OFFICE OF THE PRIME MINISTER

COOK ISLANDS TECHNOLOGY NEEDS ASSESSMENT REPORT

Cook Islands Climate Adaptation Technologies

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Foreword

BY THE DIRECTOR, Wayne King

Kia Orana,

Technology is playing an ever increasing role in addressing climate change, whether it relates to mitigating, reducing emissions of greenhouse gases going into the atmosphere or adapting to the increasing impacts of climate change. There are no boundaries in these circumstances. Countries are bound by being a part of the international community and are fully aware that in their own jurisdictions they have to undertake action.

While the Cook Islands is a very small member of the international community; it needs to understand and respond to climate change, within the same frameworks as much larger members. In addition the country has highlighted at the highest level our concerns and the lack of efforts some are making in this regard.

The Technology Needs Assessment (TNA) is a small slice of the effort the Cook Islands is making to address the overall impacts of climate change. It is not an isolated set of activities, strategies or plans. Rather it is a set of distinct and strongly linked areas of consultation, planning, and foresight. This takes the TNA into the midst of design and development within a much larger sphere of work.

The TNA is the first step toward identifying relevant and appropriate technologies the Cook Islands can eventually utilise within its own development paradigm- one where climate change is overlaying development priorities. How can this be achieved, and for what gain?

The Cook Islands has been designated as a direct accredited entity to the Green Climate Fund and to the Adaptation Fund-both being multilateral finance mechanisms under the UN Framework for Climate Change and its Paris Agreement. Currently, the Cook Islands is at the stage of preparing a larger scale programme which will incorporate the identified technologies, and their uptake, through a set of barrier analysis. This will comprise of technical, financial, and policy constraints needed for the larger proposal to proceed, which is in essence, all of the factors that is the enabling environment for the technology to succeed as a measure of its benefit to all in-country.

The TNA is the first step toward implementing the identified technologies, and is already mainstreamed into the development of our larger scale programmes for which we are seeking the financial resources to prepare and then implement the programme across the entire country.

I commend the efforts of all those involved toward this end, and believe we will succeed in defining our own circumstance and eventual implementation in a structured and cohesive manner.

Acknowledgements

The Director of Climate Change would like to acknowledge the contribution of all public and private stakeholders from different sectors who were involved in preparing and finalising the Cook Islands Technology Needs Assessment report.

The report has been compiled by the Climate Change Cook Islands division and Central Policy and Planning division of the Office of the Prime Minister.

Finally, special mention to Dr Christina Newport of Akairo Consulting and Mr Raymond Newnham of Ora Moana Ltd who prepared the final Cook Islands TNA Mitigation and Adaptation assessment reports.

This report has been prepared for the Government of Cook Islands, coordinated by the Office of the Prime Minister with funding from GEF through UNEP.

List of Acronyms

AIT	Asian Institute of Technology
CIGov	Cook Islands Government
CIGT	Cook Islands General Transport Ltd.
CINIIP	Cook Islands National Infrastructure Investment Plan
CIREC	Cook Islands Renewable Energy Chart
CI TNA	Cook Islands Technology Needs Assessment Project
CP	Climate Change Country Program
CPU	Coastal Protection Units
COP	Conference of Parties
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTCN	Climate Technology Centre and Network
GCF	Green Climate Fund
GHG	Greenhouse Gas
GEF	Global Environment Facility
GHGI	Greenhouse Gases Inventory
ICI	Infrastructure Cook Islands
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
JNAP	Joint National Action Plan for Disaster Risk Management and Climate Change Adaptation
MCA	Multi-Criteria Analysis
NCDs	Non-Communicable Diseases
NDCs	Nationally Determined Contributions
NSDP	National Sustainable Development Plan
OPM	Office of the Prime Minister
REDD	Renewable Energy Development Division
SDGs	Sustainable Development Goals
SNC	Second National Communication
SPREP	Secretariat of the Pacific Regional Environment Programme
TAU	Te Aponga Uira
TNA	Technology Needs Assessment
TNC	Third National Communication
UNEP	United Nations Environment Program
UDP	UNEP DTU Partnership
UNFCCC	United Nations Framework for the Convention of Climate Change
USP	University of the South Pacific

Executive Summary

This report presents the adaptation technology needs assessment and prioritisation processes along with the results for priority sectors for Cook Islands.

The aim of the Technology Needs Assessment project is to support Cook Islands to develop possible technologies for adapting to climate change - more so in accordance with their obligations under the United Nations Framework Convention on Climate Change (UNFCCC). Cook Islands has been a party to the UNFCCC since 1993.

The Climate Change Technology Center and Network (CTCN) and Technology Executive Committee (TEC) form the technology mechanism of the UNFCCC. CTCN aims to strengthen networks with countries and collaborate and build capacity to accelerate climate technology transfer.

Cook Islands is in the South Pacific Ocean, between Tonga to the west, Kiribati to the north and French Polynesia to the east. Cook Islands has 15 islands with a total land area of 240 km2, spread across 1.97 million square kilometres of ocean. It has two main groups; the northern group consisting of seven atolls and the southern group, comprising eight volcanic and almost atoll-like islands. Of the 15 islands, 12 are inhabited and three uninhabited.

Cook Islands is active with implementing climate activities and it puts great effort to create an enabling environment for the activities to be carried out. The country is strengthening its policies and financial systems to administer project funding and facilitate future use of climate financing. More so, government and non-government agencies are incorporating and mainstreaming climate change in its polices and plans.

Forming the Cook Islands Climate Change (CCCI) office within the Office of the Prime Ministers (OPM) has heightened the importance of the country's climate change response.

The main input of Cook Islands TNA team in this Technology needs assessment report are the following:

- Identifying possible technologies for priority sectors
- Collaborating with government, private sector and relevant stakeholders on existing mitigation projects
- Prioritising technologies which are consistent with national goals, priorities and aligning with national policies
- Identifying barriers that prevent preferred technology, implementation and dissemination, and facilitate access to and transfer environmentally sound technologies

Technology prioritisation is the first step in the TNA project. This is implemented by applying the methodology proposed by the UNFCCC and UNEP/DTU partnership. The Technology

This report prioritises adaptation technology needs in Cook Islands and its response to climate change.

Technology fact sheets were created by the adaptation experts. Further consultation with relevant stakeholders was held whereby a Multi-Criteria Analysis (MCA) was carried out and two technologies for adaptation were identified.

Priority sectors as agreed by the TNA team and stakeholders are the agriculture and eco-system agriculture sector, and coastal restoration and protection sector. Priority technologies for the

Agriculture and eco-system agriculture sector include

- Climate resilient crops
- Agro-ecology technology

Coastal restoration and protection

- Hazard mapping
- Coastal protection units

The process for prioritising adaptation technologies and its response to climate change in Cook Islands took into account multiple factors. The adaptation technologies selected for the next stage of the TNA process were revised and decided upon by the CI TNA team, technical working groups and relevant stakeholders using appropriate methodologies.

CHAPTER 1 INTRODUCTION

1.1 About the TNA project

Technology Needs Assessment (TNA) is a set of country-driven activities leading to the identification, prioritisation and dissemination of environmentally-sound technologies for mitigation and adaptation to climate change. The TNA project is implemented through the Cook Islands Third National Communications (TNC) funded by the Global Environment Facility (GEF) through United Nations Environment Programme (UNEP). The technical support for TNA was provided by UNEP DTU Partnership (UDP) in collaboration with University of the South Pacific (USP) and the Asian Institute of Technology (AIT). The funding for technical support delivered by UDP was provided by Climate Technology Center and Network (CTCN) and in kind contributions were provided by Climate Change Cook Islands (CCCI) and Central Policy Planning Office (CPPO), Office of the Prime Minister, Government of Cook Islands (CIG).

The TNA process is based around three main activities. These are

a) To identify and prioritise mitigation and adaptation technologies for selected sectors;

b) To identify, analyse and address barriers hindering the arrangement and dissemination of the prioritised technologies, including the enabling framework for technologies;

c) To produce a Technology Action Plan (TAP). This can be medium or a long term plan for the implementation of identified technologies.

Enhancing technology transfer for the mitigation of greenhouse gas emissions (GHG) and adaptation to climate change through the TNA project is key to the Cook Islands response to climate change.

The Cook Islands Technology Needs Assessment Project (CI TNA) is based at the OPM. CCCI and CPPO co-coordinate the TNA project. The CI TNA team is the steering committee which includes two local experts. The team works with technical working groups in the selected sectors. The CI TNA team also consulted with relevant stakeholders in the whole process of the project.

1.2 Existing national policies related to technological innovation, adaptation to climate change and development priorities

NATIONAL PLANNING DOCUMENTS

The overarching sustainable development policy document for the Cook Islands is the National Sustainable Development Plan 2016-2020 (NSDP 2016). The NSDP 2016 is the third edition of the high-level planning document which sets out the Cook Islands national development guidelines.

The NSDP 2016 establishes 16 development goals, with 66 indicators to measure progress towards achieving those goals. These indicators are aligned to commonly identifiable sectors and together with the goals they represent a holistic, objective scorecard for the development of the country.[1] The NSDP 2016 is a national planning document, but is also closely aligned to the Cook Islands regional and international commitments such as the Pacific Regional Framework and the Global Sustainable Development Goals.

The crosscutting nature of Climate Change impacts on all sectors. However four of the NSDP Goals have a specific connection to climate change activities.

Goal 6 - Improve access to affordable reliable, sustainable modern energy and transport.

Goal 10 - Achieve food security and improved nutrition and increase sustainable agriculture.

Goal 12 - Sustainable management of oceans, lagoons and marine resources.

Goal 13 - Strengthen resilience to combat the impacts of climate change and natural disasters.

To achieve the broad development goals of the NSDP, policy statements are required to enable linkages between the NSDP goals and sector outputs and activities. In the Adaptation area, the current version of the Joint National Action Plan[2] (JNAP II) has been the Cook Islands de-facto national Adaptation Plan. The JNAP II combines Climate Change policy and Disaster Risk Management policy as a policy base for conducting activities. The action plan focusses on implementation but also outlines the policy linkages for JNAP II by recognising that the policy context aligns across different sectors and seeks to encourage a "whole-of-government, all-hazards approach".[3]

NATIONAL STRATEGIES, POLICIES AND ACTIONS RELATED TO CLIMATE CHANGE

As Cook Islands endeavours in the Climate Change area have broadened, the policy focus has shifted from a combined policy to a specific Climate Change policy. The Cook Islands Climate Change policy 2018-28 was designed to facilitate sector linkages to the NSDP and to enable mainstreaming of Climate Change into sector policies and plans.

