PACC TECHNICAL REPORT 19

JUNE 2015

PACC Demonstration Guide: Piloting climate change adaptation in food production and food security on low-lying atolls of Solomon Islands

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TABLE OF CONTENTS

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This report is an output of the Solomon Islands PACC project. It was written by Mary Taylor, with input from Casper Supa. It was reviewed by Peniamina Leavai (SPREP), Dr Netatua Pelesikoti (SPREP) and Damien Sweeney and Martin Pritchard (Pacific Research and Evaluation Associates).

EXECUTIVE SUMMARY

In Solomon Islands, the Pacific Adaptation to Climate Change (PACC) project focused on food security, with a goal 'to contribute to reduced vulnerability and increased adaptive capacity to adverse effects of climate change in Solomon Islands'. The pilot sites for the demonstration projects were the low lying atolls of Ontong Java and, in a second phase, Sikaiana. These atolls are extremely isolated and are highly vulnerable in many respects. Climate-related threats mainly come from sea level rise and extreme weather events, and impacts on food security include contamination of the freshwater lens affecting crop production. Associated soil salinisation, as well as loss of land through erosion, also have serious implications for subsistence food production in locations that are already stressed.

Project activities began in 2011, building on the experience gained by the Anglican Church of Melanesia which had implemented a food security project in Luaniua, Ontong Java. A comprehensive vulnerability and adaptation assessment was conducted in Ontong Java in May 2011. The PACC project decided to focus its activities in Pelau, the second most populated island in Ontong Java. The project conducted training in atoll farming practices, including permaculture and backyard gardens. Atoll permaculture is an agroforestry gardening system containing diverse trees and food plants and using all layers and levels, and which in time is self-mulching and self-regenerating.

Demonstration plots for atoll permaculture and backyard gardens were established with the communities. Different tree crops, root and tuber crops, vegetables and nitrogen-fixing plants were evaluated for their tolerance to the environment, their suitability to the permaculture system, and their acceptability to the community. The project worked closely with the Ministry of Agriculture and Livestock Development in the selection of planting material for the project and assessment of biosecurity risk where planting materials were moved to the atoll.

Water resources are also vulnerable on the atolls. Most families do not have water storage tanks, and therefore capacity to capture and store water for household and agriculture purposes is limited. Families depend on underground water, which is increasingly contaminated. The project provided water tanks for the communities to assist with the management of water resources.

A simple solar dryer was developed and piloted by the project. Research was conducted on the optimum methodology for processing cassava for long-term storage using the dryer. The Sikaiana community in Honiara was trained in building and using the dryer. In working with the community based in Honiara, the project put in place a measure which would enable the supply of dried cassava to communities on Sikaiana atoll when food gardens were damaged during natural disasters.

In parallel, the project team has been addressing food security and climate change at the strategic level through involvement in the development of the National Climate Change Policy.

ABBREVIATIONS

ACOM	Anglican Church of Melanesia
CBA	Cost–benefit analysis
CePaCT	Centre for Pacific Crops and Trees
EDA	Eastern Development Agency
ENSO	El Niño Southern Oscillation
GCM	Global Climate Model
HHS	Household survey
ITTA	Indigenous Traditional Temotu Agriculture
KGA	Kastom Gaden Association
MAL	Ministry of Agriculture and Livestock Development
MECDM	Ministry of Environment, Climate Change Disaster Management and Meteorology
NAPA	National Adaptation Program of Action
NDS	National Development Strategy
NDMO	National Disaster Management Office
NSC	National Steering Committee
OJWA	Ontong Java Women's Association
PACC	Pacific Adaptation to Climate Change (programme/project)
PACCSAP	Pacific–Australia Climate Change Science and Adaptation Planning program
PCCSP	Pacific Climate Change Science Program
PMU	Project Management Unit
PRA	Participatory rural appraisal
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
SWoCK	Strogem Waka Lo Communiti for Kaikai (UNDP project – enhancing resilience of communities in Solomon Islands to the adverse effects of climate change in agriculture and food security)
UNDP	United Nations Development Programme
V&A	Vulnerability and adaptation assessment

1. INTRODUCTION

The Pacific Adaptation to Climate Change (PACC) programme is the largest climate change adaptation initiative in the Pacific region, with projects in 14 countries and territories. PACC has three main areas of activity: practical demonstrations of adaptation measures; driving the mainstreaming of climate risks into national development planning and activities; and sharing knowledge in order to build adaptive capacity. The goal of the programme is to reduce vulnerability and to increase adaptive capacity to the adverse effects of climate change in three key climate-sensitive development sectors: coastal zone management, food production and food security, and water resources management. The programme began in 2009 and ended in December 2014.

In Solomon Islands, the PACC project focused on food security, with a goal 'to contribute to reduced vulnerability and increased adaptive capacity to adverse effects of climate change in Solomon Islands'. The project focused on the densely populated low-lying atolls which are highly vulnerable to sea level rise and saltwater intrusion into wells and cropping areas. The main activities of the project involved developing atoll permaculture and backyard gardens and trialling solar dryers for food processing and preservation. The project team also worked on mainstreaming of climate change at the strategic level, and helped to develop the National Climate Change Policy.

This demonstration guide provides a comprehensive description of the Solomon Islands PACC project, from inception and early planning stages, through design and implementation, to monitoring and evaluation. Aimed primarily at climate change practitioners across the Pacific region, it gives details of the planning and execution of this food security project, with a focus on lessons learned along the way and best practices identified. As with the demonstration guides from the other PACC projects, the hope is that future projects can build on these experiences, contributing to a more resilient Pacific region.

2. BACKGROUND AND CONTEXT

2.1. Solomon Islands

Solomon Islands is an archipelagic state situated in the south-west Pacific Ocean between latitudes 5° and 13°S, and longitudes 155° and 169°E (Figure 1). The distance between the westernmost and easternmost islands is about 1,500 km. It has a land mass of 28,400 km^2 extending over nearly 1,000 islands comprising nine main island groups (provinces). The capital, Honiara, is located on Guadalcanal, the largest island. The population of approximately 610,000 is mostly Melanesian (95.3%); the remainder are Polynesians (3.1%), Micronesians (1.2%) and others (0.3%) (Index Mundi, 2015).

In 2011, economic growth was a record 10.7% on the back of logging and mining revenue. However, floods in April 2014 seriously impacted on the economy. For 2015, the Solomon Islands Ministry of Finance and Treasury are forecasting a growth of 3.5%. The majority of the population is involved in subsistence/cash crop agriculture, with less than a quarter carrying out paid work (ADB, 2015).

Atoll groups are found to the north in Malaita Province, including Ontong Java, the Sikiana group to the east and Anuta in Temotu Province to the south-east. These atolls are extremely isolated and vulnerable environments. People on the atolls rely on imported rice and flour-based foods, as well as swamp taro, taro, coconut, fish and some other garden produce for their food supply. The main sources of cash income are bêche-de-mer (especially in Ontong Java), smoked fish and trochus shells.

Ontong Java atoll, also known as Lord Howe Islands, is made up of 122 islands. It has the largest lagoon in the Solomon Sea, and is the country's northernmost atoll. The total land area is 12 km^2 with the widest stretch of dry ground on the islands of Luaniua and Pelau measuring only 1 km. No island is higher than 13 m above sea level with most islands 2–3 m above sea level. Islands are composed mostly of coral debris. The two permanently inhabited islands of the atoll are Luaniua and Pelau. Luaniua Island is located in the south-east of the atoll chain and contains the atoll's largest village, with a population of about 2,000. Pelau Island is the second most populated island in the group, located in the north-east of the atoll, with a total population of 800. The two populated islands consist of freshwater swamps where natural depressions have been artificially deepened for mulching pits to cultivate taro, a staple diet on the atoll. Subsistence agriculture on the island comprises production of coconut, swamp taro (*Cytosperma merkusii*), taro (*Colocasia esculenta*), fruit trees, bananas and vegetables.

Sikaiana, located about 90 miles east of Malaita, consists of four separate islets surrounded by a coral reef about 6 miles across. Sikaiana has a resident population that fluctuates between about 200 and 250 people, with approximately 400 Sikaiana people living in other areas of the Solomon Islands, especially Honiara and Yandina.

2.2. Policy and institutional context

Key policies of relevance to agriculture, food security and climate change are described below.

NATIONAL DEVELOPMENT STRATEGY 2011–2020

The overarching development planning framework is the Solomon Islands National Development Strategy 2011–2020 (NDS). The NDS vision is of 'a united and vibrant Solomon Islands' and the overarching focus is 'to build better lives for all Solomon Islanders'. The central focus areas are 'taking better care of the people' and 'improving the livelihoods of the people'.

NATIONAL FOOD SECURITY, FOOD SAFETY AND NUTRITION POLICY 2010–2015

The goal of the National Food Security, Food Safety and Nutrition Policy is to ensure long-term food security and to improve the livelihoods of food producers, consumers and rural and urban communities in Solomon Islands. Specific aims are 'to promote and use sustainable agricultural and fisheries production as core elements for assuring both food security and economic development in the Solomon Islands' and 'increase the capacity for the Solomon Islands to respond in a timely manner to emergencies that adversely affect food security, food safety and nutrition'. The policy highlights the importance of increasing agricultural and fisheries productivity in a changing climate and to achieve this it is necessary to promote farming practices that apply environmentally friendly and organic farming practices, and the development of small household (backyard) gardens.

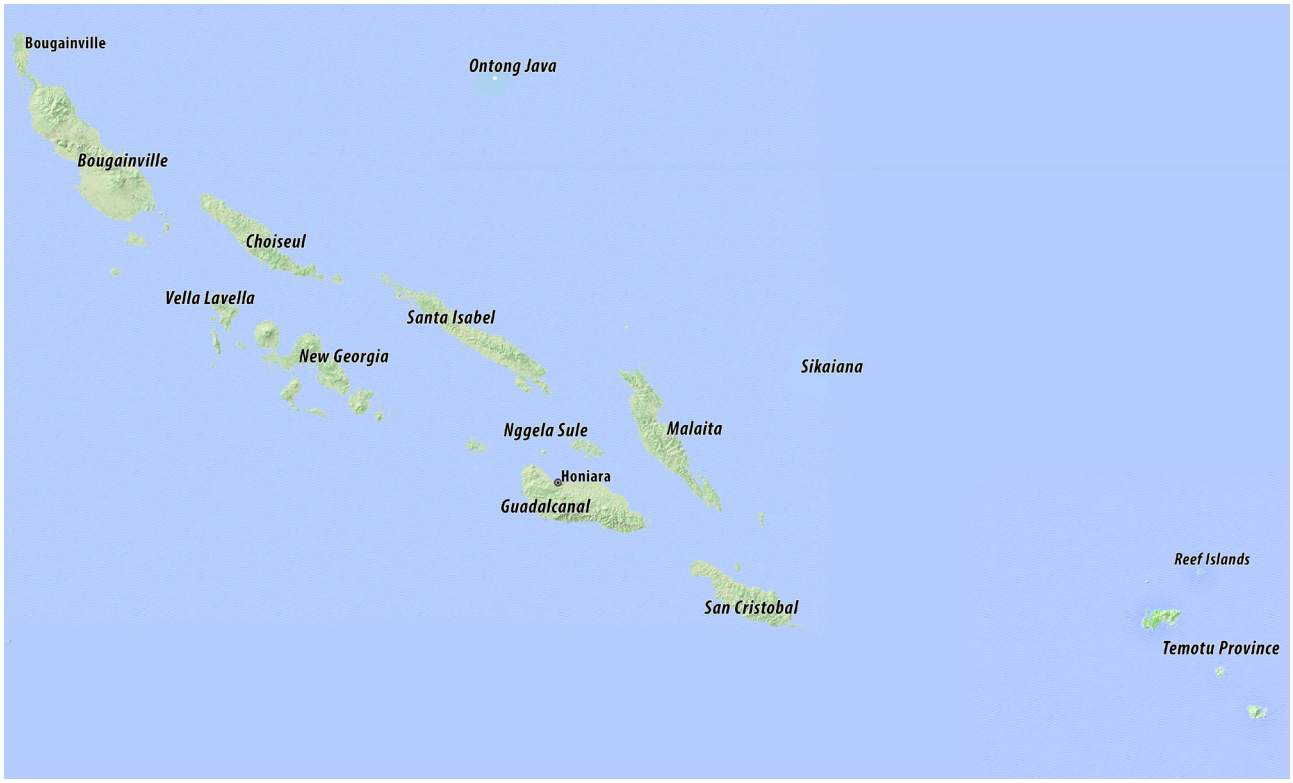

Figure 1. Map of Solomon Islands. Source: OpenStreetMap.

