# Reviving Traditional Croplands to Improve Community Climate Resilience

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**Abstract** Small islands such as Palau are highly vulnerable to Climate Change. Rising tides and extreme weather events are two climate effects that are negatively impacting Palauan communities. These effects coupled with changing demographics and urban development, have resulted in watershed degradation and declines in agriculture and coastal fisheries productivity. Given Palau's dependence on the health of its ecosystems to its economic and social objectives it is essential that Palau address these vulnerabilities, if its communities are to become resilient in the face of a changing climate. To resolve these challenges, Palau is looking to its past to inform the development of solutions that can be applied now and into the future. One solution is to adapt successful traditional soil conservation practices utilized in taro farming to modern farming and storm water management practices. The benefits of implementation of these agro-ecological farming principles in farming and as guidelines for development include increased food, environmental and economic security which are the cornerstones of resilient communities.

## Introduction

This project: *Reviving Traditional Croplands to Improve Community Climate Resilience* is one solution for Palau's communities to build resilience to climate change. Activities undertaken will enhance community resiliency by increasing food security and ensuring ecosystem health of rivers and coral reefs so that they continue to provide the provisioning services required by the Palauan people. A key project outcome is improved governance of watersheds. Project outputs include identifying traditional soil conservation best management practices to manage storm water and storm water management plans which will be trial tested during the course of the project time line and institutionalized for continuous use.

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Successful implementation of this project will result in state governments with the institutional capacity to manage their natural resources in this changing climate by addressing sedimentation in rivers, streams, and coral reefs. It will result in community members who are food secure therefore resilient with the added value of increased income. More importantly, the project will build awareness on climate change and storm water management as well as provide knowledge and guidance documents that will enable community members to become better stewards of their natural resources thereby improving their resilience to climate change impacts. These tools will enable decision makers in the communities to put measures in place to ensure future developments can occur without sacrificing the environment of each state. The end result will be improved community and ecosystem resilience to climate change by means of reviving traditional landscapes and its associated ecological knowledge to increase food, environmental and economic security of communities in Babeldaob, Palau.

## Palau and Climate Change

"As an island nation, we are literally in the frontlines of climate change. Never before in the history of our islands and humanity have we faced a bigger and more universal threat. Climate change has negatively impacted our resources, infrastructure, and livelihoods—not once, but several times in recent years. Our continuity and future existence as a people are now at the mercy of climate change." (*Message from His Excellency Tommy E. Remengesau, Jr., President of the Republic of Palau—Palau Climate Change Policy*).

For centuries, the people of Palau have existed and thrived because of their close ties and reliance on the natural environment and natural resources. In recent years, concern is mounting as we are experiencing changes in weather patterns resulting in strong typhoons, extreme drought, rising sea levels, salt water inundation and intrusion, among others. These concerns are reinforced by scientific findings of the Palau International Research Center (PICRC), a local research institution, along with findings of international groups such as the Intergovernmental Panel on Climate Change (IPCC). These findings demonstrate real and immediate impacts of climate change to our livelihoods.

As a Small Island Developing States (SIDS), Palau faces major threats from the effects of climate change such as typhoons, storm surge, drought, and persistent and prolonged rainfall events that cause major damage to community assets, infrastructure and ecosystems. This also adversely affects the sustainable economic development of Palau. In response, Palau has developed a Climate Change Policy Framework to address these and other threats. The policy has three overarching objectives: (1) enhance adaptation and resilience, (2) manage disaster and minimize disaster risk, and (3) mitigate global climate change by working towards low emission development.

Palau is susceptible to ecological disturbances related to global climate change. The effects of climate change on both marine and terrestrial ecosystems impacts the organisms that depend on them. These effects of climate change contribute to increased seawater temperature, increased air temperature, sea level rise, climate extremes, and changes in weather and precipitation patterns. These factors resulting from climate change lead to ecosystem level impacts that can adversely affect a community's social and economic well-being.