The Climate Change policy established three national goals in the climate change area:

1. To contribute to the sustainable development of the Cook Islands.

2. To strengthen resilience to the impacts of climate change through a coordinated, inclusive, culturally-appropriate adaptation and mitigation programme.

3. To work collaboratively in climate change activities domestically and internationally.

Underlying the Climate Change goals are specific objectives in the Adaptation and Mitigation areas

MITIGATION OBJECTIVES

- Promote a low carbon development approach toward development goals and Sustainable Development Goals (SDG).
- Achieve 100% renewable energy generation in all islands by 2025.
- Achieve 100% energy efficiency across the country by 2025.
- Confirm a zero emissions target for Cook Islands by 2040.

ADAPTATION OBJECTIVES

- Increase climate resilience through greater health-related activities, including reducing Non-Communicable Diseases (NCDs).
- Promote climate risk assessment and climate proofing within the development framework.
- Achieve a greater understanding on climate loss and damage and how it may apply at national level.
- Strengthen community-based and ecosystem approaches to climate resilience building.

The Climate Change Policy also lists some other climate change objectives, which support both Adaptation and Mitigation objectives. These are:

- **Capacity development:** Strengthen capacity and capabilities of Cook Islands peoples in all climate-financed programmes and projects.
- **Innovation and research:** Foster innovation in a climate context for technology application, as well as increased research for quantitative analyses on Cook Islands vulnerability and adaptation assessments.
- **Education and Public Awareness:** Strengthen education and public awareness on climate change at all levels, including through school curricula.

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[1] NSDP 2016, pg. 12.

[2] Joint National Action Plan II 2016-2020: Are We Resilient?

[3] Ibid, pg. 26.

- **Gender:** Aim to achieve 100% involvement for gender issues across all climate related activities.
- **Technology Transfer:** Complete a technology needs assessment for both mitigation and adaptation prior to investing into new climate technologies.
- **Provision of Green Investment:** Establish a set of standards and procedures that foster green investment in the Cook Islands.
- **Mainstreaming:** through this policy and other relevant tools, seek to achieve 100% climate mainstreaming within the development agenda across all key sectors.
- **Climate Financing:** Increase the total access to climate financing as an integral part of development expenditures. Identify incentives and tools to promote additional climate financing through the private sector.

1.3 Vulnerability Assessments in the Cook Islands

GEOGRAPHIC VULNERABILITY

The 15 islands in Cook Islands are a geological mix of sand cays, low-lying coral atolls, raised coral islands, and small volcanic islands. Only the main island of Rarotonga has peaks over 200 metres above sea level and the total land mass for the country is 236.7 square kilometres. Consequently, Cook Islands is particularly exposed to extreme weather events which the impacts of climate change are only going to exacerbate.

The impact of slow-onset climate change events may be less dramatic but could have more severe long-term consequences. Sea-level rise and ocean acidification are going to make life on the islands, and particularly on the atolls in Cook Islands, more marginal. Rising temperatures and changing rainfall patterns are altering the growing profile of agricultural crops throughout the country.

VULNERABILITY ASSESSMENTS

The Cook Islands has conducted Vulnerability Assessments for most of the individual islands. These focussed on assessing to what extent each island is vulnerable to changing climate parameters, and what means may be available to assist adaptation or improve island resilience to such changes. On each island, a combination of community meetings and household surveys were used to gather information. The results and analysis were compiled as a report which was presented back to the individual communities.

As well as providing the information for planning climate change activities, the assessments also served to raise awareness about climate change and the potential impacts on the community's way of life.

Three main issues were identified as priorities for the islands: food security, water security and infrastructure. Proposed activities to reduce vulnerability for these issues were also identified.

- **Food Security:** Activities to maintain food-bearing plants throughout the year in the event of salt water intrusion; introducing hybrid crops that are resistant to pests brought about by increased temperatures; crops that can stand long periods of drought, and climate resilient crops, were identified as key coping strategies.
- **Water Security:** Maintaining traditional sources of water, increasing water storage through rehabilitation of useable existing tanks and providing new ones, and improving or increasing collecting capability and storage capacity at the community and household levels, were all proposed to provide a clean potable supply of water.
- **Infrastructure:** Improving the ability to cope with extreme weather events through the review and implementation of the building code; design and construction of cyclone shelters; climate-proofing the power supply network, wharves and airports, were identified as priorities.

At a national level, the JNAP II discussed the confluence of Climate Change and Disaster Risk Management and how Cook Islands' vulnerability to the impacts of climate change increased the exposure to natural disasters.[4] Climate Change impacts on various sectors are described and potential adaption activities suggested.

1.4 Sector Selection

1.4.1 An Overview of Expected Climate Change and its Impacts in Sectors Vulnerable to Climate Change

PROJECTED CLIMATE CHANGE IN THE COOK ISLANDS

The Cook Islands Third National Communications utilised data from a study conducted by the Australian Bureau of Meteorology/CSIRO to make climate projections based on three emissions scenarios:

1. Low, marked in blue;
2. Medium, marked in green;
3. High, marked in purple.

Projections are given for three 20-year periods centred on 2030 (2020–2039), 2055 (2046–2065) and 2090 (2080–2099) - relative to 1990 (1980–1999). Confidence level in the projections is also given. These projections also refer to an average change over the whole country based on projections for the region around Cook Islands. The projections are based on IPCC assessments and simulations from up to 18 global climate models, which were combined for the three emissions scenarios.

TABLE 1: PROJECTED CHANGES IN CLIMATE ASPECTS IN COOK ISLANDS UNDER THREE SCENARIOS.

Climate Aspect	Northern Group			Southern Group			Confidence Level
	2030	2055	2090	2030	2055	2090	
Surface Air Temp (C°)	+0.6 ± 0.4 +0.8 ± 0.4 +0.7 ± 0.2	+1.1 ± 0.4 +1.4 ± 0.5 +1.4 ± 0.4	+1.5 ± 0.6 +2.2 ± 0.8 +2.6 ± 0.6	+0.6 ± 0.4 +0.7 ± 0.4 +0.7 ± 0.3	+1.0 ± 0.5 +1.3 ± 0.6 +1.3 ± 0.4	+1.3 ± 0.6 +2.0 ± 0.8 +2.5 ± 0.7	**Moderate**
Sea Surface Temp (C°)	+0.6 ± 0.3 +0.7 ± 0.4 +0.7 ± 0.4	+0.9 ± 0.4 +1.2 ± 0.5 +1.3 ± 0.6	+1.3 ± 0.5 +2.0 ± 0.8 +2.3 ± 0.8	+0.6 ± 0.3 +0.6 ± 0.3 +0.7 ± 0.3	+0.9 ± 0.4 +1.1 ± 0.4 +1.2 ± 0.4	+1.3 ± 0.4 +1.9 ± 0.5 +2.3 ± 0.7	**Moderate**
Aragonite Saturation State	+3.6 ± 0.2 +3.6 ± 0.2 +3.6 ± 0.1	+3.4 ± 0.2 +3.3 ± 0.2 +3.3 ± 0.2	+3.3 ± 0.1 +2.9 ± 0.3 +2.7 ± 0.1	+3.5 ± 0.1 +3.5 ± 0.1 +3.5 ± 0.1	+3.3 ± 0.1 +3.1 ± 0.1 +3.1 ± 0.1	+3.1 ± 0.1 +2.7 ± 0.1 +2.5 ± 0.1	**Moderate**
Mean Sea Level (cm)	+10(5–15) +10 (5–15) +10 (4–15)	+18 (10–26) +20 (10–30) +19 (10–29)	+31 (17–45) +38 (19–56) +38 (19–58)	+10 (5–15) +10 (5–15) +10 (4–15)	+18 (10–26) +20 (10–30) +19 (10–29)	+31 (17–45) +38 (19–56) +38 (19–58)	**Moderate**
Rainfall (%)	+3 ± 8 +4 ± 9 +3 ± 13	+5 ± 12 +6 ± 25 +6 ± 26	+6 ± 22 +8 ± 33 +9 ± 37	+1 ± 11 +3 ± 10 +5 ± 9	+2 ± 8 +3 ± 13 +5 ± 11	+5 ± 14 +6 ± 13 +8 ± 24	**Low**

SOURCE: COOK ISLANDS THIRD NATIONAL COMMUNICATIONS, (2020).

[4] JNAP II, 2016

SURFACE AIR TEMPERATURE

Temperatures have warmed and will continue to warm with more extremely hot days in the future. The increase in temperatures in the Northern group is projected to be slightly higher than in the Southern group. Night-time temperatures will also continue to increase.

SEA SURFACE TEMPERATURE

Sea surface temperatures are projected to increase at a slightly lower rate to air temperatures. This rate of change however, is projected to be much faster than the 0.12°C per decade up to present. Consequently, it is also predicted that coral bleaching will become an annual event rather than the 4-7 year cycles observed in the last few decades.[5]

OCEAN ACIDIFICATION

Ocean acidification has been increasing in Cook Islands waters and it is projected to continue to increase and threaten coral reef ecosystems. Under the Medium scenario, by 2055 aragonite saturation states will have dropped below 3.5 and by 2090, there may not be enough aragonite in the ocean for coral reefs to grow. As CO2 is less soluble in warmer waters, it is projected that less of an impact will occur at equatorial latitudes.

The impact of acidification change on the health of reef ecosystems is likely to be compounded by other stressors including coral bleaching, storm damage, and nutrient loading, and fishing pressure. Today, more than a billion people rely on food from the ocean as their primary source of protein.6 In the Cook Islands, both jobs and food security depend on the fish and shellfish in our lagoons and oceans.

SEA LEVEL RISE

Sea level near Cook Islands has risen and will continue to rise throughout this century. By 2055 all models are predicting an increase of 10-30 cm.

Year-to-year variability will continue along with extreme sea level events. The sea-level rise combined with natural year-to-year changes will increase the impact of storm surges and coastal flooding. As tropical cyclones are projected to become more intense, extreme sea-level events linked to these may become more dangerous.