NATIONAL AGRICULTURE AND LIVESTOCK SECTOR POLICY 2009–2014

This sector policy is designed to facilitate a structured approach towards a socially and culturally acceptable, economically vibrant and ecologically sustainable agricultural sector that will contribute to poverty alleviation, food security and economic development. It recommends enhancing the production of staple foods, and promoting risk management and climate change mitigation. The policy lists priority outcomes, which include reduced dependency on food imports and increased agricultural exports.

SOLOMON ISLANDS GOVERNMENT POLICY ON ORGANIC AGRICULTURE SYSTEMS

The overall aim of this policy is to provide safe and nutritious food, and at the same time contribute to improved environmental conditions, and income generating opportunities. The policy recognises that climate change will result in fluctuations in rainfall, often extreme, and therefore it is important that farmers have access to clean water sources. It recommends that farmers focus on rain water harvesting and use of drip irrigation to optimise water use in relevant areas.

NATIONAL CLIMATE CHANGE POLICY 2012–2017

The mission statement for this policy is 'to enhance adaptation, disaster risk reduction and mitigation capacity throughout the Solomon Islands that contributes to increased resilience and achievement of sustainable development goals'. The policy links to the priority sectors of the National Adaptation Program of Action (NAPA) and reinforces their importance as urgent adaptation needs. The policy highlights the importance of technology transfer to enhance the country's capacity to carry out adaptation and mitigation actions, but emphasises that technology transferred should be proven and adaptable, environmentally friendly, appropriate to the user, and culturally friendly.

NATIONAL ADAPTATION PROGRAM OF ACTION (NAPA)

In 2008 Solomon Islands developed a National Adaptation Program of Action (NAPA) with funding assistance from the Global Environment Facility and the United Nations Development Programme (UNDP). The NAPA presents Solomon Islands' immediate and urgent adaptation needs based on rapid vulnerability and adaptation (V&A) assessment in selected parts of the country. The NAPA describes and prioritises the country's vulnerable sectors: (1) agriculture and food security, (2) water supply and sanitation, (3) human health, (4) human settlements, (5) fisheries and marine resources, (6) coastal protection, (7) infrastructure, (8) waste management, and (9) tourism.

2.3. Climate

Information on climate has been sourced from the Pacific Climate Change Science Program (PCCSP) and the Pacific–Australia Climate Change Science and Adaptation Planning program (PACCSAP) (Australian BoM and CSIRO, 2011, 2014).

2.3.1. Current climate

Solomon Islands' climate is tropical with two seasons: a wet season from November to April and a dry season from May to October (Figure 2). The wet season is more marked in the west of the country, while rainfall is more constant year-round in the east. The El Niño Southern Oscillation (ENSO) has a strong influence on the year-to-year variability, particularly in the wet season. The impact of ENSO is stronger in Santa Cruz (east) than in Honiara. Annual and half-year rainfall trends show little change at Honiara since 1950 and Munda since 1962. There is a lack of specific data for rainfall for Ontong Java and Sikaiana, however records for nearby locations, particularly Auki in Malaita, show an annual average of about 3,000 mm, with March the wettest month and August the driest.

Annual and half-year minimum temperatures have been increasing at Honiara since 1953 and Munda since 1962. Maximum temperatures have increased at a rate of 0.15°C per decade since 1951. Minimum temperature trends, however, are generally stronger than maximum temperature trends. There have been significant increases in warm nights and decreases in cool nights at Honiara and Munda. Tropical cyclones affect the country mainly between November and April. An average of 29 cyclones per decade developed within or crossed the Solomon Islands' exclusive economic zone between the 1969/70 to 2010/11 seasons. Wind waves vary across the country, being small at Honiara but much larger at the outlying islands, such as Santa Cruz. The sea level rise near Solomon Islands measured by satellite altimeters since 1993 is mostly over 8 mm per year, larger than the global average of 3.2 ± 0.4 mm per year.

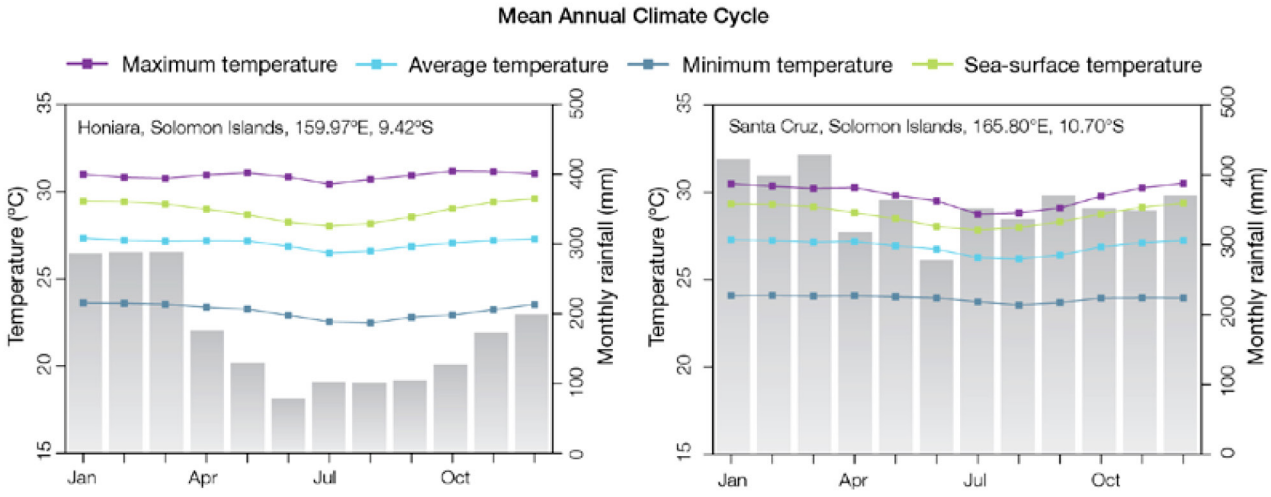

Figure 2. Mean monthly temperature and rainfall for Solomon Islands. (Source: Australian BoM and CSIRO (2011), with permission.)

2.3.2. Climate projections

Global Climate Model (GCM) projections and climate science findings for Solomon Islands for the period to 2100 indicate that:

- El Niño and La Niña events will continue to occur in the future but there is little agreement between the models on whether these events will change in intensity or frequency (very high confidence);
- Annual mean temperatures will continue to rise (very high confidence) (under all scenarios the warming is up to 1.0°C by 2030 relative to 1995, but after 2030 there is a growing difference in warming between scenarios);
- The temperature on extremely hot days is projected to increase by about the same amount as average temperature (very high confidence);
- Annual rainfall is projected to increase slightly (low confidence);
- The frequency and intensity of extreme rainfall events are projected to increase (high confidence);
- Sea level will continue to rise (very high confidence). The GCMs simulate a rise of between approximately 7 and 18 cm by 2030;
- December–March wave heights are projected to decrease (low confidence), while there are no significant changes projected in June–September waves (low confidence);
- There is a growing level of consistency between GCMs that on a global basis the frequency of tropical cyclones is likely to decrease by the end of the 21st century. For Solomon Islands, the projection is for a decrease in cyclone genesis (formation) frequency for the south-west basin. About two-thirds of models suggest the conditions for cyclone formation will become less favourable in this region with about one-third of projected changes being for a decrease in genesis frequency of between 5% and 30%. The confidence level for this projection is medium.

2.4. Risks and vulnerabilities of low-lying atolls

2.4.1. Climate-related risks and vulnerabilities

Climate-related threats mainly come from sea level rise and extreme ENSO events resulting in a contaminated freshwater lens, which will affect crop production, and in particular, taro patches. Reported examples of where this has occurred in the Pacific include Mortlock atoll east of Bougainville (Bourke and Betitis, 2003), Tuvalu (McGregor and McGregor, 1999), and Palau (McGregor, 2011). Islands such as Ontong Java and Sikaiana are very vulnerable to king tides and high swell. The problem of saltwater contamination is likely to be further exacerbated in the future with ENSO-induced tidal fluctuations around an ever-increasing (albeit gradual) average sea level. The associated loss of land through erosion and soil salinisation has serious implications for subsistence food production in locations that are already stressed.

Sea level rise alone, with no changes in climate variability, would increase the risk of flooding and inundation on the low-lying atolls. However, in recent years changes in climate variability in Ontong Java have been observed. Dry seasons have expanded into wet seasons, as experienced in the 2011 El Niño and La Niña events.

An increase in the frequency and intensity of extreme rainfall events is likely to create flooding and waterlogging problems. Waterlogging would impact on crops, for example sweetpotato tuber formation. Despite the projection that the incidence of drought will decrease, the influence of the ENSO cycle on the occurrence of severe drought must be acknowledged. For the atoll countries in the equatorial Pacific Ocean (Kiribati, Tuvalu and Nauru) the La Niña phase can be accompanied by below average rainfall; the extreme drought conditions experienced in Kiribati in 2010/11 corresponded with a prolonged La Niña. Ontong Java and Sikaiana could experience repeated extreme drought events mainly driven by the ENSO cycle. Prolonged droughts will impact on taro cultivation due to the crop's sensitivity to moisture stress.

Long-term variability in temperature and rainfall and an increase in the frequency and intensity of extreme heat and rainfall events are likely to impact on land and marine resources. Anecdotal information from the Pacific

region reveals that farmers have already observed changes in fruiting patterns of many crops, such as breadfruit. High temperatures could also affect yam and sweetpotato tuber formation, and a warming sea is likely to affect the availability of marine resources.

2.4.2. Non-climate drivers of vulnerability

Non-climate factors contributing to vulnerability of the low-lying atolls in Solomon Islands include the following:

- Population growth. According to the 2009 census, the population of Ontong Java stood at 2,857 – a doubling of the population in the 13 years since 1986. Bayliss-Smith (1986) forecast that the population of Ontong Java would reach 1,830 by 1996 and to support this population at current consumption levels would require one or more of the following: (a) the full use of subsistence resources; (b) an intensification of copra production; and (c) further exploitation of bêche-de-mer. However, since then both subsistence production and copra production have declined significantly (McGregor and Supa, 2012).
- Limited sources of income. Marine resources and specifically bêche-de-mer are the main source of income for Ontong Java (95.4%). However due to unsustainable harvesting, the government places periodic bans on harvesting of bêche-de-mer. A three year ban ended in March 2013, but was re-imposed three months later. This ban was lifted in December 2014, allowing the harvesting period to continue until March 2015. As 63% of people's total income accounts for food expenses, the ban reduces the ability to purchase food, directly affecting food security.
- Low soil fertility. Atoll soils are very low in nutrients, particularly nitrogen and most of the trace elements, which poses serious risks to crop production. Two land systems have been identified in Ontong Java. The Lomousa land system consists of deep freely drained soil from coral and mineral sand soils, where the common limiting factors are soil salinity, rockiness, and poor texture. Only coconuts thrive well in this system and they are found in abundance on the islands. The Pusaraghi land system consists of poorly drained peat and alluvium soils which are found mostly towards the back of the islands, about 15 metres from the shoreline. These depressions are suspected to be contaminated with salt due to infiltration of seawater which is currently causing harm to the swamp taro crop (Wall and Hansell, 1976).

3. THE DEMONSTRATION PROJECT

3.1. Objectives, outcomes and outputs

The overall goal of the PACC project is 'to contribute to reduced vulnerability and increased adaptive capacity to adverse effects of climate change in Solomon Islands'.

With food security as its priority focus, the objective is 'to increase the resilience and enhance adaptive capacity of communities, socio-economic activities and infrastructure'.