Palau's susceptibility to the effects of climate change is clearly demonstrated by past extreme climate events. In 1998, an El Niño event resulted in significant ecosystem damage in both marine and terrestrial environments in Palau. This event created elevated seawater temperatures that contributed to massive coral bleaching and decline of sea life in near shore areas. To date and to some extent, affected areas are still recovering from the event. In March 1998 at the peak of the El Niño, Palau received the lowest amount of rainfall in over 100 years of records. This resulted in depletion of water supplies, crop failures, and uncontrolled wildfires on some islands.

Palau experienced drier than normal conditions in March 2016 with Koror recording 2.68 in. of rainfall which is lower than the minimum threshold of 4–8 in. required to meet monthly water needs. Historical data for the US Affiliated Pacific Islands (USAPI) demonstrated that the months of October 2015 to March 2016 were the driest for Koror out of 65 years of data collected (NOAA State of the Climate: Drought for March 2016).

This led to approximately 80% of Palau experiencing decreased water supply resulting in crop damage, wildfire outbreaks and the shutting down of the Ngerimel Dam, one of the two water sources for the Koror-Airai Water System. Water rationing was implemented for 5 hours each day which was eventually reduced to 3 hours per day due to diminishing water level at the Ngerikiil Dam (Drought Report, Republic of Palau, June 2016).

The Ring of Fire or typhoon belt is a large Pacific Ocean region between 10° and 40° north latitude where typhoons, volcanic eruptions and earthquakes occur. Palau is located 7° north latitude and therefore considered outside of the typhoon belt. However, the country recently experienced two major typhoons. Typhoon Bopha hit Palau in December 2012 and Typhoon Hyan followed 11 months later in November 2013. Both typhoons went on to cause substantial death and destruction in the Philippines. In Palau these typhoons caused significant wind damage to homes and trees, storm surge flooding coastal areas, heavy rains, and alterations in lagoon channels. Typhoon Haiyan caused particularly severe damage in Kayangel state. Nearly all structures in the state were destroyed, the vast majority of trees were toppled by high winds, taro patches were inundated with seawater, and the drinking water supply was contaminated with saltwater (Republic of Palau Fifth National Report 2014).

The following table provides a snapshot of Palau's climate vulnerabilities. It illustrates the various effects of Climate Change, implications and possible impacts on Palau's communities (Table 1).

**Table 1** Climate change effect, implications and possible impact on communities

| Effect | Implications | Possible impacts on biodiversity |
|---|---|---|
| Increased seawater temperature | • Coral bleaching<br>• Decline of fisheries | • Loss of coral species, organisms dependent on corals<br>• Habitat loss<br>• Fish nursery decline |
| Increased average air and ocean temperature | • Increased energy consumption<br>• More severe weather events<br>• Changes in water quality | • Destruction and alteration of habitat by storms<br>• Coral bleaching<br>• Import of petroleum to power air conditioning |
| Increase in sea-surface temperature | • Increased frequency and severity of tropical storms and typhoons | • Coral bleaching<br>• Habitat loss due to storms |
| Sea level rise | • Flooding<br>• Coastal erosion<br>• Salt intrusion in taro fields<br>• Damage to low-lying hamlets and infrastructure | • Loss of terrestrial habitat<br>• Loss of agricultural area<br>• Contamination of freshwater lenses |
| Climate extremes | • Droughts, storms and floods | • Increased susceptibility to invasive species |
| Changes in precipitation | • Decreased reliability of water supply | • Wild fires<br>• Agricultural decline |

(PCS Grant Agreement)

The Palau Climate Change Policy Framework further highlights Palau's vulnerability to both human-induced and natural disasters, which may be exacerbated by the impacts of climate change. These impacts include:

- Sea level rise of 3.0–6.3 in. by 2030;
- Increased frequency and severity of extreme weather events (particularly rain events), with increasing numbers of extreme rainfall days and rainfall intensity;
- Increased inundation, storm surges, erosion, and other coastal hazards;
- Changes to quantity, quality, and variability in seasonal and annual flows of surface and underground water;
- Adverse effects to subsistence and commercial agriculture and fisheries;
- Reduced food security due to extreme weather events and changes in seasonal weather patterns;

Palau's food production and watershed are predicted to be negatively affected due to the impacts of climate change. Today, increased frequency and severity of rainfall, salt water inundation and intrusion, and droughts affect taro production-based livelihoods which is a sector managed by women. Furthermore, Palau's watersheds are continuously degraded as a result of poorly planned developments which often result in soil erosion and sedimentation into estuaries and coral reefs. Sustainable economic development is negated by this degradation

of Palau's terrestrial and marine ecosystems. More importantly, these impacts of climate change greatly threaten the food, environmental, and economic security of Palau.