RAINFALL

Average annual rainfall in Cook Islands is not projected to change significantly, but rainfall patterns are projected to change over this century with more frequent and more intense extreme rainfall days. Rainfall may decrease in the dry season in the Northern Cook Islands. There is uncertainty around projected changes in the South Pacific Convergence Zone (SPCZ), so there is only low confidence in rainfall changes for the Cook Islands.

TROPICAL CYCLONES

In the Cook Islands region, projections tend to show a decrease in the frequency of tropical cyclones by the late 21st century, but a possible shift towards more intense categories. There is likely to be an increase in the average maximum wind speed of cyclones by between 2% and 11% and an increase in rainfall intensity of about 20% within 100km of the cyclone centre.

SUNSHINE HOURS

As average annual rainfall is not projected to change, then sunshine hours should also not be altered significantly. The patterns of cloud cover however are changing as our climate changes and more extremely hot days will mean more harsh sunshine.

SECTORAL IMPACTS OF CLIMATE CHANGE

Given the projected scenarios, some of the expected impacts have been identified at the sectoral level. These are outlined in Table Two below..

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[5] Hoegh-Guldberg, O., Mumby, P.J., Hooten, A.J., 2007. Coral reefs under rapid climate change and ocean acidification. Science 318, 1737–1742

[6] Nutrition: Global and Regional Food Consumption Patterns and Trends, Section 3.5, WHO Website.

TABLE 2: CLIMATE CHANGE IMPACTS AT SECTOR LEVEL.

SECTOR	CLIMATE CHANGE IMPACTS				
	Sea Level Rise	**Ocean Acidification**	**Extreme Weather Events**	**Rainfall/ Sunshine Variation**	**Sea and Air Temperature Rise**
Agriculture	Salt water intrusion of low-lying agriculture lands. Inundation of planting areas. Time and labour intensive cost	Affects growth of shell-fish foods and fish. Reduced food sources and income.	Damage to infrastructure, agricultural crops and economic losses Time and labour intensive. Strain on national budget	Drought, flooding, sunburnt crops, invasive species and disease. Reduced production increase economic losses.	Increased prevalence of invasive species and disease. Reduce production increase economic losses.
Biodiversity (Terrestrial and Marine)	Degradation and loss of habitats and breeding sites. Reduction of biodiversity.	Casualties, habitat damage and loss, reduced biodiversity, displacement, food loss.	Casualties, habitat damage and loss, displacement, food loss. Economic loss	Increased prevalence of invasive species. Reduce growth rate of species. Degradation of biodiversity and environment	Increased prevalence of invasive species, species distribution or migration. Loss of species and reduce biodiversity.
Coastal Zones	Erosion, increased storm surges, damage to coastal infrastructure, receding coastline, economic loss, strain on national budget	Coral reef habitat and species degradation. Economic and food loss	Wave damage to coastal infrastructure, erosion, increased sedimentation, changes to coastline features Economic loss, strain on national budget	Run-off nutrient and terrigenous sediments, increased debris to lagoons, lower salinity. Economic loss and reduction of food sources.	Coral bleaching, algal blooms, anoxic conditions in lagoons, coral disease. Loss and reduction of species and food sources
Health	Impact on coastal infrastructure, housing etc. Mental stress, cardiovascular diseases, loss of lives, strain on health budget	Loss of marine food species, economic loss. Increase in NCDs, and mental health	Injury during and increased disease risk following an event, stress & social disruption. Increase ciguatera outbreaks	Increased gastrointestinal, water and vector-borne diseases and sunstroke Cardiovascular, NDCs and mental stress.	Emergence of tropical disease, heat stress, productivity impacts. NCDs, cardiovascular diseases, mental health

[1] Refer to V&A Assessment Reports of the NES carried out during the NATCOM 2 process to site the method used. V&A Assessment Reports include those prepared for Manihiki, Rakahanga, Penryhn, Pukapuka and Atiu.

Marine Resources	Reef drowning, loss of inter-tidal communities, damage to coastal infrastructure.	Habitat changes, species loss, loss of economic sustainability.	Damage to coastal infrastructure and vessels, stock loss, increased ciguatera poisoning.	Habitat changes, Shifts in marine resources productivity, increase cost of living	Algal blooms, food chain disruption from migratory and distribution changes. Loss of important food sources.
Water	Increased salinity of freshwater table. Reduce agriculture land and production	Potential impact on cloud formation and water ph	Water pollution, infrastructure damage. Economic loss, strain on national budget	Drought, flooding, contamination, blockages. Infrastructure stress, economic loss, strain on national budget	Increased demand, compromised quality. Economic loss, strain on national budget

SOURCES: JNAP II (2016), THIRD NATIONAL COMMUNICATIONS (2020)

1.4.2 Process and results of sector selection

SECTOR PRIORITISATION

During the latter half of 2018, the Cook Islands developed a Climate Change Country Programme (CP). It was based on a review of national policy and planning documents, national and individual island vulnerability assessments, meetings with Pa Enua Island representatives, and community consultations and workshops on Rarotonga.

The documents analysed included:

- National Sustainable Development Plan 2016-2020
- JNAP II – Are we resilient? The Cook Islands 2nd Joint National Action Plan: A sectoral approach to Climate Change and Disaster Risk Management 2016-2020
- Intended Nationally Determined Contributions (INDC) 2015
- Second National Communication to the UNFCCC
- Cook Islands National Infrastructure Investment Plan 2015-2025
- Individual Island Community Development Plans
- Cook Islands State of the Environment Report 2017
- Cook Islands National Biodiversity Strategy and Action Plan
- Marae Moana Policy 2016.

In addition, two national consultations were conducted in 2016 (Brilliant Resilient Workshop) and 2017 (Fostering Resilience Workshop) to engage with a wide array of stakeholders to define national priorities for climate change and for development of a pipeline for submission to the GCF. As well, during 2018, community, island and village consultations were held on priorities for inclusion in the Country Programme.

The Cook Islands government and communities recognised that the country's response to the impacts of climate change had to be prioritised and had to be cognisant of capacity levels. Eleven thematic areas were identified as a means to organise the Cook Islands response to climate change and to facilitate the implementation of activities to address vulnerability at both national and island/village level.

COOK ISLANDS COUNTRY PROGRAMME THEMATIC AREAS:

1. Renewable Energy Development (including clean energy transportation).
2. Coastal Protection and Restoration.
3. Water Security.
4. Disaster Risk Management.
5. Waste Management.
6. Climate Proofing Infrastructure.
7. Flood Management.
8. Agriculture and Ecosystem Based Adaptation.
9. Oceans Management and Climate Change.
10. Livelihoods of People and Communities.
11. Knowledge, Research and Innovation.

The CP formed the basis of discussion at the Climate Change and Resilience Round table which was held in March 2019. The Roundtable was a two-day event at which donor partners involved in Climate Change, were all invited to discuss and evaluate partnering with Cook Islands in various climate change projects.

The work done to identify the thematic areas established the basis for the TNA Team to further prioritise the sectors for the TNA project. The team which met on Thursday 31 October 2019 consisted of the Director of the Climate Change Office, the TNA Coordinator and the two TNA Consultants. Three criteria were agreed in order to facilitate the selection process:

- **National Priority:** The sector had to be one of the thematic areas identified in the Country Programme;
- **Activity Facilitation:** The sector should have some technologies that were already under consideration, or activities that a technology could support;
- **Impact Potential:** If technology is introduced into a sector, how much impact would it have on climate change activities?

After considering the above, the TNA team identified two priority sectors in each area. For the Mitigation area, Waste Management and Clean Energy Transportation were selected. In the Adaptation area, Coastal Protection and Restoration, and Agriculture and Ecosystem-based Adaptation, were chosen.

CHAPTER 2 INSTITUTIONAL ARRANGEMENT FOR THE TNA AND THE STAKEHOLDER INVOLVEMENT

2.1 TNA Institutional set-up

The Cook Islands Technology Needs Assessment Project (CI TNA) is based at the Office of the Prime Minister. Climate Change Cook Islands and Central Policy and Planning Office co-coordinate the Technology Needs Assessment project. The core CI TNA team comprises of the National TNA Coordinators and two national consultants. The core CI TNA team works with technical working groups in the selected sectors. The CI TNA team also consulted with relevant stakeholders in the whole process of the project.

National TNA co-coordinators
The Climate Change Cook Islands office designated Rima Moeka'a and Valentino Wichman as the TNA co-coordinators. Ms Moeka'a is involved in national reporting for the climate change office and Ms Wichman is the director of CPPO and the senior policy expert. The TNA co-coordinators are the focal points for the overall management and coordination of the TNA process. The TNA co-coordinators are responsible for facilitating and managing the project, and communicate with national consultants, sectoral working groups, stakeholders, regional agencies and UDP.

National Steering committee
The national steering committee is key in guiding the project. It provides high level guidance to the national TNA team and is responsible for policy making. Its role includes providing guidance to the national team and assisting in securing political acceptance for the TAP.

The national steering committee consists of members from relevant ministries, private sector and key stakeholders. It provides high level guidance to the national TNA team and is responsible for policy making.

National consultants
The lead national consultants were recruited by CCCI and CPPO. The national TNA co-coordinators were nominated by CCCI, in consultation with UDP. CCCI and CPPO appointed Mr Raymond Newnham as the Cook Islands TNA adaptation expert, and Dr. Christina Newport as the mitigation expert.

The adaptation and mitigation experts are responsible for consulting relevant stakeholders; identifying and prioritising technologies for specific sectors; leading the analysis process with stakeholders and sector working groups; participating in capacity-building workshops; working with the national co-ordinators, sector working groups, and stakeholders; and preparing the TNA, BAEF and TAP reports.

Sector working groups
The Climate Change Cook Islands office, on the suggestion of the co-coordinators and national consultants, established two working groups on the mitigation technologies for the transport and waste sectors, and two working groups on adaptation technologies for. Coastal Protection and Restoration, and Agriculture and Ecosystem-based Adaptation

The composition of the sectoral working group include representatives from government ministries, private sector, academia, the area of climate change and civil society.

Stakeholders
Stakeholders include representatives of the government ministries, private sector, academia, climate change experts and civil society.