To achieve this objective, the three outcomes sought by the project are:

- Outcome 1: Climate change coordination mechanisms strengthened for the various institutions dealing with climate change at the national level;
- Outcome 2: Improved ability of isolated low-lying island communities to address food security challenges;
- Outcome 3: Increased understanding of climate change impacts and awareness of how to adapt and build resilience (at community/country level).

The following outputs relate to the above three outcomes and are numbered to reflect the relevant outcome:

Output 1.1: National Climate Change Policy for Solomon Islands approved by Cabinet;

Output 1.2: National and provincial level consultation on the National Climate Change Policy carried out;

Output 2.1: Permaculture system demonstration project delivered (reflecting guidelines);

Output 2.2: Guidelines developed (technical synthesis);

Output 2.3: Backyard gardening encouraged and promoted;

Output 2.4: Food production, processing and preservation trialled;

Output 3.1: Climate change awareness programmes for low-lying island communities are developed;

Output 3.2: Knowledge management products produced.

The project logframe, including indicators, targets and details of data collection, is given in Appendix 1.

This report focuses on activities under Outcome 2, with a brief summary of activities under mainstreaming of climate change (Outcome 1) and awareness and knowledge-building activities (Outcome 3).

3.2. Preparatory phase

3.2.1. Selection of project and site

The early stages of the PACC project involved stakeholder consultations, workshops and focus group meetings with representatives of relevant ministries, government agencies and a non-government organisation in Solomon Islands. Eight government ministries and agencies (Ministry of Agriculture and Livestock Development (MAL); Ministry of Transport, Work and Public Utilities; Ministry of Finance and Development Planning; Department of Environment and Conservation; Department of Mines and Energy; Solomon Islands Meteorological Service; Solomon Islands Water Authority; and National Disaster Management Office (NDMO)) and one non-government organisation (Solomon Islands Red Cross) involving 15 experts were consulted over a period of five days. The purpose of these initial consultations was to select a priority area from the three PACC focus areas of food production and food security, water resources management and coastal zone management; and then to identify a demonstration project within that priority area.

Recognising the huge importance of food production and food security for the country, and the threat posed by climate change, this was selected as the sector for adaptation intervention under the PACC project. As well

as a demonstration project, PACC would assist in integrating climate change concerns into the planning and budgetary processes relating to food production and food security – at the time of the project there was limited integration of climate change adaptation into these aspects.

Criteria for identifying the demonstration project were:

- A strong alignment with the Government's existing programmes;
- All necessary baseline assessments have been carried out, and additional activities are ready for implementation; and
- Ability to co-finance and ability to deliver.

Data provided by the NDMO highlighted the fragility of food security in the low-lying atolls, in particular Ontong Java, the country's northernmost island. Ontong Java is often severely affected by tropical cyclones and other extreme climate events. Cyclone Namu (1986) caused widespread damage to food crop production and the El Niño of 1997/98 brought drought conditions. Cyclone Jim (2006), coinciding with high tides, also affected food production. Food shortages resulted in the government sending a number of shipments with disaster relief.

Even without extreme events, food production on the atoll is affected by saltwater intrusion. The swamp taro sites at Luaniua and Pelau have been inundated with seawater, and at the same time, dry conditions and higher temperatures have increased evaporation rates so the roots of the swamp taro are exposed to higher salt levels for longer periods of time, destroying the crop or rendering it unsuitable for consumption. The main fruit trees, which include cutnuts of both *Barringtonia novae-hibernia* and *Barringtonia procera*, bananas (*Musa* spp.), and crops such as sweetpotato, are also affected by higher levels of salinity as a result of saltwater intrusion.

The high population in Ontong Java depends mainly on subsistence farming, and this encourages over-cropping and soil degradation. Poor soils and little or no crop diversification compounds the problems caused by the inundation and/or intrusion of saltwater into agricultural land. A reliance on the sale of marine products, in particular bêche-de-mer, combined with limited alternatives, also means that communities can struggle securing income to purchase food.

Water resources are also at risk. Most families do not have water storage tanks, and therefore capacity to capture and store water for consumption and agriculture purposes is limited. Families depend on underground water, which is increasingly contaminated.

Based on this analysis, the stakeholder consultations agreed that the PACC adaptation intervention would focus on enhancing the resilience of food production systems and food security on Ontong Java island (Figure 3).

The project began activities in 2011. A comprehensive vulnerability and adaptation (V&A) assessment was conducted in Ontong Java in May 2011. Shortly after the V&A was completed (September 2011), a National Steering Committee (NSC) meeting was held and it was decided that, as the Anglican Church of Melanesia (ACOM) was implementing a food security project in Luaniua, the PACC project would implement activities in Pelau, but build on the experience gained by the ACOM in Luaniua.

3.2.2. Institutional arrangements for the PACC project

The focal point for the PACC project was the Ministry of Environment, Climate Change Disaster Management and Meteorology (MECDM) who have responsibility for all climate change projects in Solomon Islands. The implementing agency was MAL. The Project Management Unit (PMU), comprising the Project Coordinator and Project Assistant, was housed in the Research Division of MAL and was responsible to the MAL Permanent Secretary (the Project Director). The NSC consisted of representatives from MAL, MECDM, Ministry of Development Planning and Aid Coordination, World Vision, UNDP, Sikaiana Community, ACOM and Kastom Gaden Association (KGA). The Chair of the NSC alternates between MAL and MECDM.

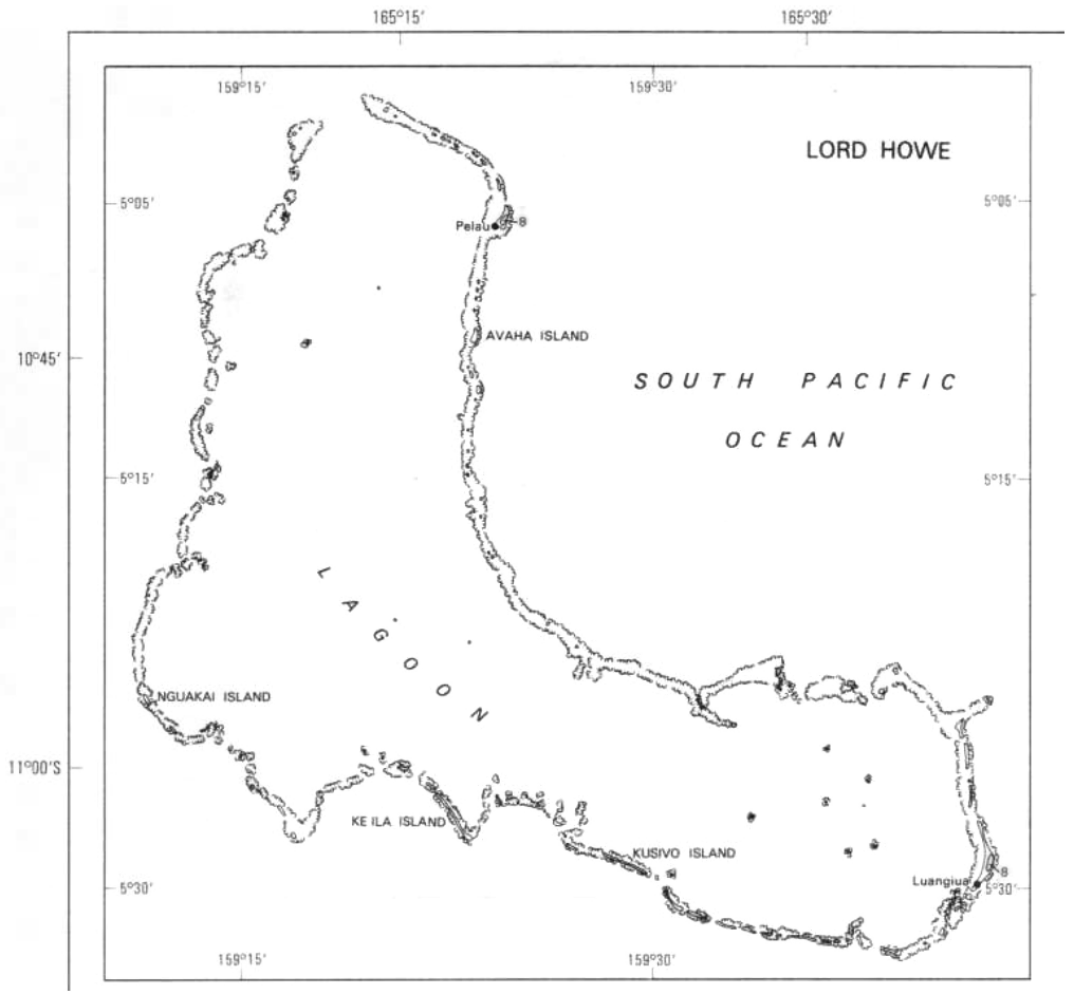

Figure 3. Ontong Java. (Source: McGregor and Supa, 2012.)

3.2.3. Linkages with strategic plans and processes

The PACC project and the interventions on Ontong Java (and later on Sikaina) atolls directly contributed to a number of strategies of the NDS (2011–2020), namely:

- Promote development of environmentally sound and sustainable subsistence-based farming systems, including organic farming, indigenous crops, and improved post-harvest handling, to increase household food security and marketable surpluses and downstream processing;
- Ensure that increased agriculture, livestock and fisheries productivity contributes to sustainably enhanced food security and improved livelihoods of the people of Solomon Islands;
- Mainstream climate change by raising awareness and understanding of government and non-government policymakers and the general public about climate change and its causes and consequences and build consensus to facilitate, coordinate and implement climate change enabling activities;
- Establish a framework for integrating climate change considerations into national development planning and relevant sectoral policies;
- Support conservation and sustainable use of natural resources for food security and agriculture through integrated agriculture and land management strategies and the conservation and rehabilitation of agro-ecosystems.

Similarly, the project is aligned with the goal of the National Food Security, Food Safety and Nutrition Policy, and directly contributes to the major outputs for the outcome 'Sustainable management of natural resources and the environment' under the National Agriculture and Livestock Sector Policy, namely:

- Farmers are shielded from impacts of natural disasters and climate change through disaster and risk management and climate change mitigation;
- Soil conservation and management is enhanced;
- Land fertility and productivity are increased.

Finally the PACC project directly contributes to the NAPA priority sectors (the core of the National Climate Change Policy), in particular:

- Increase the resilience of food production and enhance food security to the impacts of climate change and sea-level rise;
- Increase the resilience of water resources management to impacts of climate change and sea-level rise;
- Promote climate change education, awareness and information dissemination;
- Facilitate adequate adaptation to climate change and sea-level rise in low-lying and artificially built-up islands in Malaita and Temotu provinces;
- Increase the resilience and enhance adaptive capacity of coastal communities, socio-economic activities and infrastructure.

3.2.4. Community engagement

Engaging communities was central to the successful implementation of adaptation activities under the project. In the early stages of engagement, seven public meetings were conducted in Ontong Java (Pelau and Luaniua) and Sikaiana, while four public meetings were conducted in the communities of Matema, Nifiloli, Pileni and Nukapu of Reef Islands in Temotu Province (sites for project upscaling). Consultations were also held with provincial governments in Malaita and Temotu.

The PACC project team first met with Pelau community representatives in Honiara. In late 2012, the PACC team travelled to Pelau and met with the House of Chiefs, the highest authority that represents the community, of Luaniua and Pelau and their Member of Parliament. Through these consultations four farmers were nominated to lead the demonstration trials. Following these consultations the team discussed the project in an open public meeting in Pelau. At this meeting four women farmers were selected to assist the lead farmers and it was agreed that all produce harvested from the demonstration plots would be divided equally amongst the community. The consultations with the House of Chiefs and the community provided an opportunity for the agriculture officers to review the V&A findings (see Section 3.3.1) and obtain feedback regarding the proposed adaptation interventions.

The project team spent three weeks within the community demonstrating farming techniques, and showed interested farmers how to deal with soil infertility and to improve food production. The team also carried out awareness work with the community and encouraged women and young people to take part in agriculture activities. In early 2014 two separate community meetings and consultations with lead farmers and House of Chiefs committee representatives were conducted in Pelau. Community awareness sessions were conducted in Sikaiana prior to the project being extended/upscaled to that island.