## Palau's Agriculture and Climate Change

Through years of colonization, Palauans have been exposed to, influenced, and now practice agricultural methods developed in and used in other parts of the world including Spain, Japan, US, and more recently, China and the Philippines. These agriculture techniques have become widespread however it is now clear that they are not suitable or sustainable for Palau's soil and climate conditions.

Traditional Palauan farming techniques along with other sustainable farming methods produce erosion rates that fall well below the erosion conservation goal of 11.2 metric tons per hectare per year (5 tons/acre/year). However, unsustainable techniques have been found to result in erosion rates up to 65 times higher than the erosion conservation goal.

Research conducted by the Palau International Coral Reef Center (PICRC) show that "land-based development activities have a direct impact on the amount of sediment that goes into rivers and eventually ends up on coral reefs. The amount of sediments being released into the rivers and reefs on Babeldaob Island, Palau, depended on the degree of development within adjacent watersheds" (Golbuu et al. 2003).

To persist in these unsustainable techniques will continue to result in high rates of erosion therefore continued decrease to agricultural productivity. This not only leads to food insecurity, it also leads to environmental and economic insecurity for the communities of Babeldaob thereby exacerbating the impacts of climate change for these communities.

## *Mesei* and Taro Cultivation

According to the legend of *Iluochel*, taro cultivation has been around since the first people arrived in these islands dating back to approximately 3500 years before Christ. Iluochel, a demi-goddess carved out the first *Mesei* or taro patch in Angaur and continued to develop *Mesei* as she migrated north through Peleliu and unto Babeldaob. It is this belief of divine origin that makes the *Mesei* sacred to the people of Palau. Yet another proverb: "*A Mesei a delal a telid*" literally means "The Taro Patch is the mother of our breath". In other words, the *Mesei* is the essence of our being providing sustenance for Palauan families, taro used in cultural ceremonies, and provides a source of income for most families especially in the rural areas of Babeldaob.

The *Mesei* is a paddy like system in Palau's wetlands where taro is cultivated. This is the most productive and sustainable method of food production in Palau. A domain dominated by women, the skills for taro cultivation is handed down from mother to daughter and traditionally, a source of pride for Palauan women. In most cases, the same area has been farmed in taro for hundreds if not thousands of years.

Within a *Mesei* system are many individual taro patches that share one water source that is irrigated through the taro patches by means of a series of ditches and dikes. This makes taro production a shared community activity as individuals must work together to ensure the "*bong*" or waterways are always clear and functional to ensure fresh water flows to each taro patch. The health of the whole system is dependent on the health of individual taro patches to ensure weed and pests are controlled and not transferred to adjoining patches.

The taro patches are arranged where one is always slightly higher than the other to allow for water irrigation to all patches from a water source upstream. Narrow water channels are built in and maintained to ensure fresh water flows from one patch to another. The in and out flow of water is controlled by each taro cultivator depending on the stage of growth of the taro. This also serves to slow the rate of flow of water traveling through taro patches resulting in sediment particles in the water settling in the taro patches or waterways thereby filtering the water.

In recent studies, the *Mesei* has been proven to help protect the environment from ridge to reef. A research paper titled "*Palau taro fields and mangroves protect the coral reefs by trapping eroded fine sediment*" published by the Palau International Coral Reef Center found that taro fields are able to trap sediments similar to the sediment trapping capacity of mangroves.

> A 4-month long field study was conducted to quantify the sediment accumulation rate for three different types of taro fields and to determine their sediment trapping efficiency. The results showed that the taro fields have the capacity to trap up to 90% of sediments (Koshiba et al. 2013).

