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Lessons From the Pacific Islands – Adapting to Climate Change by Supporting Social and Ecological Resilience

Elizabeth Mcleod[1]*, Mae Bruton-Adams[2], Johannes Förster[3], Chiara Franco[2], Graham Gaines[1], Berna Gorong[2], Robyn James[4], Gabriel Posing-Kulwaum[5], Magdalene Tara[5] and Elizabeth Terk[2]

[1] The Nature Conservancy (United States), Arlington, TX, United States, [2] The Nature Conservancy (Micronesia), Kolonia, Micronesia, [3] Helmholtz Centre for Environmental Research – UFZ, Leipzig, Germany, [4] The Nature Conservancy (Australia), Brisbane, QLD, Australia, [5] Nature Conservancy Manus, Manus, Papua New Guinea

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***Correspondence:**
Elizabeth Mcleod
emcleod@tnc.org

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By necessity, Pacific Islands have become hubs of innovation, where climate strategies are piloted and refined to inform adaptation efforts globally. Pacific Island ecosystems are being degraded by pollution, overfishing, and unsustainable development. They also increasingly face severe climate impacts including sea-level rise, changing temperature and rainfall patterns. These impacts result inchanges in food and water security, loss of identity, climate-induced migration and threats to sovereignty. In response, communities in the region are leading climate adaptation strategies, often combining traditional practices and cutting-edge science, to build the resilience of their communities and ecosystems in the face of increasing climate risk. For example, communities are implementing resilient networks of marine protected areas using the best available science and strengthening tribal governance to manage these networks, experimenting with salt and drought tolerant crops, revegetating coastlines with native salt-tolerant plants, revitalizing traditional wells, and implementing climate-smart development plans. Often these efforts contribute to local development priorities and create co-benefits for multiple sustainable development goals (SDGs). These community efforts are being scaled up through provincial and national policies that reinforce the critical role that ecosystems play in climate adaptation and provide a model for the rest of the world. While adaptation efforts are critical to help communities cope with climate impacts, in some cases, they will be insufficient to address the magnitude of climate impacts and local development needs. Thus, there are inherent trade-offs and limitations to climate adaptation with migration being the last resort for some island communities.

Keywords: small island developing states (SIDS), climate change, Pacific Islands, vulnerability, adaptation, ecosystem-based adaptation

INTRODUCTION

The Pacific Islands are facing devastating impacts of climate change including increasing droughts and water scarcity, coastal flooding and erosion, changes in rainfall that affect ecosystems and food production, and adverse impacts to human health (IPCC, 2014, 2018).

Overpopulation, pollution and overuse of natural resources (e.g., overfishing and intensive land and water use), and unsustainable development and mining are also degrading island ecosystems

(Burke et al., 2011; Hills et al., 2013; Balzan et al., 2018). While the Pacific Islands are often described as highly vulnerable to climate change and lacking adaptation options (Pelling and Uitto, 2001), such descriptions disregard the ways in which Pacific Islanders are leading climate action and combining their own systems of knowledge with western science to implement locally relevant climate solutions (Barnett and Campbell, 2010; Mcleod et al., 2018). The lack of appreciation for Pacific climate leadership is exacerbated by biases in climate research that prioritize western science and technological solutions over other systems of knowledge (Jasanoff, 2007; Alston, 2014). It is critically important for global climate policy and national governments to recognize and support community efforts to build resilient communities and ecosystems through ecosystem-based adaptation strategies that are rooted in traditional knowledge and reinforced and supported by climate science, traditional leadership structures, and sustainable climate solutions.