Community engagement was considered effective as the majority of the community fully participated in the project activities, which the PACC PMU considered an achievement as the atoll communities are more accustomed to working with marine resources than land resources. Village leaders have shown interest in and commitment to the project by providing their land for use as demonstration plots.

For engagement beyond the project pilot sites, a national communications plan was developed, which included a media strategy. The project engaged trained journalists to produce communication materials which included:

- Quarterly newsletters during 2013 and 2014;
- Four promotional posters;
- Two information pamphlets;
- A factsheet;
- A video – 'Vital Garden';

- A media folder containing all newspaper cuttings;
- Cabinet briefing papers.

Other communications activities at the national level included:

- Radio programmes: the PACC team was provided with the opportunity to talk on 'Farmers', aired by the National Broadcasting Corporation, while community consultations conducted by MAL and PACC PMU featured in the National Radio Program – Solomon Islands Broadcasting Corporation (SIBC) and aired on their news bulletins during 2012;
- Participation in national events, i.e. World Food Day, World Environment Day and World Water Day;
- PACC engaged the Tuvaruhu Youth Group to produce a drama highlighting climate change, which was presented in high schools in two Honiara communities.

3.2.5. Addressing gender

Climate change is affecting all members of the community however the impacts felt by each member are likely to be different depending on their role in the community. Women and men have different roles and responsibilities which determine their knowledge and skills as well as their vulnerabilities. These differences need to be recognised by climate change projects because of their influence on the vulnerability of the community and also the adoption and success of any adaptation approach. Gender consideration is very important for food production and food security projects, where women may have roles in farming as well as responsibility for the family food.

A Gender Action Plan was developed for the PACC programme (PACC, 2014a), with objectives including:

- Adaptation measures in selected pilot communities, and all replication and upscaling activities, address gender-specific vulnerabilities and result in gender-specific benefits for both women and men;
- Women and men at local and national levels acquire technical knowledge and skills to be able to plan for and respond to climate change risks.

The PACC Solomon Islands team pursued these gender objectives. The community in Pelau selected four women to work with the lead male farmers nominated by the House of Chiefs. PACC activities targeted both men and women, with a focus on women where appropriate, for example the cassava processing activities worked with women through the Honiara-based Sikaiana community and the Ontong Java Women's Association.

Gender-sensitive indicators were developed within the project logframe (Appendix 1), and as monitoring and evaluation progresses, these will help to understand how the project is benefiting women and men.

3.3. Problem and solution analysis

3.3.1. Vulnerability assessment

The PMU recognised the need for specific skills to conduct the vulnerability and adaptation (V&A) assessment and engaged a local agency – the Eastern Development Agency (EDA) – to facilitate the V&A on Ontong Java in early 2011. The EDA team, consisting of six facilitators, spent one week in Ontong Java. Prior to undertaking the V&A exercise the facilitators, who were mainly from Ontong Java, received training on the V&A tools and methodologies from the EDA with the support of senior officers from MAL. The V&A covered the following sectors: human settlements and health; water resources and freshwater ecosystems; energy, industry, commerce, and financial services; agriculture, food security, land degradation, forestry, and biodiversity; and coastal zone and marine ecosystems.

The V&A consisted of two main components, a household survey (HHS) and a participatory rural appraisal (PRA). A total of 56 households from Luaniua and 20 households from Pelau (20% of total households) were consulted during the survey. Survey workers, recruited from the Ontong Java settlement in Honiara, used an open questionnaire to encourage responses. Community members (men, women and youths) also took part in the PRA.

The main findings of the V&A are summarised in Table 1. The full V&A report has been published as PACC Technical Report No. 4 (PACC, 2014b).

Table 1. The key issues discussed and main findings from the Ontong Java V&A.

Sector/key area	Key issues	Main findings
Agriculture	Soil fertility and soil erosion Saltwater intrusion Invasive species Land availability Pests and diseases	Older members of the community observed decline in soil fertility and water quality. Loss of traditional knowledge suggested as partly responsible – less priority being given to soil health. Less land available due to coastal erosion, saltwater intrusion and increasing population. Increase in incidence of whitefly affecting banana, pawpaw and fruit trees.
Food security	Limited choice of crops for cultivation in atoll conditions Reliant on imported foods (93% use rice, flour and biscuits) Main source of income is bêche-de-mer; 63% of income spent on food Swamp taro (island's most important staple) affected by saltwater intrusion	100% of survey respondents had a garden, mainly of coconut and swamp taro (80%), but also bananas, true taro (*Colocasia esculenta*) pawpaw and pumpkin. 85% of the respondents eat cassava, supplied by boat from Honiara. People lack income to buy rice and flour when ban on bêche-der-mer is in place increasing dependency on swamp taro – supply can run out in 3–6 months. High swells flood swamp taro pits with saltwater – plants either die or corms are inedible. In absence of swells, rotting of immature plants occurs at the base, suggesting high salt levels around the roots.
Land degradation	Soil fertility Coastal erosion due to storms	Land has been intensively farmed. Older people confirmed that shoreline erosion has intensified in the recent years. Many gathering sites along the coasts have been washed away.
Forestry	Status of forest cover	Forest cover declined due to cutting for firewood for cooking and drying bêche-de-mer, compounded by increasing population – vegetation mainly coconuts growing with sporadic patches of pandanus and shrub undergrowth mixed with ferns.
Biodiversity	Status of biodiversity	Very limited biodiversity which enhances the vulnerability of the communities and reduces livelihood options.
Human settlements	Overcrowding Land shortage Relocation to other islands	Coastal erosion caused people to move further inland. Increasing population and inland relocation causing overcrowding. People are in favour of relocation to other islands but this is based on uncertainty about the future.
Health	Mosquitoes Diarrhoea Non-communicable diseases	Poor drainage in swamp taro pits, increasing temperatures, high rainfall worsening mosquito problem. Contamination of well water increasing diarrhoea. Virtual absence of protective foods (survey showed a very low daily intake of 11.1%) – HHS revealed incidences of high blood pressure and diabetes.
Water resources and freshwater ecosystem	Freshwater availability Saltwater intrusion	13 wells and 68 water tanks on Luaniua; 17 wells and 55 water tanks on Pelau. Average size of tanks is 800 gallons. Well water contaminated with saltwater making it unfit for drinking, therefore community relies on water tanks for good water. Lack of freshwater affects sanitary and health conditions. Change in freshwater status impacting on ecosystem.

Sector/key area	Key issues	Main findings
Energy, industry, commerce and financial services	Energy options Industry status Effect of commerce on communities Banking/credit scheme services	100% of respondents use solar; 83% firewood for cooking; 17% gas for cooking. Firewood use continues to affect vegetation – cutting of trees close to shoreline increases coastal erosion. Small primary industries – harvesting of marine products. Commerce – mainly trading in consumer goods; often at very high prices which affects most vulnerable (women and children). No financial services.
Coastal zone	Sea level rise	HHS revealed change in sea level – beach erosion and coastal flooding. Communities feel that more trees and mangroves should be planted and also a seawall built.
Marine ecosystems	Marine resources as the main livelihood Sustainability	Main resources harvested – bêche-de-mer, shark's fin, trochus, shells. Increasing population putting pressure on these resources, threatening sustainability.

The V&A report proposed a large number of recommendations. Of relevance to the PACC project are the following:

- Promote mixed farming to maximise the output from a relatively small land area. The ACOM is implementing a mixed farming system in Luanuia (atoll permaculture) which includes seven tree crop species, five root crop species (five main varieties of taro), and eight vegetable crop species. The system allows for various levels of shading generated by the canopy and the production of biomass.
- Encourage food processing and preservation using traditional methods, and/or the use of simple technology such as solar power to ensure hygiene in preparation processes as well as in preservation and the length of time they can be stored.
- Supply water tanks to the communities to address water shortage issue.
- Build on the existing project implemented by the ACOM and collaborate with Malaita National Disaster Management Office (NDMO).
- Employ farming methods that will build up soil fertility and trial different crops and varieties to identify those best suited to an atoll environment.
- Engage in advocacy and education on climate change variability and its impacts on the people, livelihoods and environment.
- Conduct specialised training on climate change vulnerability and adaptation issues for selected individuals from the Ontong Java community. Studies and trainings could be provided by training institutions such as Solomon Islands College of Higher Education through its School of Natural Resources Programme, Rural Training Centres and NGOs such as the Kastom Gaden Association (KGA).
- Encourage traditional practices, including agroforestry and food preservation, to improve sustainability and food security.
- Observe strict quarantine measures to manage the safe introduction of new crop varieties. Planting material should only be introduced after proper clearance by relevant government authorities.
- Consult with other Pacific Island countries with atoll environments to source information on crop and farming practice suitability and water management systems and practices.

The V&A generated an adaptation options summary matrix (Table 2).

Table 2. Identified adaptation options summary matrix.

Adaptation option	Effectiveness	Cost	Technical feasibility	Social and cultural feasibility	Implementation rate
Introduce new farming systems, suitable salt-resistant crops, build on existing ACOM food security project	Medium	High	High	Medium	Medium
Traditional food preservation practices	Medium	Medium	High	High	Medium
Supply water tanks for rural communities	Medium	Medium	High	High	Medium
Climate change awareness	Low	High	High	High	Medium
Environment and resource management training for communities	Medium	Low	High	Medium	High
Financial literacy training	Medium	Low	Medium	High	High
Improve communications	Low	High	High	Medium	Low
Improve shipping services	Low	High	High	Low	Low
Relocation plan	Low	High	High	Low	Low

Since January 2011, the ACOM worked in Luanuia, Ontong Java, implementing a two-year food security and climate change project. Following a food security assessment carried out by ACOM, which identified saltwater intrusion and infertile soil as two of the major root causes of food insecurity on Ontong Java, the ACOM project promoted agroforestry gardening and access to good planting material as two strategies which would address these problems, and established permaculture plots to demonstrate these strategies.

In September 2011, the PACC Coordinator presented the V&A report to the PACC NSC to discuss the project approach and adaptation options. It was agreed that PACC would work closely with ACOM because of their existing food security project in Ontong Java, but that activities would focus on Pelau.

The NSC also agreed that:

- The V&A report should be presented to the Ontong Java communities;
- The project would implement farming practices appropriate for atoll agriculture, in particular the atoll permaculture system implemented by ACOM in Luanuia;
- The project would encourage backyard gardening;
- Any crops/varieties to be introduced must be cleared by the MAL Research Department and screened by Quarantine for biosecurity clearance;
- More water tanks would be distributed to support agriculture activities;
- Solar drying should be considered as a project activity.

3.3.2. Cost–benefit analysis

A cost–benefit analysis (CBA) was carried out to help clarify and select adaptation options. The CBA identified three broad project options for improving food production on Ontong Java:

1. Taking measures to reduce saltwater contamination in food production areas. This engineering approach would involve the constructing of seawater retaining walls and the draining of taro swamps.
2. Introducing root crop varieties and cultivars with tolerance to salinity.
3. Modifying the soil and food production environment. This organic systems/soil health approach involves agroforestry, composting, mulching, raised beds, quality seedling production etc. It could also include simple hydroponics.

Option 3 was recommended as having the highest probability of success in the relatively short time frame, and this option was subjected to CBA. The costs considered in the CBA related to collection of baseline information, capital construction costs, and operational activities; while the benefits related to the additional taro production, health benefits from substituting taro for imported grain, and avoided costs associated with out-migration.

The results of the CBA indicated that the proposed package of measures to improve the soil and food production environment on Ontong Java would likely generate net benefits for the Ontong Java community. The CBA further recommended that the PACC project should work with and build on the ACOM project. There are major advantages in having an implementing entity already in place that has learnt from experience and is accepted by the community and the Area Council.

The CBA did not recommend a major focus on the introduction of salt-tolerant planting material, as this would need time-consuming and costly research on salinity levels and salinity tolerance trials. As an alternative, the CBA highlighted the example of the ACOM project in Luanuia, where root crop varieties were imported from Santa Cruz (a small island with similar growing conditions to Luanuia). Communities then selected for taste and yield preferences, without any expectations regarding salinity tolerance. At the same time, the project can build up the soil and enhance soil fertility, and in this way reduce the impact of saltwater intrusion. This approach also demonstrates a more integrated method for addressing salinity issues.