Taro cultivation is labor intensive requiring continuous soil conditioning through compost and mulching as well as water control within the taro patch. The method of conditioning the soil is called "*Smalo*", the act of turning over the mud, inserting "*Ramk*" (green compost) and replacing the mud. The mud that is dug up (average of 2 feet depth) is turned upside down to bring the decomposed green to the surface thus providing nutrients to the newly planted taro shoots. Once planted, the "*Dekedek*" (green mulch) is applied to the top of the mud surrounding the taro shoots for several purposes: additional nutrients, hold moisture, and prevent growth of weed. These methods among others lead to the *Mesei* being the most productive and sustainable agricultural system in Palau.

According to Dr. Aurora Del Rosario, a researcher from the Palau Community College—Cooperative Research Extension, the average taro patch size in a *Mesei* system is 12 ft by 12 ft and may yield an average of 50 lb of taro per year. The

average number of patches within a *Mesei* is 20 patches. Taro has a very high cultural value and therefore indispensable in cultural exchanges (Del Rosario et al. 2015).

To date, the taro is in high demand because it's a major staple food in the home, used in various traditional ceremonies, and provides a source of income especially for Palauans living in the rural areas of Babeldaob. Lastly, Palau is experiencing a boom in tourism in recent years creating a demand for taro from hotels and restaurants. These are just some of the reasons why the current demand for taro far exceeds the supply.

## Changing Demographics and Urbanization

Since Palau's independence in 1994, all kinds of opportunities are becoming available to young Palauan women including higher education and formal employments that turn into careers. These opportunities enable young Palauans to live abroad during their college years and eventually gain employment outside of Palau. Additionally, the Compact of Free Association allows citizens of Palau to legally live and work in the US and its affiliated states. These and other reasons are resulting in out-migration of young Palauans.

In Palau, Koror is the hub of commerce and employment as well as the seat of Palau High School and Palau Community College, the only public high school and higher education institute on island. For these reasons, many young Palauans choose live and work in Koror. This leaves only grandparents and grandchildren in the rural areas of Babeldaob.

This situation is slowly changing due to the completion of the Compact Road in 2008. The Compact Road is a 52 mile road that circles the island of Babeldaob connecting all 10 states to Koror. Part of the benefit package of the Compact of Free Association between Palau and the US, this road was affectionately called "*Bemrei Highway*" or Come Back Home Highway. One of the main purposes of this road was to enable commerce to spread to Babeldaob enabling the return of Babeldaob people to their home states. As predicted, many Palauans are moving back to their home states resulting in land clearing for the building of homes and *Sers* or dry land farms.

Due to changing demographics and urbanization, the communities in Babeldaob face a double-edged issue. On one hand young women are choosing to join the work forces, working 40+ hours per week in an office leaving no time or interest to work the taro patch. This is partly due to the intensive physical labor required in cultivating a taro patch not to mention having to "get down and dirty" as an average taro patch is two to three feet deep of soft, wet mud. Palauan women choosing to have a career and earn a salary results in a growing number of abandoned taro patches which exacerbates the community's vulnerability to climate change impacts as it threatens food and environmental security for these communities.

On the other hand we have people who are financially secure and are now able to move back to Babeldaob. This results in land clearing to build houses and for *Sers*. Most states in Babeldaob do not have clear regulations regarding land development.

In this instance, this leads to soil and sedimentation deposits in the rivers and eventually draining into the reefs. The urbanization of Babeldaob without clear development regulations results in poorly planned developments that leads to damage to the watersheds resulting in reduced quality and quantity of water supply to the community. This further increases the community's vulnerability to climate change impacts.