Figure one below is a schematic representation of the CI TNA institutional structure

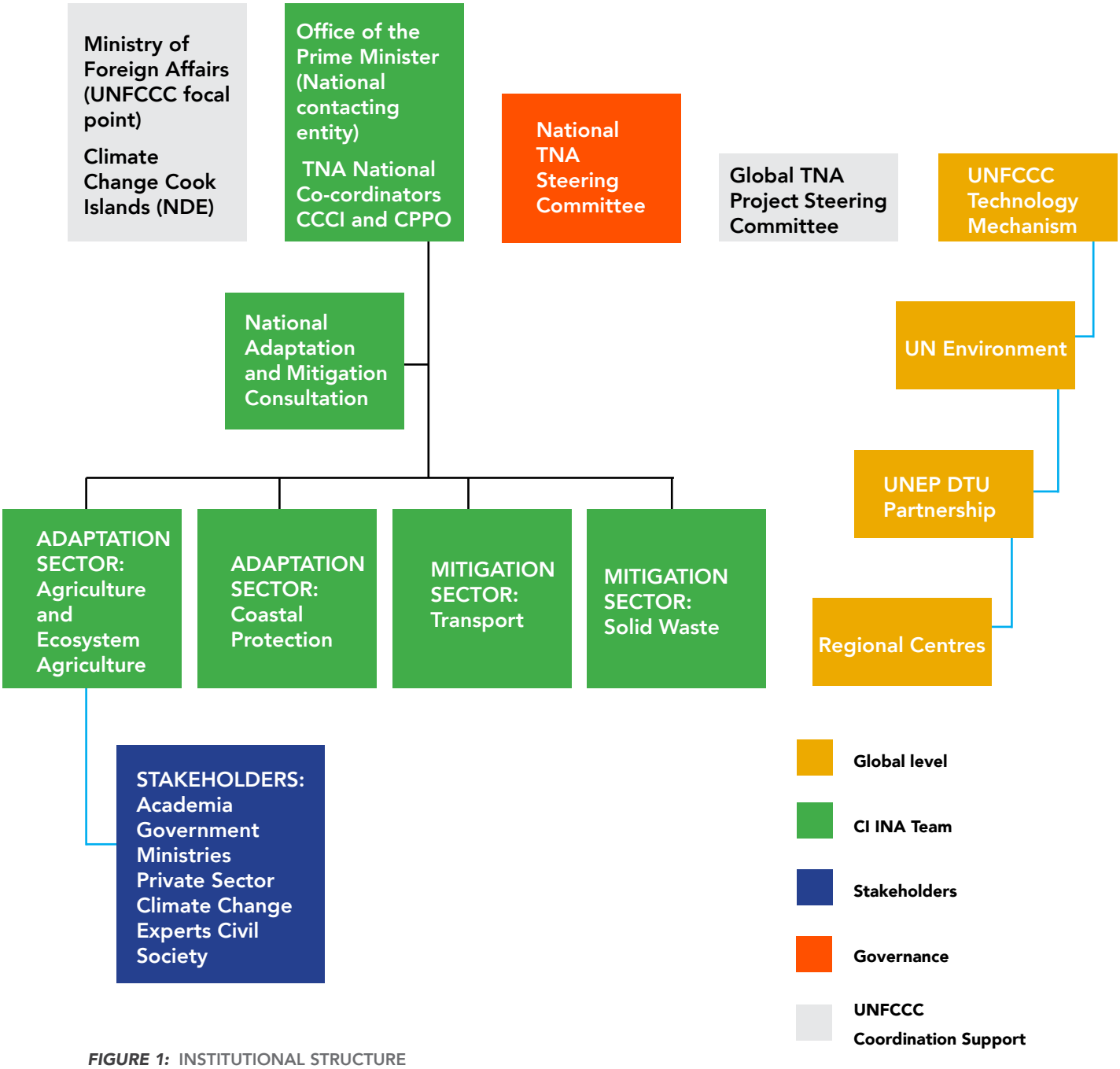

FIGURE 1: INSTITUTIONAL STRUCTURE

2.2 Stakeholder Engagement Process followed in the TNA

INSTITUTIONAL STAKEHOLDERS

After being contracted to take on the position of TNA consultant in early October 2019, the consultant attended the Second Regional Capacity Building Workshop for the TNA Phase III countries in Asia/Pacific, which was held in Nadi, Fiji on 22-24 October.

Following the regional workshop, initial engagements were conducted with the institutional stakeholders represented by Climate Change Cook Islands (CCCI) and Central Policy and Planning Office (CPPO), both of which are divisions in the Office of the Prime Minister. A timetable was agreed upon for carrying out stakeholder consultations, developing the prioritised list of technologies, and completing the TNA report.

As Cook Islands participation in the TNA process was much later than other Asia/Pacific countries, the timetable had to be compressed. An 11-week schedule was confirmed and 17 January 2020 was decided upon as the submission date for a draft TNA Report.

To facilitate the process, a meeting of the TNA Team was convened on 31 October to prioritise the sectors that potential technologies would be considered for. Two priority sectors were identified for each area in the TNA process. It was also confirmed that a meeting of the Technical Working Groups would be held in mid-December to prioritise the technologies.

STAKEHOLDER ANALYSIS

Despite the limited time to implement the stakeholder engagement, the intention was to involve as broad a cross-section of the stakeholder group as possible. The following table illustrates the initial consideration of which stakeholders would be consulted in the development of the long-list of technologies, while taking into account the prioritised sectors.

TABLE 3: INITIAL STAKEHOLDER ANALYSIS

SECTOR	ORGANISATION	RAROTONGA/PA ENUA
PUBLIC	Climate Change Office	Rarotonga
	Central Policy and Planning Office	Rarotonga
	Ministry of Agriculture	Rarotonga
	Infrastructure Cook Islands	Rarotonga
	National Environment Service	Rarotonga
	Pa Enua Island Administrators	Pa Enua
PRIVATE	Project Initiators	Raro/Pa Enua
	Business owners	Raro/Pa Enua
	Climate Change Experts	Rarotonga
NGO/ COMMUNITY	Environmental NGOs	Rarotonga
	Village Action Groups	Rarotonga

It is important in the Cook Islands that projects are not only for the main island but that the smaller outer islands are also included. Data on consultations is recorded according to gender and location. A full list of the stakeholders consulted for this project is in Annex Two.

INITIAL ENGAGEMENTS

Prior to being contracted, the TNA consultant participated in the Cook Islands Climate Change TNA Workshop in September 2019. This workshop was facilitated by Valentino Wichman and Rima Moeka'a who had been the Cook Islands representatives at the first regional TNA workshop in February 2019.

The Cook Islands workshop in September 2019 brought together locally-based climate change experts as the first step of discussing the TNA process. The TNA consultant led the breakout sessions on Adaptation which discussed sector prioritisation and identified some potential technologies.

Following the confirmation of the timetable and establishment of the priority sectors, initial meetings were held with the two Government agencies responsible for the areas that the Adaptation sectors of Coastal Protection and Restoration, and Agriculture and Ecosystem-based Adaptation would fall under. In the Cook Islands these are Infrastructure Cook Islands (ICI) and the Ministry of Agriculture (MOA). These meetings were to brief them on the TNA project and assess their interest in participating. The meeting was followed up with a letter from the CCCI Director. As both agencies responded positively, a follow-up meeting was held which focussed on identifying potential technologies for consideration by the Technical Working Group (TWG).

PA ENUA CONSULTATION

In November 2019, the Mayor and two officials from each of the Pa Enua[7] islands travelled to Rarotonga for briefings on administrative and project-related activities. This presented an opportunity for the consultants to engage with them as a group about the TNA process. The stakeholder consultation was held with the Pa Enua representatives on 14 November.

The engagement began with the TNA co-ordinator presenting an overview before the two consultants talked about the Mitigation and Adaptation areas. Breakout sessions were held and the participants were asked to put forward possible technologies for consideration. The technologies are discussed below in Sections 3.4 and 4.4.

NON-GOVERNMENT CONSULTATIONS

One of the criteria for the selection of the TNA priority sectors was the inclusion in the Climate Change Country Programme. Consequently, projects that had been proposed in those sectors in the Country Programme (CP) were considered for inclusion in the long-list. Some of these were private sector-led and meetings were held with the proponents of the projects.

Meetings were also held with an environmental NGO and a village level action group. Both groups were invited to be part of the TWG.

TECHNICAL WORKING GROUPS

As the fact sheets were developed, more meetings were held by the TNA consultant directly with potential technology-implementing groups. The composition of the TWG was also being progressed and a broad representation of stakeholders was invited to join up.

The meeting of the TWG was held on Friday 13December. Seven participants were confirmed for each group. However due to another unscheduled competing event on the day, only nine members took part in the selection. The breakdown of the two groups for Adaptation are included in Annex Five.

2.3 Consideration of Gender Aspects in the TNA process

Gender is a significant consideration in project design and implementation in Cook Islands. The Cook Islands Government project management system, Te Tarai Vaka, incorporates gender considerations as part of its social safeguards procedures. Gender mainstreaming in policies and plans is common, and the Cook Islands Government has just reviewed the National Gender Policy which is implemented by the Ministry of Internal Affairs.

In the TNA process, it was important that we ensured that the perspectives of both men and women were given equal opportunities and consideration during the engagement and prioritisation process.

[7] This is the Cook Islands Māori name given to distinguish all the other islands in the Cook Islands apart from Rarotonga

During the wider stakeholder consultation, 31 men and 26 women were consulted. However, at the decision-making level, women have outnumbered men during the TNA process. The sector prioritisation was carried out by the TNA Team which consists of two women and one male, and the Adaptation TWGs consist of six women and three men.

Participation by itself is often not sufficient to ensure equal consideration. However, women have had significant leadership roles in the discussions. Both of the lead government agencies in this process (MOA and ICI) have a woman as Head of Ministry. Similarly, the Muri Environment Care group, which provided two of the technologies considered for the Coastal Zone sector, has a leadership group which consists of only women. During the TWG meeting the ability to voice individual perspectives and make decisions, was ensured through the selection and voting process. This is described in Section 3.5 below.

For the prioritisation of the technologies, Gender was included as a criteria in scoring the social impact component on the Individual Scoring Sheet. A copy of the scoring sheet is included in Annex Three.

