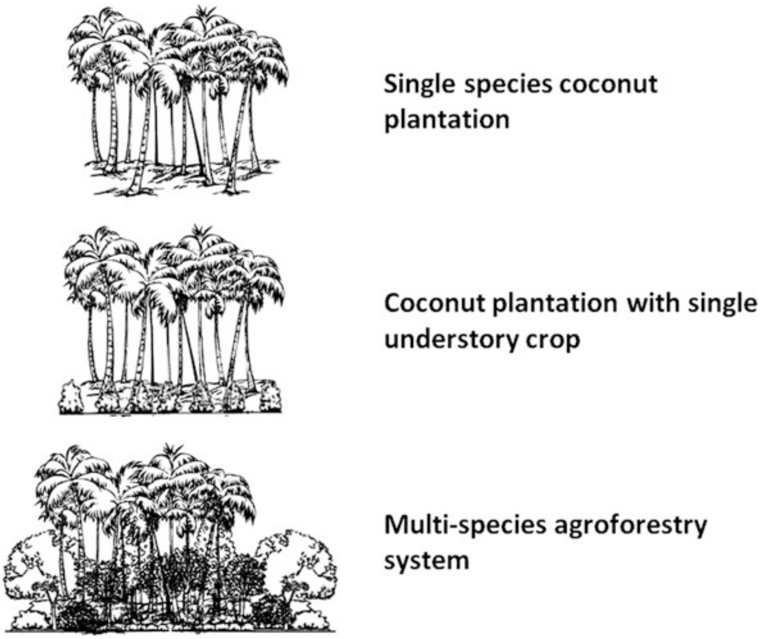

Fig. 1.3 Stages in agroforestry in Tuvalu

One year after the demonstration sites were completed, they have been productive, with yams, bananas, breadfruit, figs, sweet potato and coconuts available for market. The trees and crops planted are recorded in a database so that each variety can be assessed for its effectiveness in the Tuvaluan atoll environment. This will provide valuable information for future replication of this integrated agroforestry farming technology.

As part of the project women were targeted for home gardening activities through the Tuvalu National Council of Women. Training and equipment was provided to women's groups in each island to develop their own home gardens. A home garden competition in 2015 proved to be a strong motivating factor, and this approach is planned to be replicated annually by the National Council of Women.

Discussion

This paper has described several case studies involving the implementation of climate change adaptation interventions in several sectors (marine resources, coastal protection, food security, water security and health) in outer islands. Similarities have emerged and these are discussed below.

Adding New Technology and New Knowledge to Traditional Practices

Approaches that combine new and practical technology and traditional practices may be more appropriate for the outer island situation. For example in the Cook Islands, a relatively simple method to measure water quality combined with the full time stationing of a marine biologist at the remote outer island, is providing immediate benefit to the pearl farmers, in contrast to the more sophisticated real time technology.

In Tuvalu, combining an accepted agricultural practice, agroforestry, with new technology, the supply of "climate-ready" crops, is beginning to provide positive results for farmers by helping them move from subsistence to market production.

In the Marshall Islands the coastal areas adjacent to the new causeway were stabilised with coastal plants. Instead of using plastic bags to germinate the seedlings, coconut leaves were woven into small baskets and these served the same purpose. Another traditional technique was to use copra sacks filled with coral rock and sand and held in place along the beach berm with ironwood stakes to protect the newly planted seedlings from inundation by the sea.

The limited supply of good quality water is a serious challenge facing those living in outer islands. While there are sophisticated technologies that can augment supply such as reverse osmosis plants, enhancing traditional practices such as rainwater harvesting may be more suitable for the outer island situation where maintenance and the procurement of spare parts is often difficult. However, it is very important to understand the specific circumstances of each island, e.g. in Fais Island in FSM, the houses have very low roofs, so it was necessary to procure low rectangular tanks that fitted below the roof overhang instead of the typical cylindrical tanks.

In many atoll countries water quality is another challenge and the usual way to purify water is to boil the water. As was seen in Kiribati, research and practice has shown that a simple "new" technology, SODIS, is appropriate to the outer island situation and can reduce diseases such as diarrhoea and save money through reduced fuel costs.

Meeting the High Cost of Climate Change Interventions in Outer Islands

Implementation of projects in outer islands face very high costs and delays due to their remoteness, infrequent shipping schedules, and absence of sheltered and secure unloading facilities. These constraints need to be built into project planning and design, e.g. when planning a project in an outer island it is recommended to undertake all the necessary feasibility, design and costing studies taking into account local knowledge and best practice and then to apply the "times 2 rule of thumb." So that if the investigative and planning studies show the project will take one year to implement and cost $100,000, then budget and plan for 2 years and $200,000. Furthermore in some very special circumstances it may be necessary to increase the "times 2" factor.