## Traditional Soil Conservation

Traditional soil conservation (TSC) consists of agriculture practices that are designed to make Palau's poor soils productive and manage the climate effects of too much rain and tropical heat on agricultural production. These TSC practices are utilized in the cultivation of taro. To condition Palau's poor soils taro farmers use a constant source of organic matter in the form of fresh leaf bulk called "*Ramk*" pushed down into the bottom layer of the soft mud and leaf cover called "*Dekedek*" which is layered on top of the surface of the wet paddy after the taro is planted. Every time taro is planted utilizing this process, bringing up mud from the bottom of the patch that consists of organic matter and pushing down a fresh batch of leaf bulk, the soil becomes more fertile and therefore productive. This cyclic process is how the *Mesei* or taro farm is maintained. There is little soil erosion in this system and maintaining an organic matter layer helps to maintain soil fertility, provides nutrients, and controls weeds. The quality of the taro depends on the amount of water in the paddy. Too much or too little water yields soggy tubers that are considered low grade and at times inedible. The women who work the farms control the water flow and maintain a healthy amount for best quality crops. TSC measures also incorporate agro-forestry practices around taro farms. Trees such as the Pongamia pinnata are nitrogen fixers and are usually found planted along the dykes separating taro farms. The leaves of the pongamia tree are especially good for use as leaf bulk in the taro patch because as they decompose they release nitrogen into the soil which is then absorbed by the taro plants. Additionally the plants around the *Mesei* provide shade and hold moisture in the ground during the drier seasons. The health of the taro farm is dependent on the function of water, trees, shrubs, and grasses which ensure proper fertilization, crop production, and quality of taro corms. (PCS Grant Agreement)

According to the IPCC Report 2014, more than 70% of agriculture is rain fed. This suggests that agriculture, food security, and nutrition are all highly sensitive to changes in rainfall associated with climate change. Adaptation outcomes focusing on ensuring food security under a changing climate could have the most direct benefits on livelihoods, which have multiple benefits for food security, including enhancing food production, access to markets and resources, and reduced disaster risk. Effective adaptation of cropping can help ensure food production thereby contribute to food security and sustainable livelihoods in developing countries, by enhancing current climate risk management (IPCC Report 2014).

## The Resulting Crisis

Sediment arising from erosion on agricultural land lacking any conservation practice is particularly problematic because farming is a key driver of food security. To date, *Sers* or dry land farms, unlike taro farms are contributing to Babeldaob's sediment budget. *Sers* utilize introduced farming practices that aren't always compatible with Palau's soil profile. Additionally, a vast majority of *Sers* occurs on slopes that are cleared and planted with crops such as tapioca, sweet potatoes, other root crops and vegetables. Most *Sers* occur on slopes because Babeldaob Island is characterized by hilly terrain.

The challenge of farming on slopes is exacerbated by Babeldaob's highly acidic soils making large-scale agriculture unfeasible. In highly acidic soils, nutrients dissolve quickly and leach away leaving the soil unsuitable for large-scale farming. Most dry land farmers use fertilizers to increase soil fertility even though it can be quite costly. Additionally, widespread open burning is a common but unsustainable farming practice that releases nutrients resulting in unproductive crops. This is because open burning depletes soil organic matter, kills microorganisms, and leads to long-term land degradation.

Land degradation coupled with increased rainfall events contributes to erosion and sedimentation in estuarine and coral reef systems leading to declines in water quality and productivity of reefs resulting in environmental and food insecurity. As well, sustainable economic development for Palau is greatly dependent on the health of its environment. In this connection, the implementations of best management practices that are Palau-specific and based on traditional knowledge are necessary in order to secure the food, environment, and economic security of the rural communities of Palau. Sustainable economic development will be enabled for these climate resilient communities as agriculture, tourism and other industries will further develop and thrive.

## Project Background

*Reviving Traditional Croplands to Improve Community Climate Resilience* is a project funded by USAID and is being implemented by the Palau Conservation Society (PCS). The timeline for this project is from August 2016 to June 2018. This project focuses on three of the 10 states of Babeldaob, Palau, namely Melekeok, Ngarchelong and Ngaremlengui.

These three project sites were selected based on climate related impact to community landscapes and the community and local government's existing capacity to respond and address those impacts. The village of Ngerubesang in the

state of Melekeok was selected because this village is located along the shoreline and taro farms are susceptible to salt water intrusion and inundation, making them vulnerable to rising sea levels associated with climate change. The village of Imeong in Ngaremlengui State was selected as a project site because a number of taro farms in this village are susceptible to flooding making them vulnerable to projected intense rainy events associated with Palau's climate change profile. The villages of Ngebei and Ngriil in Ngarchelong State were selected because they have taro farms that have consistently been cultivated in the traditional manner and can serve as a control site for project field investigations. Finally, all the three states are rural communities with very little development and minimal institutional structures to manage natural resources or to address impacts of climate change on those resources and as such would benefit from the lessons in storm water management best practices work arising from this project.