There are social impact implications not just for the TNA part of the process, but for the whole climate change technology implementation system. Gender considerations will be maintained as an important part of the design and implementation of the selected technologies, throughout implementation.

CHAPTER 3 TECHNOLOGY PRIORITISATION FOR COASTAL PROTECTION AND RESTORATION

3.1 Key Climate Change Vulnerabilities in Coastal Protection and Restoration

On Rarotonga, the coastal zone has the country's main ports, provides sites for domestic properties and commercial businesses, and hosts recreation facilities and specific businesses such as lagoon cruises. The area is also a source of food and retains cultural significance for Cook Islanders.

On the other islands in Cook Islands, the coastal area is less congested, but the vulnerabilities remain. In the Northern group, where the islands are low-lying coral atolls, the coastal areas are even more vulnerable due to the narrow width of land between ocean and lagoon, and that land being only metres above sea-level. A strong sea surge can go across the island and wash into the lagoon.

Coastal areas are particularly vulnerable to extreme weather events, sea-level rise and ocean acidification. The impact of these occurrences on coral will reduce the protection that the reefs and lagoons provide to the coastal zone. Coastal infrastructure and beach front properties will be more exposed to damage as storm events become more extreme.

The coastal swamp areas are favoured for planting crops such as taro. The fish and shellfish in the lagoons are important for food security, particularly for women. These same areas are also impacted on by land-based events such as flooding and soil run-off which affect the health of the lagoons.

Maintaining healthy lagoons and beaches is essential for tourism which is the main economic activity in Cook Islands. Coastal protection and restoration are essential for building resilience of both man-made and natural environments, and for maintaining the livelihoods of communities.

3.2 Decision context in Coastal protection and restoration

COASTAL ZONE PROGRAMMES

The Cook Islands Climate Change Country Programme has identified Coastal Protection and Restoration as one of the priority areas for implementing climate change-related activities. Despite this, a specific land-use policy to guide development in the coastal zone is lacking.

This land-use policy would highlight such things as focal points for urban growth, key areas for commercial and industrial activities, productive agricultural areas, tourism zones, and ecologically sensitive areas to be protected.[8]

Some planning guidance in the coastal zone is provided under the Environment Act. Any development activity within 30 metres of the mean high-water mark, requires an EIA (Environmental Impact Assessment). This applies for both domestic and commercial activities. Excavation and removal of sand from the beach is also prohibited under the Environment Act.

Some climate hazard analysis work has been carried out by the Cook Islands Government. A climate Risk Assessment for the Avatiu Port area was completed in 2013 and ICI has done aerial survey work looking at climate risk areas. Foreshore protection in some areas where the road is adjacent to the beach, is also being carried out by ICI. This work is normally done by using hard options such as installing seawalls. The same agency is also looking at moving the main road further inland at critical sites on Rarotonga where the road is exposed to sea surge.

A government-funded feasibility study is being conducted for the Muri coastal area by a New Zealand company. The study is looking at options to control flooding and erosion in the Muri catchment area. Different control options are being evaluated including exploring softer options such as maintaining wetlands and foreshore planting.

Coastal Protection Units (CPU) are in place around Rarotonga, but deployment of the units has been on an ad-hoc basis. No new units have been installed for 20 years.

[8] CINIIP (2015) pg. 10.

BROADER OBJECTIVE

To identify two appropriate adaptation Technologies that can be applied to coastal zone areas within Cook Islands to increase the resilience of the sector.

3.3 Overview of Existing Technologies in Coastal Protection and Restoration

COASTAL PROTECTION UNITS (CPU)

There are different designs of Coastal Protection Units for addressing different causes of beach erosion. The CPU currently used in Cook Islands targets sand retention on the beach it protects. The concept was tested in the 1980s in a wave pool by scientists at Victoria University, Melbourne. They found this technology could diffuse the negative energy of a wave and stop sand from returning out through the CPU once the wave carried sand through it.

The technology has already been tested at some sites around Rarotonga. However it may be rolled out further around the south side of the island in Titikaveka.

Hazard Mapping Technology

The Cook Islands Government, through ICI, want to explore alternative inland road development options for Rarotonga to protect against sea surge and flooding. Evaluation of the alternatives would be based on hazard mapping across Rarotonga using LiDAR technology.

Airborne Light Detection and Ranging (LiDAR) data is an optical remote sensing technology that provides accurate, high-resolution topographic data and aerial imagery. LiDAR measures distances, height and depth by sending a pulse of light from a laser towards an area being surveyed, measuring how long the light pulse takes to return. The laser and sensor are mounted on a specialist aircraft where a GPS system is used to position the aircraft. The process produces elevation data and other derived products such as digital elevation models (DEMs) and contours which can be used in a range of applications. Airborne LiDAR data is able to provide highly detailed maps and 3D models.

Soft Options

Various soft options for coastal protection have been utilised on Rarotonga. Beach feeding and foreshore planting have been implemented directly on the beach. The model is based on restoring the natural shape of a beach-slope. This will help to dissipate incoming wave energy and encourage sand retention.

Flood control and wetlands regeneration are being implemented to control water and sedimentation run-off from the area inland from the foreshore. Some of the tourist resorts have been successful with soft-engineering of the shoreline using sculpted dunes and extensive planting of vegetation.

3.4 Adaptation Technology Options for Coastal Protection and Adaptation and their Main Adaptation benefits

An initial long-list of 10 potential technologies was developed by the Consultant. The Techonologies were based on the Country Programme, Pa Enua consultations, and meetings with Rarotonga-based individuals and groups.

TABLE 4: INITIAL COASTAL PROTECTION AND RESTORATION TECHNOLOGY LONG-LIST

TECHNOLOGY	PROPONENT	ADAPTATION BENEFITS
Seawall in Pukapuka	**Pukapuka Island Council**	**Sea surge protection, land reclamation**
Hazard Mapping	**Infrastructure Cook Islands**	**Identification of alternatives for exposed roading**
Coastal Protection Unit	**Teava Iro**	**Coastal protection and sand retention**
Foreshore Protection	**Infrastructure Cook Islands**	**Coastal protection**

Northern Group Project Coral Gardens	**Pacific Divers**	**Reef resilience**
Southern Group Aerial Surveys	**Mauke Island Council**	**Coastal protection**
Wetlands restoration	**Teina Rongo**	**Flooding control, land run-off attenuation**
Muri Artificial wetlands	**Muri Environment Care**	**Flooding control, land run-off attenuation**
Muri Beach Restoration	**Muri Environment Care**	**Coastal protection and sand retention**
Re-forestation planting on foreshore	**Ministry of Agriculture**	**Coastal protection and sand retention**

The projects that the Technologies were going to be part of were in various stages of development. The time available for the process of Technology prioritisation was limited and as a result, there was no ability to enhance the available information of the 10 projects.

Consequently, a pre-screening was done in order to facilitate the writing of the fact sheets. Three criteria were identified as essential to developing the fact sheets for the Technology prioritisation.

- **Information Availability:** Some of the proposed projects had not reached concept note level and information to develop fact sheets was very limited. Other projects were further advanced in planning and information was easily available.
- **Technology Development:** In some of the projects, the technology was proven and the emphasis would be on the diffusion of the technology. In others, the technology was still in the early stages of development.
- **Technology Impact:** Some of the projects are multi-million dollar large scale projects, which decreased the potential impact of TNA support, relative to other smaller projects.

The three criteria were applied to the long-list of 10 projects and the long-list was reduced to five Technologies for consideration by the TWG. The fact sheets are contained in Annex One.

The Technology factsheets included a brief description of the technology and its present implementation status as well as the climate change rationale for the technology. The environmental, social, and economic area that would be impacted by the application of the technology is also described. Potential issues were noted, and an initial cost estimate was also provided.

3.5 Criteria and Process of Technology Prioritisation

The Technical Working Group meeting was held on Friday 13 December 2019. A general briefing was given to all the four groups on the process and aims for the day, which was to get two prioritised Technologies from each of the working groups. These would then go forward to the next stage of the TNA process. Following the briefing, the participants split into four working groups.

Seven members were invited to be part of the TWG for Coastal Protection and Restoration. The members were a combination of public servants, technical experts, environmental NGOs and community groups. On the day of the meeting five members were able to attend.

For Coastal Protection, each member was given a technology fact sheet, with an Individual TWG Member Technology Scoresheet attached. The members read the fact sheet and then were able to individually score the Technology based on the criteria outlined in the scoring sheet. During this process, the TWG was able to discuss openly any issues related to the technology.

Six criteria were used to assess the Technology. The criteria had previously been screened to ensure that there was no overlap and for each criteria, guidance was set out on how to assess the criteria in relation to that particular Technology. Discussion points were described on the sheet and potential scoring ranges given based on the discussion points. The six criteria were:

- **Technology availability:** is the technology developed and ready to use, available in-country, and is training required to use the technology?
- **Implementation:** how easy or difficult will the project be to implement and can the project be implemented with local resources; is it part of an existing project and are there any resource access issues?
- **Socio-Economic Impact:** Does the technology influence income generation; are there adverse health and cultural impacts, or negative or positive gender considerations?
- **Cost:** Can the full cost of the Technology be met by the TNA and if it is part of a larger project, is the relevant project funding approved; is co-financing available?
- **Climate Change Rationale:** How much does the technology reduce vulnerability or contribute to building resilience?
- **Environmental Impact:** How significant are the environmental impacts and is the biodiversity protected?

The MCA guide was used and referred to in developing the locally-relevant MCA process to prioritise the Technologies. The criteria were well defined, relevant, and did not overlap. More importantly, they were locally identified as significant in assessing the priority of a Technology.

The process of evaluating the Technology against the criteria to compile a performance matrix was not carried out separately but was part of the assessment and scoring by the TWG. Familiarity and understanding of the criteria was facilitated by the sub-criteria (Points) and the group discussion.

The criteria were weighted with Climate Change Rationale and Environmental Impact having a slightly higher weighting at 20% each, than the other four criteria at 15% each.

Each person assessed the criteria and gave it a score between zero and 100. This score was then multiplied by the weighting to achieve a weighted score for that criteria. The weighted scores were then totalled to get a Technology Total Weighted Score from that TWG member.

After each person had scored the Technology, their score was put up on a whiteboard for compilation of the overall score and ranking. A group discussion was held and individuals who had scored a Technology particularly high or low were able to explain their reasoning. This was also the last opportunity for TWG members to revise their scores.