Pacific Island leaders, along with leaders from other Small Island Developing States (SIDS), have been instrumental in shaping climate policies and the Paris Climate Agreement (UNFCCC, 2015). They called for a loss and damages clause that allows islands to assess and quantify impacts of cyclones and weather-related events and were vocal advocates to limit warming of global mean temperature to 1.5°C. The recognition that warming of 1.5°C or higher increases the risk associated with irreversible damages such as the loss of entire ecosystems has just been articulated in the latest IPCC report (IPCC, 2018). Despite their minimal contribution to global greenhouse gas emissions (Hoad, 2015), many SIDS included ambitious mitigation targets in their national climate plans (i.e., Nationally Determined Contributions, NDC) to raise collective ambition to reduce GHG emissions globally (Ourbak and Magnan, 2018).

Pacific Islanders are also leading climate action at the local level, implementing strategies to help communities and ecosystems to be more resilient to climate change. The region provides important opportunities for testing and refining adaptation responses at scale. The Pacific Islands are home to species found nowhere else on earth and are incredibly diverse, in terms of their ecosystems, geography, and demographics. Pacific Islanders have lived with natural environmental impacts for thousands of years and have adapted practices to accommodate periods of environmental fluctuations. Although the pace of environmental and climatic changes has increased, many communities are implementing climate-smart agriculture and are revitalizing traditional practices that utilize drought-tolerant species and the benefits of nature, such as using seaweed as compost to make soil more fertile, using palm fronds to shade plants during droughts, and planting vegetation to reduce flooding and erosion along coastlines. They are also combining these traditional practices with new scientific advancements such as the development of salt-tolerant and heat-tolerant crops and community-led GIS mapping of breadfruit trees vulnerable to climate impacts in the Marshall Islands. Communities are revitalizing traditional wells, establishing new protected areas and improving the management of existing protected areas, and developing climate-smart development plans that incorporate ecosystem-based adaptation.

However, ecosystem-based adaptation (EBA) efforts initiated by Pacific Island communities have largely been ignored in the peer-reviewed literature. Ecosystem-based adaptation is defined as combining biodiversity and ecosystem services into an adaptation and development strategy that increases the resilience of ecosystems and communities to climate change through the conservation, restoration, and sustainable management of ecosystems (Colls et al., 2009). Researchers have highlighted the need for reflexive insights, including lessons and challenges implementing EBA projects, given the increased attention it has received in global and national climate discourse (Doswald et al., 2014). Key benefits of EBA have been identified including: (1) securing water resources to help communities cope with drought (2) food and fisheries provision; and (3) buffering people form natural hazards, erosion, and flooding (Munang et al., 2013).

Therefore, this paper presents local EBA examples that demonstrate how Pacific Island communities are leading the implementation of sustainable climate solutions and reinforcing the critical role of ecosystems in climate adaptation. We include examples that address the primary benefits of EBA including water security, food security, and coastal protection. We present examples of EBA projects that were implemented across Micronesia and Melanesia from 2015 to 2018. The EBA project s included a partnership among communities, local governments, and conservation NGOs (The Nature Conservancy, The Micronesia Conservation Trust, other local conservation partners across the Pacific). We discuss these EBA activities, identify barriers to implementation, and highlight the importance of supportive national policies and political will to reinforce and scale up these efforts.

REVITALIZING TRADITIONAL WELLS

Oneisomw (formerly Oneisom) is an island located in Chuuk State lagoon in the Federated States of Micronesia. It has a population of 638 inhabitants (2010 Census of Population and Housing) that is already experiencing the impacts of climate change. Villages are primarily located along the shoreline and are affected by coastal flooding during typhoons and high tide events. The communities rely on a combination of water tanks, aquifers, streams, and wells but freshwater security is threatened by drought and saltwater intrusion. Human impacts are also adversely affecting these freshwater sources and the coastal environment (e.g., pollution from dump sites, waste from pig pens, inadequate sanitation systems, erosion from unpaved pathways, solid waste dumping, and sediment runoff from inland clearing). To improve water security and reduce impacts in the coastal environment, Oneisomw residents have rehabilitated traditional water wells by cleaning them, planting vegetation buffer strips around wells and streams to stabilize degraded banks and reduce sedimentation and installing concrete covers over the wells to reduce trash and other pollutants from entering the wells. They also developed agreements with landowners who had wells to allow others to access water during drought. This approach was presented during a national mayor's summit in 2018 and other communities have requested support to implement these actions to improve water security in their municipalities.