Project activities are composed of strategies and actions to "*enhance adaptation and resilience*" (objective 1, Palau Climate Change Policy) with specific emphasis focused on the development of climate change-resilient agriculture and watershed management strategies and interventions. In other words, we are looking to the past to inform the development of solutions that can be applied now and into the future.

Palauans rely heavily on ecosystem services and goods for their livelihoods and cultural practices therefore ecosystem degradation and its associated impact on water quality and biodiversity poses a major threat to communities as it leads to Palau's food, environmental and economic insecurity. This project will address the climate associated drivers of food, environmental and economic insecurity. However, project efforts will be focused on mitigating inadequate agriculture and watershed management and institutional weaknesses of state governments to effectively manage natural resources necessary for a resilient community.

These challenges will be addressed by utilizing a mixture of traditional and modern resource management in an effort to improve watershed management and agriculture in Babeldaob. The major objective of this project is to increase the adaptive capacity of Palau's rural communities by strengthening community and ecosystem resilience to the impacts of climate change. Achieving this objective comprise actions to revive traditional landscapes into productive agricultural landscapes. This includes efforts to document associated traditional ecological knowledge of soil and water conservation derived from a long tradition of taro farming into best practices that can be integrated into existing watershed and resource management regimes. Reviving traditional croplands and sustainably managing watersheds are key actions in Palau's efforts to increase food, environmental and economic security of the rural communities in Babeldaob, Palau.

Additionally, the objectives of this project are aligned with both Palau's Climate Change Policy Framework and Palau's agriculture and aquaculture policy. Specific action of this project will enable Palau to meet a number of objectives in both policies.

## Project Goal

The overall goal of this project is to improve community and ecosystem resilience to climate change by reviving traditional landscapes and its associated ecological knowledge to increase food, environmental and economic security in Melekeok, Ngarchelong, and Ngaremlengui states of Babeldaob Island. Enhancing community resiliency by increasing food security and ensuring ecosystem health of rivers and coral reefs will result in continued provisioning services required by the Palauan people. Project outcomes such as mainstreaming of the taro farmer/state partnership have built in sustainability features because there is interest and means for taro production to occur. The project will also document traditional soil conservation methods, trial test methods on *Sers*, and work with project partners to produce guidance and knowledge documents in an effort to provide reliable information to enable sound decision and policy making for communities and decision makers of the states of Babeldaob. Finally, these tools and guidance will allow community members to become better stewards of their natural resources thereby improving their resilience to climate change impacts.

## Project Components

This project will utilize an Ecosystem-based Adaptation (EbA) approach via three interrelated strategies or components.

Component 1: Improve existing institutional and personal capacities of local or state governments to manage their watersheds via storm water management.

Component 2: Implement priority actions to promote traditional wetland taro farming. These actions will focus on reviving neglected taro patches through the creation of community partnerships and optimizing dry land farming using traditional soil conservation measures.

Component 3: Strengthen knowledge management of Climate Change across all local sectors so that communities are empowered to take local action to address global climate change impacts.

The overall project rationale asserts that effective water regime management in both agriculture production and watershed management must be incorporated in the natural resource management in Palau. As well, this water regime management must utilize traditional soil conservation measures. Traditional soil conservation measures can be used to slow down the rate of water flow to ensure that crops get the water and nutrients they need and used to reduce runoff to ensure that sediment drops from the water column so that it does not enter rivers, streams and the coral reefs. Effective management of water resources through agriculture irrigation or storm water management results in enhanced watershed management. Achieving

effective watershed management improves the health of both terrestrial and marine resources, enhances community development and leads to community resiliency.

A key project outcome is improved governance of watersheds. Project outputs include best practices to manage storm water and storm water management plan which will then be implemented during the project life time and then institutionalized for continuous use. Additionally, the Environmental Quality Protection Board (EQPB) as a technical partner and project implementer has indicated that it will institutionalize the traditional soil conservation measures as best practices for erosion control for farming and other related development at the national level.

## Activity Narrative

Implementation of this project's three components and achievement of its associated objectives provides the foundational building blocks of community sustainability and resiliency in Palau because it ensures that communities are able to develop their economies and society without compromising the health of their natural resources.