The CBA recommended an approach, in line with traditional food production on atolls (Wall and Hansell, 1976), which integrates the following measures:

- Agroforestry techniques that involve the use of nitrogen-fixing trees and legumes;
- Growing vegetables in raised beds and containers (including appropriate hydroponics) and improved home gardening techniques;
- The establishment of small nurseries for high quality vegetable seedlings and agroforestry planting material;
- The introduction of the 'soils school' extension methodology so people understand their soil and how best to utilise it for sustainable food production.

The CBA highlighted the management challenges that the project would face in view of the isolation and poor communications (shipping and telecommunications) of Ontong Java. The CBA therefore proposed that the Coordinator of the ACOM project be engaged as the PACC Project Manager, and that expertise in organic production, agroforestry etc., be sourced primarily from MAL and KGA. It recommended that the project should focus on developing lead farmers and champions.

More details of the CBA are published in PACC Technical Report No. 2 (PACC, 2013). The outcome of the CBA was presented to senior government officials from MAL, MECDM and other stakeholders.

3.4. Project design and planning

3.4.1. Atoll farming practices

The PACC project engaged the services of the ACOM food security and climate change project coordinator to be the PACC Project Team Leader.

The Project Team Leader, in consultation with MAL Research Department, identified the following food production systems for demonstration in Pelau:

- Indigenous Traditional Temotu Agriculture (ITTA), also know as atoll permaculture, an agroforestry-based gardening system comprising a multi-layered system of fruit and nut trees, vegetables and root crops (see Appendix 2). The basic principles behind the system are permanence, self-mulching, self-sustaining and self-regenerating. Tree crops are the key to the success of atoll permaculture as the main source of biomass.
- Backyard gardens with a focus on composting and mulching.
- Intercropping under coconut.
- Pusaraghi (swamp) farming systems which require heavy mulching of swamp taro pits, therefore planning is required to generate biomass for mulching.

Planting materials for the project were collected from MAL research sites in Temotu and Guadacanal and a nursery in Honiara. The crops and varieties selected were based on suitability for the atoll environment, availability of planting material and community acceptance. For example the taro (*Colocasia esculenta*) variety known as 'selfish taro' was selected because the PACC Team Leader knew this variety grew well on sandy soil in Santa Cruz; similarly banana and breadfruit varieties tolerant of atoll conditions were selected.

Polybags, sawdust and chicken manure were purchased for transporting the planting material to Ontong Java. All planning had to fit in with the shipping schedules. Prior to loading the ship for transporting materials to Ontong Java, a final biosecurity check was carried out on the planting material by MAL Quarantine.

During the planning and design stage the PACC team discussed the timeline and schedule for the implementation of project activities with the Pelau community in Honiara. The Honiara-based community liaised with the community in Pelau.

On arrival in Ontong Java the PACC team met with the House of Chiefs who identified four male farmers to work with the PACC project on the demonstration plots for atoll permaculture. During the public meeting the community highlighted the importance of gender balance and therefore four women were selected to work with the four lead farmers. It was also agreed during the meeting that all produce harvested from the plots would be shared equally among the people in the community.

The permaculture demonstration plot designs were developed with the lead farmers in Pelau (Figure 4). Plots were 50 m x 30 m.

The community and the PACC team agreed that the backyard gardens of the lead farmers would be used to demonstrate best practices in backyard farming. As reported in the V&A, most members of the community had backyard gardens but their contribution to food security was not as effective as it could be, therefore improved understanding of best practices for backyard gardens was needed.

The PACC team also discussed the importance of intercropping with coconuts, in particular using banana, and discussed the spacing requirements when implementing this approach.

The Pusaraghi swamp farming systems had been established prior to PACC and ACOM intervention under government initiatives, but the maintenance of these systems had been poor in recent years. The PACC team highlighted the importance of swamp taro to food security and the need to build up biomass for mulching in the pits.

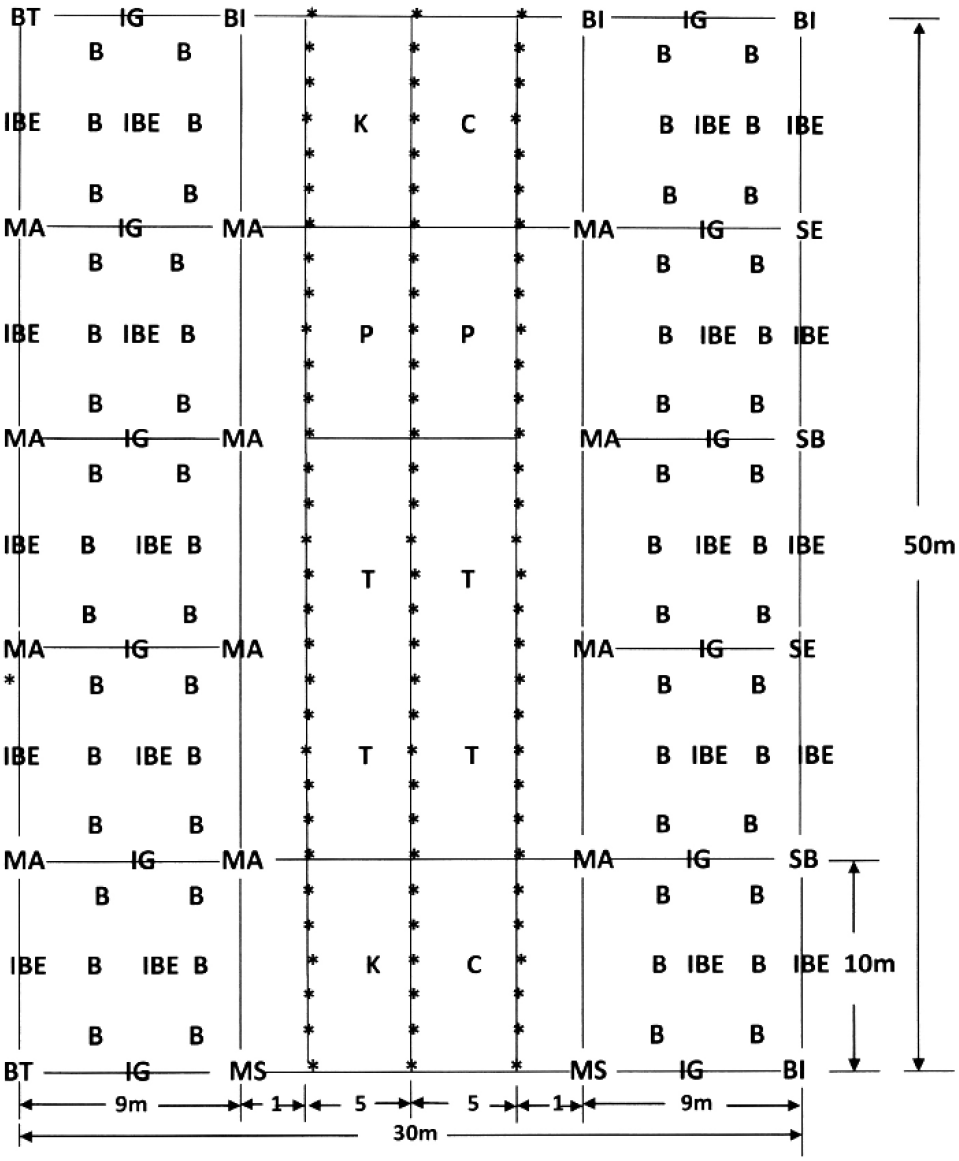

Figure 4. Plot design of one of the permaculture demonstration plots.

BT = *Terminalia catapa* (common name alite), BI = *Inocarpus fagiferus* (Polynesian chestnut), MA = *Artocarpus altilis* (breadfruit), MS = *Spondius cyathera* (funny face), SB = *Burkella obovata* (local avocado), SE = *Eugenia malascensis* (Malay apple), IBE = *Barringtonia procera* (cutnut), IG = *Gnetum gnemon* (king tree), B = *Musa* spp. (banana), C = *Manihot esculenta* (cassava), K = *Ipomoea batata* (kumara/sweetpotato), * = *Leucaena leucocephala* (lusina).

3.4.2. Food processing and preservation

The NSC, in the September 2011 meeting, identified solar drying as the most sustainable and low-input method for food preservation. Local company Maraghoto Holdings was engaged to carry out research into processing cassava for long-term storage. The research demonstrated that cassava can be stored long term providing the cleaning and drying process is thorough.

Agribiz Ltd was then engaged to develop a solar dryer to dry root crops for food processing, for use by communities. The criteria for the dryer were:

- Easy to build, use and maintain;
- Built from local materials where possible;
- Effective primarily with root crops;
- Takes food safety into consideration.

Two solar dryer prototypes were developed by Agribiz, using materials readily available in Solomon Islands with the exception of the plastic covering which was imported from New Zealand. One design relied completely on solar drying whereas the second design was a hybrid, powered by solar and sawdust, so that the dryers could be used in cloudy or bad weather. These simple solar dryers were made using a roll of clear plastic, a roll of wire, a few nails, some timber and some stones. Temperature data was collected two-hourly, day and night, during the testing. The following crops were evaluated: cassava, kumara (sweetpotato), Xanthosoma, banana, coconut, ngali nuts, cutnuts, alite and peanut. The two prototypes were compared with a firewood fuelled oven. Test results showed that the models worked well and, unlike the open dryers commonly used, these models keep insects away from the food.

3.5. Implementation

3.5.1. Farming practices and water resources

A one-week training programme was organised by the PACC team for the eight lead farmers at the site of demonstration plot 1 in Pelau. The purpose of the training was to introduce the farmers to atoll permaculture, explain the design of the permaculture demonstration plot, the crops used and the reasons for their use. The training also covered:

- Handling and caring for plants to ensure survival;
- The importance of mulching and composting:
  - Mulching: the farmers were well versed with mulching as mulches are used in the swamp taro plots. They were advised how to generate more mulching material especially in the context of the permaculture plots, namely to use the plant debris cleared from the plots; and later mulching material would be provided by the green manure crops and the foliage from the trees as they develop;
  - Composting: the permaculture plot, once established, will be self-feeding. Prior to that stage compost will have to be used. Households were informed of the nutrition value of 'rubbish' and advised how to use their kitchen waste and rubbish for compost. In the establishment stage, the lead farmers were provided with fuel so they could visit a nearby island and collect bird manure as a source of fertiliser;
- Backyard gardens;
- Intercropping under coconut, with the focus on utilising banana under coconuts;
- Pusaraghi farming systems for swamp taro and sweet taro (*Colocasia esculenta*, variety 'selfish').

Permaculture plots and backyard gardens were demonstrated to the community. Maintaining the Pusaraghi farming system requires intensive mulching in order to minimise the impact from saltwater intrusion. Generating the volume of mulch is very labour intensive which limits the attractiveness of this farming system for the community; further these swamp taro areas are located away from people's homes, which again adds to the effort needed to maintain these systems.

The following activities were carried out to establish the permaculture demonstration plots.

- Under the ACOM project in Luaniua, plots for permaculture demonstration were completely cleared of existing vegetation. In contrast, the PACC project maintained existing trees to provide shade for plant establishment and to reduce soil disturbance thereby limiting loss of soil and soil nutrients.
- Land clearing and sub-dividing the plot: the four 50 m by 30 m demonstration plots were divided using a pegging frame to make planting easier. Any plant debris cleared from the land was retained for mulching. The beds were edged with old coconut trunks which helped in building up the level of the beds to 30–40 cm above ground level.
- Soil preparation: legume crops (peanut and *Leucaena leucocephala* or lusina) were planted to improve soil fertility. Lusina has been found to grow well in Ontong Java soils. (Mucuna or velvetbean (*Mucuna pruriens*) was tested but germination and growth was very poor – this same poor performance has been demonstrated on other atolls, such as Kiribati.)

- Seedlings of different crops were provided to the Pelau lead farmers (Table 3). Table 3 also shows the seedling numbers needed for further planting of the plots and for members of the community who were keen to plant up their backyard gardens.