Such local actions need to be reinforced by the implementation of state and national water policies that promote watershed management and provide the foundation for the sustainable use and conservation of water resources (e.g., Pohnpei State Water Policy passed in 2018). This need was articulated at a stakeholder workshop in Pohnpei in 2017 that brought together local leaders, land-owners, and others who utilize the watershed area. While traditional leaders endorsed the process of managing the watershed sustainably, lack of cooperation and planning was noted along with the need to integrate State water management regulations into a national water policy framework to ensure a consistent flow of funds to manage the watershed and protect the full suite of ecosystem services.

IMPLEMENTING CLIMATE SMART AGRICULTURE

Climate-smart agriculture (CSA) is defined as an integrated approach to managing cropland, livestock, forests and fisheries that aims to support food security under the new realities of climate change through sustainable and equitable transitions for agricultural systems and livelihoods across scales (Lipper et al., 2014). It is designed to increase productivity (i.e., produce more food and boost local incomes), enhance the ability of communities to adapt to climate change and weather extremes, and decrease greenhouse gas (GHG) emissions from food production (Steenwerth et al., 2014). When implemented in an island context, CSA can also support benefits to coastal ecosystem (e.g., by reducing sediment into the coastal zone through taro swamps, reducing pressure on wild-caught fisheries, reducing pollutants from fertilizers; Clarke and Thaman, 1993; International Fund for Agricultural Development [IFAD], 2017).

Communities across the Pacific are revitalizing traditional farming practices, based on agroforestry, to increase food security and reduce vulnerability to climate impacts, and they are also experimenting with salt and drought-tolerant crops (FAO, 2010; Mcleod et al., 2018). Traditional farming practices include shading crops with palm leaves, maintaining trees around plants to provide shade, composting using seaweed. Some coastal fishing communities (e.g., Ahus, Papua New Guinea) have historically relied on fishing for food security and are now working with local NGOs, women's groups and government agriculture officers to plant household gardens. Ahus is off the coast of Manus Island in Papua New Guinea and has a population of more than 700 residents. Observed climate impacts include sea-level rise, reduced marine protein sources, saltwater inundation of water wells, coastal erosion, storm surges, droughts, heavy rains, ocean acidification and coral bleaching. With support from the government and NGOs, Ahus has introduced new farming practices that are designed to improve food security, the health of the marine environment, and provide an important source of income for local households (Tara, 2018). These include the introduction of growing food crops including greens, tomatoes and cabbages, composting in very sandy soils, raised gardens and local water collection in drums and small tanks. Women's groups, in partnership with local conservation NGOs and agricultural extension officers have led trainings on farming methods such as the use of organic fertilizers and pesticides, raised beds to improve soil quality and eliminate saltwater intrusion, and the diversification of crops. These farming practices are being replicated and scaled through the provincial women's network Pihi Environment and Development Forum (PEDF). Benefits have included changing and improving the diet of Ahus families, increased cash income for women selling produce at market and to local restaurants, food security especially when bad weather prevents fishing, better community cohesion as people shared ideas and produce.

Low cost aquaculture projects are also being implemented in Ahus, such as clam farming techniques from Palau that have been adapted to local conditions to provide food security and reseed local reefs with clam larvae to re-establish the local wild population. Community members in Tamil, Yap built a nursery utilizing traditional composting techniques and including food crops and plants to revegetate coastal areas vulnerable to erosion (e.g., Nipa Palm). The nursery reduces reliance on coastal fisheries that are being depleted, increases the diversity of food sources, improving community health, and reduces the impact of coastal erosion.