TABLE 5: COASTAL PROTECTION AND RESTORATION SECTOR SCORESHEET

Sector	Technology	TWG Member Score	TWG Member Score	TWG Member Score	TWG Member Score	TWG Member Score	Combined Total Average Score	Priority Ranking
Coastal Protection and Restoration	Coastal Protection Unit	44.0	54.9	90.5	43.5	36.75	269.65	2
	Hazard Mapping (LiDAR)	64.5	63.1	54.5	55.5	40.0	277.6	1
	Muri Beach Restoration	48.0	14.5	69.5	68.0	64.45	264.45	3
	Seawall & Sand Retention	60.75	47.4	10.0	38.45	62.0	218.6	4
	Muri Wetlands	5.0	41.0	37.0	55.8	50.0	188.8	5

SENSITIVITY ANALYSIS

A sensitivity analysis was conducted of the results. In the tables below, the highest and the lowest scores for each Technology have been deducted from the total score.

The results of the analysis were that the three highest scoring Technologies remained as the top ranked, but the ranking order changed. In each scenario, the Coastal Protection Unit Technology now became the third ranked. This shows the effect that one high score can have on a ranking. As mentioned, this was addressed in the group discussion.

TABLE 6: COASTAL PROTECTION AND RESTORATION SECTOR SCORESHEET

TECHNOLOGY	Total with Highest Score Removed	Total with Lowest Score Removed
Coastal Protection Unit	**179.15**	**232.90**
Hazard Mapping (LIDAR)	**213.10**	**237.60**
Muri Beach Restoration	**194.95**	**249.95**
Seawall & Sand Retention	**157.85**	**208.60**
Muri Wetlands	**133.00**	**183.80**

3.6 Results of Technology Prioritisation

The technology prioritisation by the Coastal Protection and Restoration TWG resulted in Hazard Mapping being ranked number one and Coastal Protection Units as number two.

Hazard Mapping

The Cook Islands Government, through Infrastructure Cook Islands, want to explore alternative inland road development options for Rarotonga to protect against sea surge and flooding. Evaluation of the alternatives would be based on hazard mapping across Rarotonga using LiDAR technology.

Airborne Light Detection and Ranging (LiDAR) data is an optical remote sensing technology that provides accurate, high-resolution topographic data and aerial imagery. LiDAR measures distances, height and depth by sending a pulse of light from a laser towards an area being surveyed, measuring how long the light pulse takes to return. The laser and sensor are mounted on a specialist aircraft where a GPS system is used to position the aircraft. The process produces elevation data and other derived products such as digital elevation models (DEMs) and contours which can be used in a range of applications. Airborne LiDAR data is able to provide highly detailed maps and 3D models.

This project will be implemented by ICI. The technology has already been tested on a limited basis and ICI would like to expand the use of the technology. The initial concept is to assist in identifying options for shifting the outer ring road further inland away from areas prone to sea surge and flooding. This will reduce vulnerability to sea level rise and severe storm events which cause sea surge and flooding.

Coastal Protection Units

A single CPU unit is made of concrete measuring about 2m x 1m x 1m and is placed directly on the seabed, in the lagoon, side by side, and parallel to the shoreline to which it will shelter. The distance that it will sit into the lagoon can be measured by the natural gradient of the beach. No new units have been built for 20 years and the TNA project will facilitate the construction and deployment of new CPUs.

Retaining the sand will increase resilience to impacts of storm events and improve adaptation to impacts of Sea Level Rise. Building the resilience of the beach and lagoon will help to protect the properties located along the Titikaveka coastline. The beaches on the south side of the island are also increasingly being utilised by tourists and the maintenance of sand along that coast will benefit the many tourist properties located on the beachfront.

CHAPTER 4 TECHNOLOGY PRIORITISATION FOR AGRICULTURE AND ECOSYSTEM-BASED ADAPTATION

4.1 Key Climate Change Vulnerabilities in Agriculture and Ecosystem-based Adaptation

As a primary production sector, agriculture by its nature is exposed to the elements. As our climate changes, the vulnerability to adverse weather will only increase.

Agricultural production is very vulnerable to temperature variations. Temperature increases are already impacting on crops and are stimulating fruit trees like mango (vi) and mountain apple (ka'ika) to fruit two or three times a year. However, these crops tend to be smaller in volume and have higher proportions of under-matured fruit.

Temperature increases are also affecting the types of invasive pests that are entering Cook Islands. Often there is no natural protection or inhibiting factor such as a local predator. A scientific response can take several years to develop, which allows the invasive species to gain a foothold.

In the Northern group, the low-lying atoll islands have always been vulnerable to sea-level rise, salt spray and sea water intrusion. As climate change exacerbates these events, crop growth will be impeded and the amount of land available for crop production will decrease.

In the Southern group, traditional swampy coastal areas used for growing taro will be vulnerable to a combination of salt-water intrusion and a change in rainfall patterns. Dry-land crops are also likely to suffer increased damage as more intense rainfall events occur, such as during tropical cyclones.

The Agriculture sector in Cook Islands has a growing awareness that there is a link between reducing vulnerability to climate change and ecologically friendly farming practices.

More farmers need to be informed about this shift in farming methodology and the improved resilience and economic returns that can be generated.

4.2 Decision context in Agriculture and Ecosystem-based Adaptation Programmes

The Cook Islands Climate Change Country Programme has identified Agriculture as one of the priority areas for implementing climate change-related activities.

The Ministry of Agriculture (MOA) has over the last few years completed an integrated policy and planning framework built on the Strategic Agriculture and Food Sector Plan 2015. This Plan was conducted by the Food and Agriculture Organization (FAO) and instigated the development of the MOA Strategic Plan 2017-20 and the Cook Islands National Agriculture Policy 2017-21.

These documents have developed a vision, mission goals, and strategic objectives along with principles and values to guide the development of the Agriculture Sector. The three documents have also described the alignment to national policy frameworks such as the National Sustainable Development Plan (NSDP), and the consistency with the country's international agricultural commitments.

Presently, the Agriculture sector in the Cook Islands is dominated by part-time and subsistence activity, with few full-time commercial growers. Growing their own fruit and vegetables is an important part of household food security and this practice is actively promoted and supported by the Ministry of Agriculture (MOA) through its nursery programme.

The introduction of more climate resistant crop species, particularly around adaptability to temperature variation is being trialled by the MOA. In coordination with the Pacific community, some strains of dryland taro have been imported and tested. Other species that are being considered are yams and cassava (maniota).

In the Northern group, small hydroponic gardens have been established by the MOA as an alternative to soil-based planting. Initially meant as demonstration gardens to encourage households to adopt the technology, the gardens are improving the supply of fresh vegetables such as lettuce, tomatoes

and cucumber by selling directly to households.

On Rarotonga, a multi-million dollar project to upgrade the supply and storage of water will improve both household and farmer water security. Methods to better control the dispersal of water on farms, such as drip irrigation, are also being tested.

A small number of growers have begun implementing agro-ecological practices on Rarotonga. They utilise enhanced soil improvement and management techniques including use of composted and organic matter, green manure, cover cropping, and identifying better suited machinery that will cause less soil compaction.

Broader Objective

To identify two appropriate adaptation technologies that can be applied to the agriculture sector within the Cook Islands to increase the resilience of the sector.

4.3 Overview of Existing Technologies in Agriculture and Ecosystem-based Adaptation Programmes

FARMING MODELS

There is an increased awareness that the present systems of mono/intensive cropping, extensive use of chemicals and inorganic fertilisers, and intensive tilling and ploughing of land, is not sustainable and increases vulnerability to climate change. Shifting to more agro-ecological and organic farming practices should reduce the impact on the land and lagoons and improve climate change resilience. T

The MOA has included this shift to an agro-ecological farming model as one of the programmes in the Agriculture Sector Plan. Production systems are being developed as adaptation measures to combat the effects of climate change.

CLIMATE RESISTANT CROPS

The introduction of varieties more appropriate to the changing environment can help farmers to reduce the impacts caused by climate change. The MOA has begun a programme to build up a range of plant species that can be trialled and possibly cross-fertilised with local varieties.

FARMING HARDWARE

Drip Irrigation

Some Cook Islands growers are already experimenting with drip irrigation systems as a means to conserve and better manage water usage. Drip irrigation technology can support farmers to adapt to climate change by providing more efficient use of water, particularly in areas subject to climate change impacts like extended droughts.

Food dryers

Sun-drying of fruit crops as a means of preserving food, has been a traditional practice in Cook Islands. Warming temperatures are changing the fruiting times of many crops such as mango (vi), avocado (apuka) and banana (meika). The abundance of the fruit at these times is also variable. Having the ability to process fruit by drying them will improve food security, and also improve the resilience of growers.

Agricultural Information Dissemination

When making decisions on what seasonal crop to plant and when, planters rely mostly on their own experience. Planning for planting schedules always contains an element of uncertainty about how much the weather will impact on the selected crop. As Climate Change causes weather patterns to change, improving the ability of growers to adapt their planting schedules based on up-to-date information, will improve their resilience.

The Cook Islands Meteorological office can offer predictions of likely weather patterns up to three months ahead of time. However, there is no system for distributing that information and getting it to the planters in a timely fashion so that it can be used to better plan their crop selection and to adjust their planting schedules.

4.4 Adaptation Technology Options for Agriculture and Ecosystem-based Adaptation Programmes and their Main Adaptation benefits

An initial long-list of eight potential technologies was developed by the Consultant. These were based on the Country Programme, Pa Enua consultations, and meetings with Rarotonga-based individuals and groups.

TABLE 7: INITIAL AGRICULTURE AND ECOSYSTEM-BASED ADAPTATION TECHNOLOGY LONG-LIST

TECHNOLOGY	Proponent	Adaptation Benefits
Agro-Ecology Technologies	**Ministry of Agriculture/ Natura Kuki Airani**	**Reduced farming impacts, more resilient farms and ecosystems.**
Bio-Char	**Teava Iro**	**Improved water quality, more resilient ecosystems.**
Solar Hydroponics Greenhouse	**James Herman**	**Improved food security**
Drip Irrigation	**Pa Enua Island Councils**	**Improved food security**
Food Dryers	**Ministry of Agriculture**	**Improved food security**
Climate resistant crops	**Ministry of Agriculture**	**Improved resilience to temperature variations**
Arorangi Reservoir	**Arorangi Growers**	**Improved water security**
Agintel	**Ministry of Agriculture/C.I. Meteorological Office**	**Improved planning and preparation for climate variation**

The process for developing the fact-sheets was the same as for the Technologies in the Coastal Protection and Restoration sector. A pre-screening was carried out on the long-list using the three criteria of information availability, technology development and technology impact. This resulted in the long-list being reduced to five Technologies for consideration by the TWG. The fact sheets are contained in Annex One.