- **Objective 1** applies Palau's traditional ecological knowledge of soil conservation to address the problems of sedimentation that is pervasive throughout Babeldaob. These traditional soil conservation measures will be identified and documented during the implementation of component 2 activities of this project. Implementation of storm water management measures utilizing locally relevant best management practices such as the traditional soil conservation measures identified in component 2 are a low technological and low cost measure to ensure that land based activities do not result in erosion and sedimentation. These measures have a high sustainability factor because they are cost effective and easily applied and do not require any engineering knowledge as well as high budgets.
- **Objective 2** identifies and documents traditional soil conservation measures that are utilized in taro farming which can be modified for dry land farming to ensure soil productivity and minimize runoff. These modified practices can then be utilized to reduce runoff from farms, road construction and building development. Additionally, component 2 has the added benefit of increasing food production in the communities as a result of utilizing traditional soil conservation measures to revive non-productive farms.
- **Objective 3** is intended to capture the lessons learned from implementation of components 1 and 2. The overall project rationale asserts that natural resource management in Palau needs to incorporate effective water regime management in both agriculture production and watershed management and that this water regime management is one that utilizes traditional soil conservation measures. Traditional soil conservation measures can be used to slow down the rate of water flow to ensure that crops get the water and nutrients they need and used to

reduce runoff to ensure that sediment drops from the water column so that it does not enter rivers, streams and the coral reefs. Effective management of water resources through agriculture irrigation or storm water management results in enhanced watershed management. Achieving effective watershed management improves the health of both terrestrial and marine resources, enhances community development and leads to community resiliency.

## Conclusion

Palau identified its main vulnerabilities due to climate change in a National Communication to the United Nations Framework Convention on Climate Change (UNFCC). These vulnerabilities are related to: increased drought and storm activity; extreme high tides; sea level rise; coastal erosion; habitat fragmentation; sea surface temperature rise; and coral bleaching. Palau has also identified a number of potential adaptation actions in the areas of water and agriculture, among others. Adaptation measures for water include the following: improved management and maintenance of existing water supply systems is a high priority; centralized water treatment in urban centers; catchment protection and conservation; and drought and flood preparedness strategies. For agriculture, measures include the following: identify and document the uses, potential uses and preferred growing environment for trees and plant species in order to better enable selection of species suited to a particular physical environment; introduction of salt-tolerant root crops for use in low-lying areas; breeding more drought resistant cultivars and crops for use in drought prone upland areas; introduction of alternative cultivation practices such as use of irrigation and raised-bed systems; improved soil and water conservation practices; promote use of Agroforestry; preservation and dissemination of traditional knowledge; and diversification of subsistence crops (Palau Climate Change Profile V2—June 2013).

The goal of this project reflects Palau's adaptation measures. Activities undertaken in this project will enhance community resiliency by increasing food security and ensuring ecosystem health of rivers and coral reefs so that they continue to provide the provisioning services required by the Palauan people. A key project outcome is improved governance of watersheds. Project outputs include best practices to manage storm water and storm water management plan which will then be implemented during the course of the project life time and then institutionalized for continuous use. Additionally, the EQPB as a project partner and implementer has indicated that it will institutionalize the traditional soil conservation measures as best practices for erosion control for farming and other related development at the national level.

Successful implementation of this project will result in state governments with the institutional capacity to manage their natural resources in this changing climate by addressing sedimentation in rivers, streams, and coral reefs. It will result in community members who are food secure therefore resilient with the added value

of increased income. More importantly, the project will build awareness on climate change and storm water management as well as provide knowledge and guidance documents that will enable community members to become better stewards of their natural resources thereby improving their resilience to climate change impacts. These tools will enable decision makers in the communities to put measures in place to ensure future developments can occur without sacrificing the environment of each state. The end result will be improved community and ecosystem resilience to climate change by means of reviving traditional landscapes and its associated ecological knowledge to increase food, environmental and economic security of communities in Babeldaob, Palau.

Sustainable economic development for Palau is greatly dependent on the health of its environment. In this connection, the implementations of best management practices that are Palau-specific and based on traditional knowledge are necessary in order for tourism, agriculture and other industries to develop and thrive. This is the basis of this project.

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