The plot was designed so that all tree crops were planted 5–10 m apart depending on the species (Figure 4). Below this tree canopy bananas and pawpaws (papaya) were planted. Other crops, for example cassava, stem taro and kumara, were spaced at 1–2 m apart, within their selected positions. The taro variety 'selfish' (imported from Santa Cruz, Temotu) was the main root crop in the permaculture plots. Pumpkin and peanuts were planted to help in the control of weeds and provide green mulch. Figure 5 shows community members working on establishing the permaculture plots.

Table 3. Crops and seedling numbers provided to farmers in Pelau.

Common name and symbol used in plot	Botanical name	Number of seedlings provided	Additional number of seedlings needed
Breadfruit, MA	*Artocarpus altilis*	30	144
Chestnut, BI	*Inocarpus fagifer*	10	12
Alite, BT	*Terminalia catappa*	70	6
Selfish (sweet taro)	*Colocasia esculenta*	500	900
Stem taro	*Xanthosoma sagittifolium*	500	–
Local avocado, SB	*Persea americana*	20	6
Cutnut, IBE	*Barringtonia procera*	120	60
Lusina, *	*Leucaena leucocephala*	160	150
Funny face, MS	*Spondias cytherea*	20	6
Malay apple, SE	*Syzygium malaccense*	20	6
Giant taro	*Alocasia macrorrhizos*	500	300
Banana, B	*Musa* species	50	120
King tree, IG	*Gnetum gnemon*	–	144
Cassava, C	*Manihot esculenta*	–	As required
Kumara, K	*Ipomoea batatas*	–	As required
Peanut, P	*Arachis hypogaea*	–	150
Pumpkin	*Cucurbita pepo* var. *pepo*	–	As required

Figure 5. Establishing the permaculture plots at Pelau. (Photos: Solomon Islands PACC Project.)

Training was provided in backyard gardening and backyard gardens were established by the four lead farmers. The training drew attention to:

- Making use of the space around the house including the planting of yams in coconut stumps;
- Composting including the use of animal manure, green manure and 'sea soil' (sea soil is a combination of fish by-products and sawdust; seaweed can also be used but must be washed well with freshwater before use);
- Raising seedlings using seed compost comprised of coconut husk and soil (3:1);
- Planting seeds and mulching.

In addition to the training in farming practices, nine water tanks (3 x 5,000 litres and 6 x 3,000 litres) were purchased and supplied to lead farmers in Pelau for agriculture and household water use.

3.5.2. Food processing

The PACC project selected the dryer that uses only solar energy (Figure 6). This model was then constructed with the Sikaina community at Red Beach, Honiara. The foundation floor was a consolidated ground base, with a layer of black sand, followed by a sheet of black plastic, and then another layer of black sand. Large black stones were placed on top of the last layer of black sand. The roofing and wall covering consisted of 'Durashelter Plastic' from New Zealand. There was no outer walling. Thirty Sikaiana women who attended a workshop in backyard farming were trained in both building and using the dryer.

The simple processing method developed by Maraghoto Holdings was demonstrated to the Sikaiana community at Red Beach, Honiara. The process demonstrated was as follows.

- Cassava was purchased from the market, washed, peeled and fully immersed in clean water in separate dishes or buckets. The washed root was chopped to the desired thickness and quickly transferred into water.
- Chopped roots were drained in a perforated dish and weighed, and weight recorded.
- Chopped roots were emptied into perforated trays or a drying net, and time recorded.
- The chopped cassava was weighed at intervals and the drying process continued until the weight was constant. The cassava could be turned to assist even drying. The time for drying varied depending on sunshine hours.
- Once dried, the products were removed from the dryer and placed in an appropriate storage container.
- Cassava should be prepared early in the morning so it can be placed in the dryer by 9–10am.
- Roots/tubers should not be soaked overnight as some, for example cassava, will start fermenting.

Figure 6. The solar dryer. (Photo: Solomon Islands PACC Project.)

Food tasting sessions, which included members of the Ontong Java Women's Association, were conducted at MAL to evaluate both taste and recipes for various dishes using dried cassava. The PACC project also supported the attendance of two women (one from MAL and one from Ontong Java community) and one man (MAL Research Officer) at a food processing workshop arranged by the National Agriculture Research Institute in Papua New Guinea.

3.6. Adaptive management

In the early stages of the project the PACC team recognised the importance of partnerships and out-sourcing to ensure the project could provide all the skills and expertise required for effective implementation. Examples of this approach include:

- Engaging the ACOM Project Coordinator to be the PACC Project Team Leader;
- Engaging skilled journalists to provide the necessary communication materials;
- Partnering with Kastom Gaden Association (KGA) to provide the backyard gardening skills for upscaling of the project to Sikaiana.

Initially the NSC agreed that the PACC project would work with the Ontong Java Women's Association to establish cassava gardens in the Henderson area in Honiara for supplying the solar dryer. However, evaluation of the proposed site revealed it was prone to flooding, therefore this idea was abandoned, and the project focused on working with the Sikaiana community.

Project monitoring was difficult because of the remoteness of Ontong Java and limited communications. The PACC PMU initially planned to visit every three months but bad weather and changes to the shipping schedule often meant these trips had to be cancelled. Therefore the PACC team nominated the lead farmer from permaculture plot 1 to provide monitoring information to the PACC PMU in Honiara.

Trialling crops and varieties for their salinity tolerances would be an impossible task within the duration of the project. The project addressed this challenge by sourcing planting material from Temotu, in particular Santa Cruz Island and the neighbouring Reef Islands, which enabled the MAL officers to select crop varieties likely to perform well in Ontong Java because of similarities in soil type and climate. The results of the ACOM project also provided some information to help with crop and variety selections. However, no planting material was shipped directly from Luanuia to Pelau because of quarantine concerns.

The lead farmers reported a problem with taro beetle to the PACC team. MAL immediately advised the farmers not to plant any new taro and provided training for five farmers (three women and two men) on taro beetle management.

A Mid-Term Review (MTR) was carried out by an external review team in mid-2012. The main recommendations from the MTR and the responses from the PACC team are given in Table 4.

Table 4. Key recommendations from the Mid-Term Review (MTR) team, and responses from the Solomon Islands PACC team.

MTR recommendation	PACC team response
Project needs to focus strongly on building on and extending the successful work done through the ACOM project and to continue working closely with all relevant agencies and projects.	The demonstration work currently undertaken by PACC is building on and extending the work done by ACOM Project. PACC Project has learned from the ACOM project. KGA is partnering with PACC through an agreement made with MAL in implementing backyard garden activities in Sikaiana.
The V&A exercise on Ontong Java, while valuable, needs to be simplified for other sites, in particular relating to the time and effort put into the reports. A simplified approach would be a modified form of the food security needs assessment applied in the ACOM project taking account of lessons learned through the V&A assessment.	The PACC project agrees that the V&A exercise needs to be simplified, however, the processes, approaches and steps taken to carry out this exercise need to be documented or modified as they are important steps to ensure effective on-the-ground activities.
The draft guide on Atoll Permaculture needs to be completed and published so that it can be widely circulated. Input is needed from others including any relevant contributions from KGA and the Maraghoto Ngali Nut Association.	The draft Demonstration Atoll Permaculture Guideline has been contracted to another local consultant for completion. The guide will be circulated to all PACC Stakeholders and NSC members for comment before submitted to PACC RPMU.
The purchase of a video camera is highly recommended so that the Atoll Permaculture work can be fully documented on film. The focus should be on production of short films (5–10 minutes) that capture key information and provide an effective way to share results from remote locations more widely.	Production of a short film to capture key information of PACC demonstrations is currently being undertaken.
It would be valuable to draw selectively on experiences elsewhere. Significant value could be added to the project through learning directly from the work of the Agri-Nature Foundation in Thailand.	The project has involved KGA, a regionally recognised NGO that promotes organic farming practices to improve soil systems contributes effectively to food production and crop yields in the low lying atolls.
PACC needs to consider effective and efficient ways of enabling other low island, coastal and atoll communities in Solomon Islands, other PICs, and other PACC projects to share in the experiences and lessons gained from the project's work on Temotu and Ontong Java.	PACC project is working closely with the MAL Extension Office and Research Department to take the lead in its up-scaling activities for sustainability purposes in Temotu Province. PACC PMU is liaising with World Vision, SI Red Cross and UNDP through SWOCK project.

3.7. Monitoring and evaluation

The project developed a logical framework (logframe) (which was revised in 2014) to support implementation, monitoring and evaluation (Appendix 1).

The NSC met every quarter to discuss the project activities and consider any changes necessary to improve implementation.

The PACC PMU aimed to visit the project site every quarter but this was not achievable due to weather and shipping constraints. The lead farmer from demonstration plot 1 took on the responsibility of monitoring the demonstration plots and feeding information back to the PMU, and this approach worked well. It could however be improved in future projects by providing templates for data collection. Ideally, monitoring would make use of telecommunications if available to allow data to be transferred to the project coordinator based in Honiara. Community-led participatory evaluation methods should be used for projects implemented in remote locations. A post-project community survey was designed but not delivered due to delays in the shipping schedule.

3.8. Communications and knowledge management

The project addressed communications and knowledge management at different levels, and both formally and informally.

Community engagement focused on the communities of the pilot project, and is described in Section 3.2.4. Other key target audiences were identified by the project, at both national and regional levels, and communications products were developed and disseminated. Products aimed at national audiences included radio broadcasts, quarterly newsletters during 2013 and 2014, promotional posters, information pamphlets, a factsheet, a media folder containing all newspaper cuttings, and Cabinet Briefing papers.

For communications and knowledge management targeting audiences beyond Solomon Islands, the PACC webpages (www.sprep.org/pacc), and in particular the Solomon Island project webpage (www.sprep.org/pacc/solomonislands), has been the main dissemination tool used to share information and knowledge generated by the project. Examples include news stories published on the PACC webpages (www.sprep.org/pacc), and further circulated in the online magazine Climate Change Matters; a 'country brief' describing the project and targeting decision makers across the region; and various synthesis publications, in particular the PACC Experiences series (see for example PACC Experiences No. 6: Improving resilience of food systems. Outputs are also being shared through the Pacific Climate Change Portal, and other sites such as UNDP's Adaptation Learning Mechanism, Climate & Development Knowledge Network (CDKN), Eldis and ReliefWeb.

The PACC project team was involved in a number of activities that enabled them to share experiences and lessons learned from the PACC project. For example, the PACC project coordinator took part in a week-long intensive research training event organised by MAL's Research Department, which aimed at developing a set of research guidelines for the Ministry and a research manual.

3.9. Upscaling and replication

The NSC met in late 2012 to discuss the project's achievements and they agreed that the PACC project activities should be replicated in Sikaiana. In June 2013, a consultant was contracted to carry out a technical review of the existing PACC project, and provide advice on whether the project could be replicated and upscaled elsewhere in the country. The review recommended that the adaptation options implemented by the project could be replicated elsewhere, and also made the following recommendations for improving the demonstration project:

- Provide awareness and training on the importance of and techniques for composting to build on the training provided by ACOM;
- Consider varietal diversity as well as species diversity with 'new' crop introductions;

- Increase introduction of breadfruit, especially those varieties that are found growing on atolls. Farmers should be trained in rapid multiplication techniques for trees, such as root cuttings and marcotting;
- Ensure that the problem regarding water resources and water security is addressed through providing adequate water tanks. Some water tanks purchased by the ACOM project remain in Honiara and require shipping to Ontong Java. Each of the four demonstration plots should be fitted with a 2,000–3,000 litre water tank;
- Provide training in nutrition to ensure that the value of fruit and vegetables produced in the plots/gardens is appreciated and the produce consumed;
- Improve monitoring to increase information on performance of demonstration plots;
- Consider engaging a permanent local project staff member to oversee the demonstration plot, keep records and report back progress to Honiara. The person could be trained in skills such as rapid multiplication to help with availability of planting materials for those willing to start planting their own plots;
- Ensure that the impact of the project is monitored because of the long-term nature of many of the crops in the demonstration plots. The impact will be assessed by the extent to which the food security of the community is improved and the adoption of the demonstrated adaptation measures;
- Improve on information available regarding salinity tolerance of swamp taro by requesting and supporting the Secretariat of the Pacific Community's Centre for Pacific Crops and Trees (SPC CePaCT) to evaluate their collection.