4.5 Criteria and process of Technology Prioritisation

The criteria and process used to prioritise the Technologies for this sector has been described above in section 3.5. The same system was used to conduct the analysis and the results were displayed on a separate whiteboard. The weighting of the criteria also remained the same.

The Technical Working Group had four members who were able to attend the workshop.

Each member was given a Technology fact sheet, with an Individual TWG Member Technology Scoresheet attached. The members read the fact sheet and then were able to individually score the Technology based on the criteria outlined in the Scoring Sheet. During this process, the TWG was able to discuss openly any issues related to the Technology.

TABLE 8: AGRICULTURE AND ECOSYSTEM-BASED ADAPTATION SECTOR SCORESHEET

Sector	Technology	TWG Member Score	TWG Member Score	TWG Member Score	TWG Member Score	TWG Member Score	Combined Total Average Score	Priority Ranking
Agriculture and Ecosystem-Based Adaptation	Drip Irrigationt	47.3	55.85	45.45	55.25		203.85	4
	Agricultural Information Dissemination	40.1	55.85	47.95	59.15		203.05	5
	Agro-Ecology	78.25	56.75	61.15	63.75		259.90	2
	Food Dryers	62.7	56.75	59.5	61.25		240.20	3
	Climate Resistant Crops	71.0	67.47	67.3	56.0		261.77	1

SENSITIVITY ANALYSIS

A sensitivity analysis was conducted of the results. In the tables below, the highest and the lowest scores for each Technology have been deducted from the total score.

TABLE 9: AGRICULTURE AND ECOSYSTEM-BASED ADAPTATION TWG SENSITIVITY ANALYSIS

TECHNOLOGY	Total with Highest Score Removed	Total with Lowest Score Removed
Drip Irrigation	148.0	158.40
Agricultural Information Dissemination	143.90	162.95
Agro-Ecology	181.65	203.15
Food Dryers	177.50	183.45
Climate Resistant Crops	190.77	205.77

With the highest score removed for each Technology, the ranking remained unchanged. Removing the lowest score in each Technology only changed the order of the two lowest ranked Technologies. This showed that the individuals were scoring consistently and within a small range.

4.6 Results of Technology Prioritisation

The Technology prioritisation by the Agriculture and Ecosystem-based Adaptation TWG resulted in Climate Resistant Crops being ranked number one and Agro-Ecology Technologies as number two.

CLIMATE RESISTANT CROPS

A sensitivity analysis was conducted of the results. In the tables below, the highest and the lowest scores for each Technology have been deducted from the total score.

Ensuring food security through developing food species more resistant to climate change impacts, is the main aim of this Technology. Climate resistant crops for different species of significance to Cook Islands will be sourced through the regional programme at the Pacific Community. The MOA is already doing some initial work in this area with taro species but are seeking to expand the programme.

Sourcing and importing the desired climate resistant species would be the foundation for developing an in-country programme where new climate resistant species, which have been identified in other Pacific Islands countries, can be cross-fertilised with existing traditional crops such as cassava and sweet potato.

The crops will be introduced on a trial basis so that they can be evaluated for suitability to Cook Islands climatic and soil conditions, and if successful, can then be made available to growers.

AGRO-ECOLOGY TECHNOLOGIES

Some agricultural practices in Cook Islands are highly vulnerable to climate impacts. For example, mono/intensive cropping, extensive use of agricultural chemicals and inorganic fertilisers, and intensive tilling and ploughing can have detrimental environmental impacts. There is a corresponding loss of use of traditional, more-resilient agricultural practices and biodiversity.

The project aims to build more sustainable and climate resilient food production systems through promotion of and building capacity in regenerative agro-ecological and organic practices. There is a need for enhanced soil improvement and management techniques including use of composted and organic matter, green manure, cover cropping, and identifying better suited machinery that will cause less soil compaction.

There is growing interest internationally about the benefits to using agro-ecological techniques. As an example, increasing the levels of organic matter in the soil improves soil health which improves resistance to pests and diseases. This project aims to build on that interest and grow the awareness of agro-ecology in Cook Islands. A small demonstration farm will be established to showcase the techniques.

As well as stimulating increased resilience of eco-systems and food production, there will also be some GHG reduction from more plant retention and less chemical inputs in the farming system.

CHAPTER 5 SUMMARY AND CONCLUSIONS

The Coastal Zone and the Agriculture Sector will be two key areas in the development challenge that the impacts of climate change poses to Cook Islands. Both areas are at the beginning of identifying the appropriate adaptation strategies and technology will play a vital role in their implementation.

A lack of specific policy development for the Coastal Zone has meant that adaptation planning has been influenced by related legislation and policies in the environment area. The most common response to climate change impacts in the Coastal Zone has been a hard option based around rock revetments. These have created issues such as end-wall erosion and beach scouring. CPUs sited in the lagoon have been a more successful strategy.

The Agriculture Sector has a well-developed policy and planning framework and is actively promoting adaptation strategies. Production methods in the Agriculture Sector have not built resilience however, and has left the industry exposed to climate change impacts such as drought and severe storm events. A change to those methodologies along with utilisation of more climate resistant species is being proposed.

Despite a challenging timetable, the Cook Islands TNA for Adaptation has been completed utilising the TNA methodology and templates as provided.

The first step of Sector prioritisation was set by the TNA team, based on three criteria: National Priority, Activity Facilitation, and Impact Potential. Coastal Protection and Restoration, and Agriculture and Ecosystem-based Adaptation were the two sectors chosen.

The second step of identification and prioritisation of Technologies began with stakeholder meetings and workshops. From these consultations, an initial long-list of Technologies was created for each sector. The long-lists were pre-screened to facilitate the development of fact sheets for Technical Working Groups. These groups met and used a multi-criteria analysis to select two technologies for each Adaptation Sector.

The two chosen Technologies for Coastal Protection and Restoration are Hazard Mapping, and Coastal Protection Units. The two chosen technologies for Agriculture and Ecosystem-based Adaptation are Climate Resistant Crops, and Agro-Ecology Technologies. The four technologies, along with four from the TNA for Mitigation will proceed to the next step of barrier analysis.

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ANNEX ONE: TECHNOLOGY FACTSHEETS FOR SELECTED TECHNOLOGIES
Coastal Protection and Restoration Fact Sheets

Technology:	Coastal Protection Units (CPU)
Sector Area:	Coastal Protection and Restoration
Priority Alignment:	Climate Change Country Programme
Background:	The first CPU was built in Cook Islands in response to the failures of rock revetments and retaining walls to effectively save coastal properties from erosion. The concept was tested in the 1980s in a wave pool by scientists at Victoria University, Melbourne. They found this technology could diffuse the negative energy of a wave and stop any sand from returning out through it once the wave carried the sand through. A line of CPUs was first deployed along the shoreline at the Rarotongan Beach Resort and Spa in Arorangi. These units were later removed at the direction of the hotel management in the 1990's but several units were saved from destruction by the Titikaveka community and can be seen protecting and re-building parts of the Titikaveka coastline today. A single CPU unit is made of concrete measuring about 2m x 1m x 1m and is placed directly on the seabed, in the lagoon, side by side, and parallel to the shoreline to which it will shelter. The distance that it will sit into the lagoon can be measured by the natural gradient of the beach. The design of these units was once patented by resident Don Dorrell but are now available for the benefit of the community at large.
Climate Change Rationale:	Increased resilience to impacts of storm events. Improved adaptation to impacts of sea-level rise.
Implementing Agency:	Teava Iro
Estimated Cost:	$250,000
Further Action/Info needed:	Project Proposal, EIAs
Development Impact: Economic, environmental, social, political	Environmental – The protection and rehabilitation of sandy beach areas. Economic – tourist perception of sandy beaches.
Potential Issues:	EIA approval.
Present Status:	Technology already being utilised in certain areas around Rarotonga.
Timeframe:	Can begin immediately.

Technology	Hazard Mapping: Light Detection and Ranging (LiDAR) survey
Sector Area	Coastal Protection and Restoration
Priority Alignment:	Climate Change Country Programme
Background:	The Cook Islands Government, through Infrastructure Cook Islands, want to explore alternative inland road development options for Rarotonga to protect against sea surge and flooding. Evaluation of the alternatives would be based on hazard mapping across Rarotonga using LiDAR technology. Airborne Light Detection and Ranging (LiDAR) data is an optical remote sensing technology that provides accurate, high-resolution topographic data and aerial imagery. LiDAR measures distances, height and depth by sending a pulse of light from a laser towards an area being surveyed, measuring how long the light pulse takes to return. The laser and sensor are mounted on a specialist aircraft where a GPS system is used to position the aircraft. The process produces elevation data and other derived products such as digital elevation models (DEMs) and contours which can be used in a range of applications. Airborne LiDAR data is able to provide highly detailed maps and 3D models.
Climate Change Rationale:	In terms of climate change adaptation in the coastal zone, the main benefit of wetland regeneration is the reduction of storm water impact and flooding events on coastal areas. Wetlands also act as traps for soil runoff which improves the resilience of the reef and lagoon areas which protect the coastline.
Implementing Agency:	Muri Environment Care, Infrastructure Cook Islands
Estimated Cost:	$100,000
Further Action/Info needed:	Project concept note and proposal
Development Impact: Economic, environmental, social, political	Environmental- Wetland restoration can serve to reduce coastal flooding and erosion and can also provide new habitats and environmental benefits. Economic – Reduces the cost needed for road and property repair after severe events.
Potential Issues:	Landowners may not agree to regeneration.
Present Status:	Implementation of feasibility study recommendations
Timeframe:	Depending on completion of Feasibility Study

Technology:	Seawall and Sand Retention
Sector Area:	Coastal Protection and Restoration
Priority Alignment:	Pukapuka Island Development Plan
Background:	Storm events in Pukapuka can cause inundation of swampy areas used for the cultivation of food crops. Unprotected beach areas adjacent to the swamp can also be seriously eroded by storm events. The project will upgrade the Yato Causeway to protect the brackish water lagoon from saltwater inundation. This will create a safer road from Yato to Loto villages and also protect the planting areas. The brackish water lagoon is also an area where milkfish are harvested. Part of the project will be to implement a tree-planting activity on the beach slope leading up to the causeway site, to help protect the causeway and improve the retention of sand.
Climate Change Rationale:	Improve resilience to increased storm events. Improved resilience through enhanced food security.
Implementing Agency:	Infrastructure Cook Islands, Pukapuka Island Government.
Estimated Cost:	NZ$300,000
Further Action/Info needed:	Project design and concept note.
Development Impact: Economic, environmental, social, political	Economic – Improved and more secure roading on Pukapuka. Health – Protection of important taro and puraka planting area, and milkfish growing area.
Potential Issues:	Including into ICI timetable.
Present Status:	Included in larger project to build jetty and channel through the reef on Pukapuka. No project approval or funding confirmed.
Timeframe:	Implement in FY 2020-2021.