Particularly with regional projects, there may be opportunities for economies of scales as was seen in the case studies for FSM and Palau where the water storage tanks were combined in one shipment the cost of which was then split between the two countries. Such measures need advance planning.

Sourcing local materials and applying local methods may also be a way to create cost saving. The use of boulders washed up onto the reef flat for armouring the causeway in Woja Island, in Marshall Islands, is one such example.

Effective Communication and Addressing the Required Behavioural Change

All of the cases studies have illustrated the need for communicating information about project activities in the local language. This can be exceedingly complex for many Pacific Island countries as there are several local languages. For example with the water security project in FSM, it was necessary to use the language commonly used in Yap State, Yapese, and the language of a target outer island, Ulithian, requiring more effort and investment in translation.

Climate change is a relatively new concept for most people and trying to understand English terms such as "greenhouse gases" can be difficult. Local language glossaries such as the one developed by the Marshall Islands are a good first step to addressing this challenge, although the complexity of selecting and agreeing on words and spelling for the new terms should not be underestimated.

Exchanging experiences through south-south cooperation is a very effective way to learn about others' applied knowledge. An exchange visit by Nauru's Water Strategy Manager to the Environmental Health Unit of the Kiribati Ministry of Health and Medical Services in December 2015 and February 2016 is one such example. "The visit to Kiribati was particularly useful because water resources in Kiribati are extremely scarce very like the situation in Nauru, so it was good to work with another country that experiences similar challenges" (Agir in GCCA: PSIS 2016).

Experience from the GCCA: PSIS and other projects have shown the benefits of adopting a behavioural change approach. This approach, which is based upon change theory, involves working with and understanding the intended audience to identify and address clear, measurable behavioural objectives (UNICEF 2005).

In Kiribati three workshops were held over a period of 6 months to research the situation and the audience. Reducing child mortality by preventing outbreaks of diarrhoeal diseases was identified as the objective, and the means to achieve this included: (i) encouraging parents of children less than 5 years old to boil and treat water, and (ii) promoting hand washing. Further research identified SODIS as a suitable technique to treat water. This was trialled in one community. Six community water champions, who took part in the workshops, were hired to help interested households in the community properly use SODIS, supported by communication tools ranging from videos to card games. Results showed the number of cases of diarrhoea decreased by more than 30% after 1 year (Ungaro 2016) and 4 months after the trial campaign finished, the end line survey indicated 85% of households were still practicing SODIS on a regular basis.

Customising Development Indicators for Outer Islands

Outer islands in the Pacific with their small populations, limited communication with the outside world, remoteness and subsistence economies face special challenges when it comes to measuring how aid is distributed. For example, one of the standard indicators, dollars per capita, which consists of dividing the total project cost by the number of people benefitting, provides an incomplete picture of the real situation, as it does not reflect the special needs and challenges of outer islands.

In Fais Island in FSM, for example, less than 10% of the population earn an income and the majority of the working population depends on a subsistence economy. Yet the Fais Island community contributed significantly to the project by providing many weeks of labour to install the water tanks.

Furthermore outer island residents have important knowledge to share. In the southern group of the Cook Islands, senior residents were surveyed about the environmental changes they had witnessed in their lifetimes. The results were analysed to advance the understanding of climate variability in the Cook Islands (Rongo and Dyer 2015).

There is a need for further research on indicators for outer islands that show how external finance is used and distributed and whether it is effective.

Conclusion

There are many challenges to the effective delivery of climate change response measures to outer islands including small populations with skewed demographics, high costs, infrequent and unreliable transportation, and technology and communication limitations. These limitations may not easily fit in with funded project priorities and timelines, and therefore outer islands are sometimes overlooked.

Yet outer islands have special needs that should be considered in the selection and delivery of climate change response measures. These include an absence or very few interventions in outer islands, subsistence economies with little cash available, small to micro-size markets, and a heavy reliance on the natural environment.

As described here, countries and their development partners need to consider the limitations faced in implementing climate change adaptation interventions in outer islands and develop appropriate timeframes, budgets, indicators, technologies, approaches and reporting mechanisms to enable effective delivery.