In September 2013 a team comprising representatives from MAL, ACOM and the PACC PMU visited Sikaiana to conduct a V&A assessment and identify adaptation priorities for the Sikaiana communities. Prior to this visit a briefing was also held with the Sikaiana community in Honiara. The V&A community consultations included 65 men and 35 women. The community highlighted that agriculture production is already under pressure from an increasing population and increased coastal erosion, and depletion of agricultural areas due to saltwater intrusion into the middle of the island. The community had already experienced shortage of their main staple crops (taro and swamp taro). Most families were growing crops such as bananas, stem taro, kongkong taro, cutnuts, aibika, and pumpkin in their backyard gardens.

The Sikaiana community were not familiar with yam cultivation and therefore the PACC project decided to focus on yam demonstration plots, backyard gardens and food preservation. The yam demonstration plots (15 m by 15 m) used varieties of the species *Dioscorea esculenta*, imported from the Reef Islands. These varieties perform well in drought and heavy rainfall conditions and tolerate atoll conditions. In the demonstration the community was shown how to plant yams for maximum yield in deep, well-composted and mulched pits.

The Sikaiana community practice traditional preservation methods, and the V&A recommended that the upscaling of the PACC project should focus on solar food preservation, which is more efficient and more likely to meet health standards, as the solar dryer is enclosed and therefore the food is protected from flies. Other recommendations from the V&A included improving farming systems; introduction of selected crops and trees; and planting of coastal areas to provide protection against storm surges.

On the island of Sikaiana, the village is partitioned into three wards, Vao, Loto and Tepa. Each ward has its own chiefs and community representatives. The selection of the three sites for the demonstration plots and the seven backyard gardens was agreed communally however other individuals also invited the PACC team to establish a backyard garden at their home. An agreement was made between MAL and KGA for KGA to take the lead in the backyard gardening work because of their vast experience in this area. Backyard gardening guidelines were developed and a draft is available.

Three water tanks (3,000 litres) were supplied for agriculture demonstration activities and household use in Sikaiana.

The PACC project also conducted a backyard farming workshop for 30 women and six male youths from the Sikaiana community residing in Honiara. The workshop lasted for three days and focused on improving the productivity of a small area of land, relevant for the community's urban and atoll homes. After the workshop the participants were provided with gardening tools.

Communities from other low-lying atolls, such as the Reef Islands (Temotu Province), were also keen to participate in the project, and a provincial consultation was held with the Temotu Deputy Provincial Secretary to discuss the possibility of PACC extension to other atolls islands in Temotu. The project received funding from 'PACC+', additional funds provided by the Australian Government to support upscaling activities, to upscale the work in the Reef islands, and consultations have been held with three communities, namely Matema, Pileni and Nifiloli.

The UNDP food security and climate change project (SWoCK) and the Solomon Island Marketing Authority are interested in using the solar dryer in their work.

3.10. Mainstreaming climate risk at the strategic level

The Solomon Islands PACC team devoted significant effort to the mainstreaming of climate change into policy at the national level, and the project made a significant contribution to the National Climate Change Policy (Output 1.1), which was launched in June 2012. In developing this policy the PACC teams were involved in a total of 14 consultations. For most provinces two meetings were held, one with the provincial government and one with other stakeholders. Women were involved in most consultations (about 80%).

The consultations focused on recent developments in international climate change negotiations, how to determine strategic priorities for national climate change action, how to ensure a nationally coordinated approach to addressing climate change, and how to help Solomon Islands take advantage of new opportunities that climate change brings. The consultations also promoted awareness on climate change issues and discussed the impact of climate change on communities.

A final workshop was held at the national level to finalise the policy, attended by senior government officials, provincial governments, officials from relevant government ministries, donor agencies, the private sector and business organisations, and senior government legislators.

The high level of stakeholder representation in the project's NSC also reflects efforts to raise awareness and mainstream climate risk across the many agencies.

4. PROJECT IMPACT

4.1. Sustainability

Because of the remoteness of the project site, the lead farmers took on a lot of responsibility for the project. Four permaculture demonstration plots were established in Pelau community by the project but another two plots were established by other farmers (early 2013) with support from one of the project's lead farmers. Lead farmers were also responsible for harvesting and distributing the produce from the plots. This approach increased self-reliance and also ownership of the project, adding to its sustainability.

The self-mulching, self-regenerating and low-maintenance aspects of the permaculture approach make it a sustainable system for producing food.

Building the solar dryer with the Sikaiana community in Honiara, rather than building it elsewhere and shipping it in, was an important step in strengthening the sustainability of this project output. In training the Sikaiana community in Honiara to use the dryer, the project ensured access to cassava through the market, thereby contributing significantly to food security (because the dried cassava can be shipped to Sikaina) and sustainability.

Project activities were linked to the National Development Strategy sectoral policies to ensure sustainability after the project finishes. MAL staff were very closely involved with the project from planning through to implementation. MAL staff were very supportive of the project and intend to ensure MAL extension officers provide the Pelau and Sikaiana communities with the necessary technical support to continue the approaches introduced by the PACC project.

Of the two sites where the PACC project has carried out activities, the Sikaiana community were more enthusiastic than the Pelau community. This is likely due to a number of reasons:

- Involvement of the Sikaiana community in Honiara;
- Backyard gardens were the main activity implemented in Sikaiana, which involved more members of the community compared to the major activity implemented in Pelau (permaculture plots), which involved only eight farmers;
- The Sikaiana community does not rely as much on marine resources for their livelihood as the Pelau community, and therefore was more receptive to farming.

For these reasons and also the involvement of Kastom Gaden Association (KGA) in the Sikaiana project, which resulted in six people (four men and two women) from Sikaiana becoming members of the KGA Planting Materials Network, the project activities are more embedded in the Sikaiana communities (on the island and in Honiara) and therefore more likely to be sustained in the long term. Further, one of the final activities of the project was training for nine people from Sikaiana (three from each ward) through one-week-long attachment with KGA in Honiara. Of the nine people, three were teachers (two women and one man).

4.2. Relevance

Agriculture under atoll conditions is notoriously difficult due to poor soils, limited water availability, harsh environmental conditions and the scattered and isolated nature of the islands. The farming practices introduced by the project, in particular the self-sustaining permaculture, are characterised by low levels of external inputs and the intensive use of local materials, which are very relevant considering the difficulties and cost of accessing non-local inputs.

Building up the soil through the use of compost and mulching is a very relevant approach on a low-lying island where saltwater intrusion is the main challenge. Very little is known about the salinity tolerance of Pacific crops, except from anecdotal information which infers that some varieties of swamp taro or breadfruit, for example, are more tolerant than other varieties. As Webb (2007) points out the response of giant swamp taro to salinity is complex. The duration and intensity of any salinity event have to be considered, along with other environmental

conditions such as shade, soil conditions, planting depth etc., which makes determining salinity tolerance difficult. However, importing crops and varieties from islands with similar challenges is an appropriate option, in the absence of any scientific data or the time and space within the project to carry out trials.

The development of a solar dryer so that dry food could be shipped to atoll communities is also a very relevant approach for communities whose crops could be wiped out through storm surges. To have access to dried food, whether on island or food that could be easily shipped to the island, not only strengthens food security but also provides an opportunity to improve nutrition, if communities can be encouraged to consume cassava rather than white rice and other imported foods that are often low in nutrition.

4.3. Effectiveness

The project was effective in that it provided farmers and communities with farming practices that could generate food from marginal land. Lead farmers in Pelau were asked for planting material by other interested members of the community who wanted to develop permaculture on their land. There was particular interest in taro, banana and breadfruit and the lead farmer provided 100 taro suckers to 10 families in Pelau through their respective House of Chiefs. One farmer wanted to establish a breadfruit collection of different varieties. The project was effective in strengthening food security through introducing a more diverse range of crops than had previously been grown in Ontong Java or Sikaiana.

4.4. Efficiency

There were some significant delays in the implementation of the project due to funding problems and also the challenges involved with having project sites so far from the PACC main office, with access dependent on shipping and the weather. Putting in place a local staff member could have speeded up the on-the-ground work in Ontong Java and Sikaiana. The project spent a considerable amount of time on Outcome 1 which then delayed the implementation of the agriculture-based activities. Lack of a nursery to bulk up the planting material also resulted in shortages of planting material for the initial activities; this could have been avoided if the agriculture work (Outcome 2) was started in parallel with Outcome 1, but at the same time this would only have been possible provided there was access to funding.

Engaging the services of the ACOM Project Coordinator as the PACC Project Team Leader was invaluable to the project. This approach ensured that lessons learned from the work of ACOM in Luanuia were taken into account in the project activities implemented in Pelau, and avoided any unnecessary repetition.

5. LESSONS LEARNED

The following are the main lessons derived from the Solomon Islands PACC project, which may be used to inform similar projects in the Pacific region in the future.

- The project showed the importance of identifying where skills and expertise were needed and the partners that could bring those skills and expertise to the project. The involvement of MAL in the project has been crucial to its success, both in the short term and for long-term sustainability. The Director of Research of MAL commented that "This was the first time that Quarantine has been used for such a programme and it speaks well of the level of cooperation between the departments of MAL." Other important partnerships included ACOM, Kastom Gaden Association and the Ontong Java Women's Association. Collaboration and partnerships have been a major part of the project's history since its establishment.
- Building on the work of ACOM and engaging the services of the ACOM Project Coordinator as the PACC Project Team Leader was invaluable to the project. This approach ensured that lessons learned from the work of ACOM in Luanuia were taken into account in the project activities implemented in Pelau, and avoided any unnecessary repetition. Extending the farming practices such as permaculture from Luanuia to Pelau added to the knowledge bank of atoll permaculture development.
- Ideally crops and varieties known to be salinity tolerant should be introduced to any atoll environment, however, in the absence of such information, the project introduced crops and varieties from a similar environment. A notable success has been the introduction of a variety known as 'selfish taro' from Santa Cruz (Temotu), which has proved very popular in Pelau and has been named 'sweet taro'.
- The project recognised the difficulties resulting from a remote and isolated project site and therefore gave a lead farmer responsibility for monitoring the permaculture demonstration plots and reporting back to the PACC PMU. This approach worked well and the farmer was involved in the development of two permaculture plots outside of the project.
- This food security project recognised the importance of food processing and preservation for atoll-based communities. Supplies of dried cassava can be distributed to communities when food gardens are damaged during natural disasters. This approach is also unusual in that it put in place measures away from the community directly affected by the climate event.
- There was a shortage of planting material, in particular for members of the community keen to establish backyard gardens. The project should have allocated sufficient time for bulking up planting material, so that sufficient planting material would be available for farmers wanting to adopt the demonstration measures. Enthusiasm is easily lost if planting material is not available.
- Identifying the factors that affect the adoption of climate change adaptation approaches is important. The project identified labour input as a potential deterrent in the uptake of an adaptation approach. Backyard gardens were generally more attractive because they were close to houses and required less labour input than other approaches, such as the Pusuraghi farming systems which needed intensive mulching to be effective.
- The replication of this project to other sites in the Solomon Islands will rely on ensuring the same project staff/participants are involved in the replication and/or the accurate recording of information. The replication of this project to another country will be, to a large extent, dependent on the accurate recording of information. The project adapted well to the remoteness of the project site in Ontong Java through involving the lead farmer(s) in monitoring and progressing project activities, however the farmer was not trained to record information and produce reports. For this reason, if funding was available, another approach would be to have in place a local staff position to oversee the demonstration plot, keep records and report back to Honiara. The person could also be trained in skills such as rapid multiplication to help with ensuring sufficient volume of planting material for interested farmers.