IMPLEMENTATION OF PROTECTED AREAS

Tamil is a municipality on the island of Yap in the Federated States of Micronesia. It includes twelve villages with a total population of about 1200 people living in 848 households (Office of Statistics, Budget and Economic Management, Overseas Development Assistance, and Compact Management, 2011). The community has experienced flooding, erosion, and drought driven by climate change, in addition to saltwater intrusion into freshwater sources and taro patches. Water security is further impacted by poor water management, high dependence on the watershed, and lack of alternative water sources as many local wells are degraded or contaminated by waste and sedimentation from erosion. The community noted the following ecological impacts: declines in coral health, seagrass beds, and reduced fish populations due to increased sedimentation in the coastal environment and pollution run-off driving algal increases (LEAP 2017). To improve water security and coastal ecosystem health, the community declared their first Watershed Protected Area in 2017 (320 acres of watershed protected by traditional council members and recognized by state law). The Tamil watershed provides water to over half of the population of Yap, and its protection provides greater resiliency to and recovery from wildfires, and designates the area as a water conservation zone to increase water security in times of drought.

Similarly, in the island of Chuuk, the community of Oneisomw agreed to implement a locally managed marine area (LMMA) to reduce threats facing coral reefs (e.g., controlling dynamite fishing and overfishing, coral and sand removal, commercial harvesting). The LMMA supports seasonal or permanent closures and fishery management through the traditional management system (*mechen*). Based on the traditional *mechen* system, Oneisomw coral reef "owners" initiated an agreement to collectively enforce seasonal or longer closures of reef areas, based on scientific knowledge and community inputs, to ensure access to coral reef resources for future generations. The LMMA is the first marine protected area for the newly passed Protected Area Network (PAN) legislation. In 2018, the community initiated the process to develop their first land-based protected area by signing a memorandum of understanding with well owners to maintain healthy watersheds. The land-based protected area will reduce pollution and runoff around water sources and will include revegetation with green buffers to help maintain water quality. The next step is for the community to produce a management plan that will integrate a ridge-to-reef approach, which will help to design one of the first Ridge-to-reef protected areas in the country. These collective efforts support the FSM's climate adaptation commitment to the UNFCCC and demonstrate that western and traditional natural resource management methods can be complimentary and mutually beneficial in meeting conservation and human wellbeing goals. They also show how local ideas addressing local needs in the FSM can help to support the ambitious targets of the Paris Agreement.

CLIMATE-SMART DEVELOPMENT PLANS

Melekeok State is located along the east coast of the main island of Palau. The population includes about 300 residents (about 90 households) and the State is also host of the capitol building of the Palau national government. Most of the homes and infrastructure (e.g., elementary school, State office, retirement center) are located along the coast within 5 meters of the high-water mark, thus highly vulnerable to flooding and erosion due to storm impacts and sea-level rise (ADB, 2012; Melekeok State Government, 2012). For example, Typhoon Bopha in 2012 caused significant damage to the community. In response to climate impacts and projections of future impacts, Palau developed a national climate change policy (Government of Palau, 2015) which identifies the need for building ecosystem and community resilience. Additionally, the Melekeok community developed a climate-smart guidance document (Polloi, 2018) due to their high dependence on their terrestrial and marine ecosystems (Brander et al., 2018; Förster, 2018) in partnership with the Melekeok State government and conservation NGOs (e.g., the Nature Conservancy, Micronesia Conservation Trust).

The climate-smart development document provides guidance for updating current infrastructure, designated upland lease development for migrating vulnerable community members and infrastructure away from the coast, and recommendations to make future development less vulnerable to climate impacts. A key focus is to ensure that new development and refinement of existing structures are climate smart and do not cause environmental damages that threaten water quality and the marine ecosystem. For example, the state residential lease/housing program incorporates sustainable designs and approaches to support the resiliency and enhancement of ecosystem services. The residential lease agreement requires individuals to revegetate bare soils to reduce run-off and sedimentation into the coastal system, minimize stormwater flow to promote water infiltration and support water supply, install water catchment systems to reduce vulnerability to drought, and include renewable energy systems (e.g., solar panels) through existing national loan programs. In addition, new permits for land use, the development of residential areas, and commercial developments require measures that support water security and erosion control (e.g., hedge rows and filter strips to mitigate soil erosion). Melekeok State leadership is also considering legislation for climate proofing new residential houses that would require new houses to use hurricane clips in the construction.