Future prospects for climate change adaptation interventions in outer island communities include:

(i) Developing new indicators that take the special needs and circumstances of outer island communities into account. For example, outer islands are often able to effectively contribute to development or adaptation initiatives, but often this contribution is in-kind.
(ii) Redesigning the scope of project timeframes beyond the typical 3–5 years duration by adding a second phase of 3–5 years with a much smaller level of funding (e.g. 10% of the phase 1 funding). This could provide for full impact evaluation, monitoring and maintenance, and overall sustainability of the intervention.
(iii) The GCCA: PSIS and the Pacific Adaptation to Climate Change (PACC 2012) projects, among others, have shown the usefulness and benefits of practical climate change adaptation demonstration projects. They have also paved the way for future interventions to roll out different approaches and technologies which might include working directly with private sector enterprises. For example, instead of using international procurement procedures to purchase water security items like rainwater tanks, first flush devices and solar pumps, to work with existing private sector contractors and businesses at the national level to see if there are ways in which they can cost effectively stock and promote use of these best practice technologies. Including in-country private enterprises in ongoing behavioural change is a promising approach for new interventions and sustaining existing ones into the future.

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Chapter 2
Customary Land and Climate Change Induced Relocation—A Case Study of Vunidogoloa Village, Vanua Levu, Fiji

Dhrishna Charan, Manpreet Kaur and Priyatma Singh

Introduction

The South Pacific being the hub of climate change associated environmental and social developments is irrefutably one of the world's most predisposed regions when it comes to the climate and weather induced disasters (Boege 2011). Particularly susceptible are the several of the low-lying coral islands (Nunn 2012). The livelihoods of majority of the Pacific Islanders which revolve around the Pacific Ocean is being acutely affected due to rising sea levels, increased coastal erosion, inundation, flooding and salinization of coastal aquifers (Ferris et al. 2011). For several of the communities in the South Pacific, adaptation has become an immediate necessity for survival. The pressing need to acclimatize to climate change adversities has escalated over the last couple of years and the issue of climate change taking its toll in many island nations has surfaced in recent discourses (Barnett and Campbell 2010).

On the onset, Fiji's marine and coastal ecosystems endow considerable physical, financial, societal, ecological and cultural benefits to approximately half of the country's estimated 902 964 population (Govan 2009). Yet, the repercussions of climate change on the coastal ecosystems are threatening the way of life of the coastal inhabitants and for the residents of Vunidogoloa in the province of Cakaudrove in Vanua Levu, relocation has emerged as a reality for more than three decades.

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In February 2014, the village was the first in Fiji to reposition; moving 2 km inland after years of inundation, storm surges, coastal abrasion and unwarranted flooding had made their village susceptible to the impacts of climate change (United Nations Office for the Coordination of Humanitarian Affairs 2014). The traditional responses of disaster relief were no longer protecting the village community despite thousands of dollars spent on the construction of sea walls. Community relocation was the only cogent solution to safeguard the inhabitants of Vunidogoloa (Edwards 2012, p. 3). Conversely, this was an enormously emotional and harrowing headway for the villagers especially since they had to retreat from their customary land which has been part of their culture and identity for their entire life.

Relocation may be the last resort but also one of the best adaptation responses for several of the coastal Fijian villages currently facing similar tribulations as Vunidogoloa (Rubelli 2015). This also indicates that quite a few of these vulnerable villagers will be experiencing similar limitations as faced by the people of Vunidogoloa. Some of the drawbacks are the availability of land for settlement, governance and funding and perhaps the most intricate of all is the traditional and emotional place attachment. Disputes over land rights as well as loss of social and communal cohesion will highly likely create some of unconstructive effects of population relocations (Ferris et al. 2011). According to Wewerinkle (2013), the cultural identity of the people is likely to be impeded by the loss of customary land that is anticipated to occur as a result of climate change. A report by Nurse et al. (2014) explains that barriers to taking action have also been attributed to endogenous factors such as traditional values and awareness.

In many indigenous communities access to land depends on membership in a specific clan. For the iTaukei (indigenous Fijians) the ownership of land is vested in the *mataqali* (Fijian clan or landowning unit) (Fonmanu et al. 2003). Land offers not only livelihood but it is also the source of the traditional and spiritual wellbeing for many of the island communities. This is why despite the distressed situation on the islands there are still people who do not want to relocate (Boege 2011). Generation gap also influences the decision to relocate. In the Vunidogoloa resettlement case, it was particularly the elderly who did not want to move, while members of the younger generation were keen to move.

Developing countries also have a major limitation in capacity making adaptation difficult. Limitations include both human capacity and financial resources. The lack of funding available in various forms and difficulties in accessing the funds which are available represents a major barrier for adaptation, particularly for local community action (United Nations Framework Convention on Climate Change 2006). Climate-induced population displacement entails a governance and policy framework that can holistically respond to communities challenged with harsh impacts of climate change. Lack of proper awareness and institutional capacity also limits adaptation process (Amundsen et al. 2010). Relocation of Vunidogoloa village provides an opportunity to address the multiple societal issues to foster long term sustainability in the process of relocating communities.

The document on Peninsula Principles on Climate Displacement within States (Displacement Solutions 2013) forms a preliminary guiding framework and premise