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APPENDIX 1. LOGFRAME OF THE SOLOMON ISLANDS PACC PROJECT (EDITED EXTRACT)

Project description	Indicator	Source / data collection method	Baseline	Target
Goal: To contribute to reduced vulnerability and increased adaptive capacity to adverse effects of climate change in Solomon Islands				
Outcome 1: CC coordination mechanisms strengthened for the various institutions dealing with climate change at the national level	Sector plans (at ministerial/department level) modified in line with new National Climate Change Policy	Sector plans	No sector plans in line with NCC policy	Five sector plans or policies incorporate NCC policy
	No. of govt. agencies briefed about climate change and how to incorporate adaptation measures	Training/briefing/ meeting records	No govt. agencies incorporating CC adaptation measures	Five govt. agencies briefed on CC impacts and adaptation
	National Climate Change Working Group meetings No. of meetings Who attended (gender disaggregated) Actions from meetings	Meeting records/ minutes	A strong institutional set up at the national level albeit new to address climate change and include the following: National CC Council, MECDM, MAL, NCCCT, PACC NSC, PACC Technical Team, PACC Village Committees	CC coordination mechanisms strengthened. A systematic and able CC coordination mechanism is strengthened to address CC adaptation in the Solomon Islands
Output 1.1: National Climate Change Policy for Solomon Islands approved by Cabinet	Parliamentary approval records are available	Cabinet records Office of the Prime Minister MEDCCM MAL	No policy guidance on addressing climate change exists at the national level	A National Climate Change Policy document developed through public consultation and endorsed by Cabinet exists and is shared with all relevant stakeholders
	No. of women's ministries or departments, women's NGOs and CBOs and gender focal points involved	Meeting records		Female representation at meetings Vois Blong Mere (biggest women NGO) consulted Women's group in outer island communities consulted

Project description	Indicator	Source / data collection method	Baseline	Target
Output 1.2: National and provincial level consultation on the National Climate Change Policy carried out	No. of meetings	Meeting records	No consultation with provincial level on CC	Meetings with each provincial govt.
	No. of people attending (male/ female)	Meeting records		Consultation with men, women, and representatives of government, private sector, community
	No. of comments/ feedback received (and incorporated into final CC policy)		No stakeholder input into CC policy	Provincial level input into CC policy
Outcome 2: Improved ability of isolated low-lying island communities to address food security challenges	Total no. of people and communities benefiting from project (gender disaggregated)	Lead farmer feedback or other	No beneficiaries	At least 8 lead farmers (4 men and 4 women) and 100 people in Pelau (OJ) and 200 in Sikaiana
	No. of consultations with provincial govts involved with PACC demonstration (Malaita and Temotu)	Meeting records	No consultation with government	Provincial governments consulted at least once in design phase
Output 2.1: Permaculture system demonstration project delivered (reflecting guidelines)	No. of permaculture plots established	MAL field monitoring reports, PACC Project (SI) Field Reports, PACC Demonstration Team Leader's Report, ACOM FSP Report	Five plots have been set up (4 at Luaniua and one at Pelau)	Thirteen (13) permaculture plots established
	Salt-tolerant crops trialled (crop varieties resilient to adverse CC used)	MAL field monitoring reports, PACC Project (SI), PACC Demonstration Team Leader's report, ACOM FSP Report	No varieties trialled	At least 9 varieties trialled

Project description	Indicator	Source / data collection method	Baseline	Target
Output 2.2: Guidelines developed (technical synthesis)	Atoll permaculture system guide for atoll islands (gender sensitive)	Final guideline published	No guide	Guide developed
Output 2.3: Backyard gardening encouraged and promoted	Backyard gardening guideline developed	Final version of guide Project records Household survey	No backyard gardening guideline	Backyard gardening guideline available
	% of households engaged in home gardening in Ontong Java and Sikaiana (PACC+)	PACC Demonstration Team Leader's report	Only 10% of households engage in backyard gardening	70% of households garden at their backyards
Output 2.4: Food production, processing and preservation trialled	No. kg or jars etc of food preserved with solar units Satisfaction rating for usefulness of solar dryer, and quality of solar dried food No. of women taking part No. kg or shipments of preserved food from Honiara to Ontong Java and Sikaiana No. of families benefitting	Ontong Java Women's Association records Interviews Photos	No food preservation methods available	At least one food preservation technique made available and women trained
Outcome 3: Increased understanding of CC impacts and awareness of how to adapt and build resilience (at community/country level)	Change in understanding of CC impacts (gender disaggregated)	Community survey (note: post-project survey not delivered)	People of low-lying communities have little understanding of climate change	80% of the population understands climate change.
Output 3.1: Climate change awareness programs for low-lying island communities are developed	% of comms plan implemented Number and type of activities delivered	Communications plan	No national comms plan for PACC project	National Comms Plan for PACC project exists by 2013

Project description	Indicator	Source / data collection method	Baseline	Target
	No. of public meetings in three communities in low-lying islands conducted No. of people attending (gender disaggregated)	MAL field monitoring reports, PACC Project (SI) field reports, PACC Demonstration Team Leader's reports, ACOM FSP Report	Four (4) public meetings held	Seven (7) public meetings held
Output 3.2: Knowledge management products produced	KM products	KM products register	No KM products	Climate change brochures, posters, quarterly newsletters and pamphlets developed and made available to the communities, VA reports, short films, technical guidelines, technical report- solar dryer

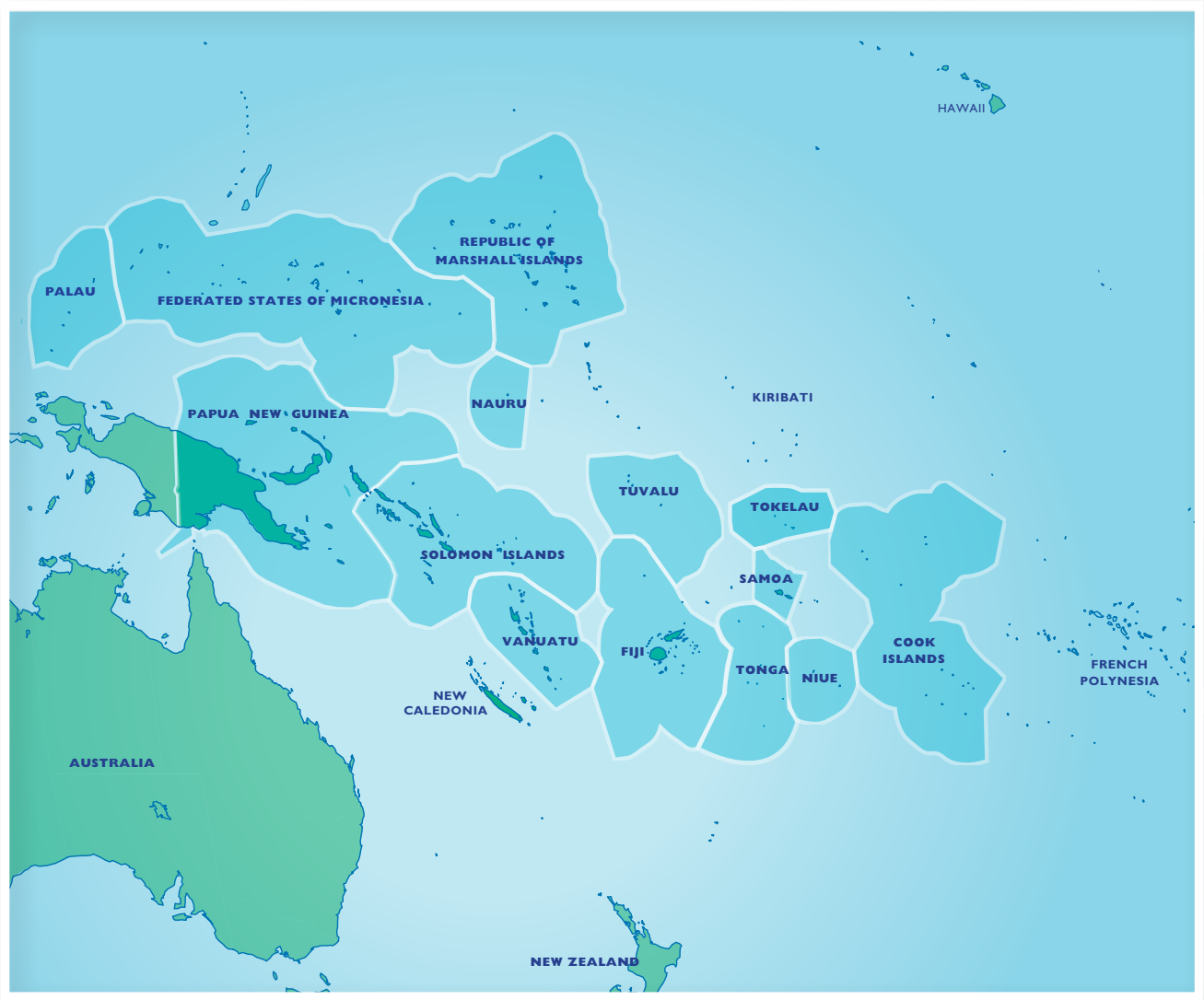
APPENDIX 2. IMPROVED TEMOTU TRADITIONAL AGRICULTURE (ITTA)

ITTA, also called 'atoll permaculture', is an agroforestry gardening system used by over 400 farmers in the Temotu Province of Solomon Islands. The system was developed in the 1980s and 1990s as a method for farmers to improve degraded land. The main characteristic of the ITTA is that it is intensive – it is a tree-based multi-storey structure containing diverse food plants and uses all layers and levels. The tallest fruit trees make up the upper storey, medium and smaller trees grow underneath and beside them, and at the ground level are the root crops. Plants in the lower canopies must be able to grow well in the shade. Root crop vines, such as yams, are trained to grow up live trellis plants such as the king tree.

The crop species used in this multi-storey system can be divided into salt-tolerant and not salt-tolerant; the latter are the species suited for raised beds.

Species that tolerate salt	Species that do not tolerate salt
Alite (*Terminalia catappa*)	Banana (*Musa* spp.)
Polynesian chestnut (*Inocarpus fagifer*)	Cassava (*Manihot esculenta*)
Breadfruit (*Artocarpus altilis*)	Kong kong taro (*Xanthosoma* spp.)
Funny face/inkori (*Spondias cytherea*)	True taro (*Colocasia esculenta*)
Malay apple (*Eugenia malaccensis*)	Shade pana (*Dioscorea esculenta*)
Local avocado (*Burckella obovata*)	Pacific yam (*D. nummelaria*)
Stem taro (*Alocasia* spp.)	Eggplant (*Solanum melongena*)
Topia (*Alocasia* spp.)	Slippery cabbage (*Abelmoschus manihot*)
	Pawpaw (*Carica papaya*)
	Pumpkin (*Cucurbita pepo*)
	Sweet potato (*Ipomoea batatas*)
	Yard-long bean (*Vigna unguiculata* subsp. *sesquipedalis*)
	Chilli pepper (*Capsicum frutescens*)

Crops are spaced on a 15 m x 15 m grid in the tree based system – especially the upper canopy trees. The lower canopy trees are planted on the mid points of the 15 m x 15 m squares. Crops below are spaced as appropriate for each crop, for example taro will be planted 0.5–2.0 m apart, depending on the variety.



PACC – building adaptation capacity in 14 Pacific island countries and territories

PACIFIC ADAPTATION TO CLIMATE CHANGE (PACC) PROGRAMME

The PACC programme is the largest climate change adaptation initiative in the Pacific region, with activities in 14 countries and territories. PACC is building a coordinated and integrated approach to the climate change challenge through three main areas of activity: practical demonstrations of adaptation measures, driving the mainstreaming of climate risks into national development planning and activities, and sharing knowledge in order to build adaptive capacity. The goal of the programme is to reduce vulnerability and to increase adaptive capacity to the adverse effects of climate change in three key climate-sensitive development sectors: coastal zone management, food security and food production, and water resources management. PACC began in 2009 and is scheduled to end in December 2014.

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www.sprep.org/pacc

PACC TECHNICAL REPORTS

The PACC Technical Report series is a collection of the technical knowledge generated by the various PACC activities at both national and regional level. The reports are aimed at climate change adaptation practitioners in the Pacific region and beyond, with the intention of sharing experiences and lessons learned from the diverse components of the PACC programme. The technical knowledge is also feeding into and informing policy processes within the region.

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