These innovations in Palau provide a model for how to develop climate-smart development that also include benefits to the coastal and marine ecosystem. To upscale implementation and enforcement at national level, policies are needed that support sustainable financing mechanisms. Access to loans for building new homes should be provided under the condition of complying with guidance for climate-smart homeowners, similar to the Energy Efficiency Subsidy Program of the National Development Bank of Palau. Such policies could enhance the upscaling of adaptation strategies and their inclusion in local and national infrastructure development programs.

CHALLENGES TO IMPLEMENTING ADAPTATION STRATEGIES

A number of challenges threaten the success of local community-based adaptation projects including the remoteness of some islands, lack of capacity to implement and sustain projects, lack of governance and the way that impact is measured.

Remoteness of Islands

Logistical, technological, and weather-related obstacles are common in remote islands in the Pacific, causing delays to material-dependent projects. High costs of transportation and certain goods divert spending from on-the-ground implementation. Distance from markets can also limit economic growth. Such issues can lead to decreased interest in the region from international conservation supporters and investors. However, the logistical challenges and high costs related to often remote locations of islands is also a factor driving the development of local solutions for climate adaptation that build on local traditional knowledge. While some of the solutions are specific to the needs of islands, they inspire innovative approaches that can be applied in other areas.

Lack of Technical and Financial Capacity

Pacific Island countries face a number of capacity constraints (e.g., financial and project management, climate modeling and spatial analysis, and infrastructure maintenance; Dornan and Newton Cain, 2014). Sustained capacity in the local NGOs also is a challenge; as talented youth rise through the ranks of conservation programs, they are often recruited into higher-paying government or private sector jobs or seek opportunities abroad. Such staff turnover problems hinder long-term conservation projects by causing significant portions of funding sources to be repeatedly used toward capacity development. Local adaptation projects supported by external sources of funding (e.g., climate grants) often end when the grant is over, if there is not sufficient local capacity to continue the project. Finally, lack of technical capacity is also a challenge.

For example, enforcement of marine resource harvesting regulations requires expensive investments in equipment (e.g., boats and surveillance technologies) and advanced training. Enforcement funding is often gleaned from the end of project budgets, as expenditures such as staff time, materials, and planning commonly absorb substantial amounts of initial funding. Technical capacity for climate resilient agriculture is limited, and on-going support is often needed to address emerging threats (e.g., new garden pests in Ahus, Papua New Guinea).

Governance

Complex land tenure structures commonly follow traditional or tribal governance systems which can conflict with Western judicial laws and processes, making governance approaches ineffective. This can deter climate financing from large international organizations who require stringent contract-based agreements such as land transfers and easements for protected areas. Nevertheless, traditional tenure and knowledge systems can inform sustainable adaptation strategies and must be considered in the design of adaptation policies. Hence there is the challenge of ensuring compatibility between traditional and western governance systems. The recently established Local Communities and Indigenous Peoples Platform (LCIPP) under the UNFCCC can help to bridge these institutional challenges and ensure local traditional knowledge is considered in the provision of adaptation finance.

Measuring Impact

Many Pacific islands have small populations and small land masses. If donors prioritize their support based on the total number of hectares protected/restored or the total number of people who benefit from a given intervention, Pacific Island projects may not be selected for funding. However, the strong dependence on island communities on their ecosystems for food, livelihoods and traditional practices, provides opportunities for demonstrating how climate adaptation projects can result in direct benefits to both ecosystems and human wellbeing. Additionally, regional commitments to conservation and sustainability such as the Micronesia Challenge can be an important mechanism to scale conservation efforts by providing enabling conditions to better cope with climate change. Initiated by a coalition of regional governments and endorsed at an international level with sustainable funding and technical support for implementation, the Micronesia Challenge serves as a model for other regions. Indeed, it inspired the development of the Caribbean Challenge, Western Indian Ocean Challenge, and the Coral Triangle Initiative.

SCALING ECOSYSTEM-BASED ADAPTATION THROUGH SUPPORTIVE NATIONAL POLICIES AND INNOVATIVE FINANCING

Ecosystem-based adaptation actions that support human wellbeing and healthy ecosystems require financing and supportive policies to ensure their implementation, sustainability, and scaling across the region. Such policies must be continually evaluated and refined to ensure that they continue to address local needs in response to change social, ecological, and climatic conditions and must be developed in concert with traditional knowledge. For example, marine protected areas in Manus, Papua New Guinea work best when they reflect the latest science on fish movements and aggregation sites and also follow local tribal boundaries to enable clans to manage their customary land and seas as part of the protected area. This means that local tribes set the rules for their marine protected area that enable species sustainable and address local needs. Thus, in some communities (e.g., Ahus, Papua New Guinea), it is important to strengthen tribal governance and local institutions to mobilize resources and management of adaptation projects. Methods to do so include incorporating climate change into existing ward plans, aligning ward plans with existing provincial and government policies and plans and adapting these plans over time to address changing conditions.

Learning exchange between local, state and national governments are an important mechanism to discuss the challenges communities are encountering in adapting to climate change and to refine current policies with new scientific and local knowledge. They also can highlight gendered impacts of climate change and the differential capacities for adaptation. For example, women in some Pacific Islands are not entitled to land rights due to customary laws and practices which may limit their ability to grow food and resettle in areas less vulnerable to climate impacts. Therefore, policies are needed that consider these gendered impacts (e.g., addressing land ownership inequity as climate change is reducing the available land in some places such as Papua New Guinea; Mcleod et al., 2018).

Innovative financing for ecosystem-based adaptation includes the development of tools (e.g., green fees, payment for ecosystem services) and new partnerships with the private sector. For example, water utilities and other businesses that utilize nature for profit can be incentivized to protect the environment. Utilizing payment schemes, such as payments for ecosystem services, creates financial mechanisms to ensure that water is clean, sustainable, and generates new sources of revenue for watershed protection.

CONCLUSION

The examples above demonstrate positive steps taken by local communities and partners to implement EBA projects in small islands states, yet there is little systematic information on the large-scale effects of these measures for building climate resilience across the region. While some island communities can build resilience to climate change, others will face the limits of adaptation and use migration as a last resort for adapting to climate change impacts. Assessments that identify and predict where adaptation limits are likely to occur and who is most likely to be affected are essential to better plan for climate impacts (Dow et al., 2013). Further, scientific assessments that provide evidence for the effectiveness of the EBA projects are lacking, especially those that include controls to assess the impacts of interventions and provide plausible counterfactual arguments regarding causal mechanisms (Reid, 2011; Munroe et al., 2012). Research is also needed to highlight social, ecological, and economic opportunities for upscaling ecosystem-based adaptation and to assess the contribution of adaptation to enhancing island resilience to climate change. Current assessments tend to focus on quantifying biophysical and socio-economic benefits but fail to make the link to management and policy options that enable the implementation of local adaptation options (Hills et al., 2013). In addition to research needs, there is the need for combining traditional with more recently introduced governance systems. Cross-regional exchanges and capacity building can foster the development of innovations that tackle the challenge of including local traditional knowledge and address the needs of island communities. Furthermore, platforms and partnerships that bring together leaders of traditional governance systems with representatives of Western governance systems can help to overcome barriers between different institutional systems and encourage the implementation of holistic community- and ecosystem-based adaptation approaches.

AUTHOR CONTRIBUTIONS

EM conceived of and developed the manuscript with contributions from MB-A, JF, CF, BG, RJ, GP-K, MT, and ET. JF, CF, GG, BG, RJ, GP-K, MT, and ET collected the data that supported the analysis.

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