Agriculture and Ecosystem-based Adaptation Fact Sheets

Technology	Agriculture Information Dissemination
Sector Area	Agriculture and Ecosystem-Based Adaptation
Priority Alignment:	Agriculture Sector Plan
Background:	Planning for planting schedules always contains an element of uncertainty about how much the weather will impact on the selected crop. Planters rely mostly on the best crops to plant according to the season and their own experience when deciding what crop to plant and at what time. The Cook Islands Meteorological office can offer predictions of likely weather patterns up to three months ahead of time. However, there needs to be a better system for distributing that information and getting it to the planters in a timely fashion so that it can be used to better plan their crop selection and to adjust their planting schedules. Desktop computers will be placed at the Agriculture Office on each island and tablets loaded with the appropriate software would be distributed to farmer associations. These would have an application that presents the information in a format that can easily be interpreted by the planter. Monthly updates would be sent out by the Meteorological Office.
Climate Change Rationale:	As Climate Change causes weather patterns to change, improving the ability of growers to adapt their planting schedules based on up-to-date information, will improve their resilience.
Implementing Agency:	Ministry of Agriculture, Meteorological Office
Estimated Cost:	$150,000
Further Action/Info needed:	Concept note, project proposal
Development Impact: Economic, environmental, social, political	Economic – Improved yields from crops. Social – Improved food security.
Potential Issues:	Development of the app, training for planters on using tablets.
Present Status:	Cook Islands Meteorological Office can adapt the information being utilised for the early warning systems: rainfall, sunshine hours, temperature, and wind direction.
Timeframe:	Six months to begin.

Technology	Provision of appropriate agro-ecological and organic technologies and inputs
Sector Area	Agriculture and Ecosystem Based Adaptation
Priority Alignment:	Climate Change Country Programme
Background:	Current agricultural practices in the Cook Islands are highly vulnerable to climate impacts - for example, mono/intensive cropping, extensive use of agricultural chemicals and inorganic fertilisers, intensive tilling and ploughing. There is also a corresponding loss of use of traditional, more resilient agricultural practices and biodiversity. The project aims to build more sustainable and climate resilient food production systems through promotion of, and building capacity in, regenerative agro-ecological and organic practices. There is a need for enhanced soil improvement and management techniques including use of composted and organic matter, green manure, cover cropping, and identifying better suited machinery that will cause less soil compaction. There is an increasing awareness about the benefits to using agro-ecological techniques and this project would build on that interest.
Climate Change Rationale:	Increased resilience of eco-systems and food production. Reduced GHG from more plant retention and less chemical inputs.
Implementing Agency:	Ministry of Agriculture, Natura Kuki Airani
Estimated Cost:	$150,000
Further Action/Info needed:	More detailed costing
Development Impact: Economic, environmental, social, political	Economic - Organic products are increasing in demand, import reduction. Environmental benefits as less soil run-off and less chemical run-off into streams and lagoon. Health-benefits from organically-grown fruit and vegetables.
Potential Issues:	Resistance from farmers to new technology.
Present Status:	No project funding or approval
Timeframe:	Begin in FY 2020-2021.

Technology	Introduction of Climate Resistant Crops
Sector Area	Agriculture and Ecosystem-based Adaptation
Priority Alignment:	Climate Change Country Programme, Agriculture Sector Plan
Background:	There is a need to identify climate resistant crops for different species of significance to Cook Islands. These can be sourced through the regional programme at the Pacific Community. The MOA is already doing some initial work in this area with taro species but are seeking to expand the programme. Sourcing and importing the desired climate resistant species would be the foundation for developing an in-country programme where new climate resistant species, which have been identified in other Pacific Islands countries, can be cross-fertilised with existing traditional crops such as maniota and kumara. The crops will be introduced on a trial basis so that they can be evaluated for suitability to our climatic and soil conditions, and if successful, can then be made available to growers.
Climate Change Rationale:	Ensuring food security through developing food species more resistant to climate change impacts.
Implementing Agency:	Ministry of Agriculture
Estimated Cost:	$150,000
Further Action/Info needed:	Project proposal and identification of sites for trialling new species.
Development Impact: Economic, environmental, social, political	Economic – Increasing the resilience of our food crops will improve productivity and generate increased returns for planters.
Potential Issues:	Land availability, technician
Present Status:	Limited programme being trialled by Ministry of Agriculture.
Timeframe:	Immediate start.

Technology	Introduction of a drip irrigation water dispersal system
Sector Area	Agriculture and Ecosystem based adaptation
Priority Alignment:	Climate Change Country Programme, Island Development Plan
Background:	Drip irrigation is based on the constant application of a calculated quantity of water to soil crops. The system uses pipes, valves and small drippers or emitters transporting water from the sources (i.e. wells, tanks and or reservoirs) to the root area, and applying it under particular quantity and pressure specifications. Managing the exact (or almost) moisture requirement for each plant, the system significantly reduces water wastage and promotes efficient use. Compared to surface irrigation, which can provide 60% water-use efficiency, drip irrigation can provide as much as 90% water-use efficiency. In recent times, drip irrigation technology has received particular attention from farmers, as water needs for agricultural uses have increased and available resources have diminished. In particular, drip irrigation has been applied in arid and semi-arid zones, as well as in areas with irregular flows of water. Some Cook Islands growers are already using drip irrigation systems and this project would be aimed at increasing awareness and expanding the usage of the technology.
Climate Change Rationale:	Drip irrigation technology can support farmers to adapt to climate change by providing efficient use of water supply, particularly in areas subject to climate change impacts such as seasonal droughts.
Implementing Agency:	Ministry of Agriculture, Island Governments, Private sector suppliers
Estimated Cost:	$200,000. The cost of a drip irrigation system ranges from US$ 800 to US$ 2500 per hectare depending on the specific type of technology, automatic devices, and materials used as well as the amount of labour required.
Further Action/Info needed:	Confirmation of interest from Pa Enua. Project concepts and design.
Development Impact: Economic, environmental, social, political	Economic – Has the potential to increase the amount of productive land, especially in the Pa Enua. Environmental – More efficient usage of water resources.
Potential Issues:	Cost per hectare.
Present Status:	No project developed for the technology.
Timeframe:	Immediate start.

Technology	Food Dryers
Sector Area	Agriculture and Ecosystem Based Adaptation
Priority Alignment:	Agriculture Sector Plan
Background:	Preserving food to store in preparation for weather events like cyclones has been a traditional practice in Cook Islands. This practice has an economic benefit by improving the yield and by adding value to food crops. Dryers would be sourced for processing surplus fruit products, and distributed to growers on Rarotonga and the Pa Enua. Identifying the appropriate unit to suit the potential scale of operation will be a key aspect. Some drying of fruit for sale is already being carried out intermittently in the Pa Enua, and this project would expand the volume of production and also the range of fruit being used.
Climate Change Rationale:	Warming temperatures are changing the fruiting times of many crops such as vi, apuka and meika. The abundance of the fruit at these times is also variable. Having the ability to process these fruit by drying them, will improve food security, and also improve the resilience of growers.
Implementing Agency:	Ministry of Agriculture, Private sector
Estimated Cost:	$180,000. Each unit costs $6000 and 20 would be purchased. There would also be freight and handling costs to distribute the dryers.
Further Action/Info needed:	Project concept note and proposal
Development Impact: Economic, environmental, social, political	Economic – More efficient usage of food crops as lower crop grades can be dried. Better returns for growers through value-adding. Environmental – Less fruit wasting and rotting on the ground.
Potential Issues:	Developing value chains to sustain production.
Present Status:	Some drying of fruit for sale already being carried out in Pa Enua.
Timeframe:	Begin in FY 2020-2021

ANNEX TWO: LIST OF STAKEHOLDERS CONSULTED

NAME	ORGANISATION	ISLAND
Wayne King, Celine Dyer, Rima Moeka'a, Talissa Koteka	Climate Change Cook Islands Office	Rarotonga
Valentino Wichman	Central Policy and Planning Office	Rarotonga
Temarama Anguna, William Wigmore, Sanjinita Sunish, Takili Tairi	Ministry of Agriculture	Rarotonga
Diane Charlie-Puna, Paul Maoate, Gareth Clayton, Sonny Williams	Infrastructure Cook Islands	Rarotonga
Arona Ngari	Cook Islands Meteorological Service	Rarotonga
Teina Rongo, Teariki Rongo	Korero o te Orau	Rarotonga
Stephen Lyon	Pacific Divers	Rarotonga
Teava Iro	Titikaveka Growers Association	Rarotonga
Mii Kauvai, Mata Hetland, Jaime Short, Anne Tierney	Muri Environment Care	Rarotonga
Tingika Elikana	MP for Pukapuka	Rarotonga
Christina Newport	Akairo Consulting	Rarotonga
Rerekura Teaurere	Climate Change Expert	Rarotonga
Helen Maunga	Climate Change Expert	Rarotonga
Krysten Tuufuli	Climate Change Expert	Rarotonga
Pasha Carruthers	Climate Change Expert	Rarotonga
Alanna Smith	Te Ipukarea Society	Rarotonga
Vavia Tangatataia, Louisa Karika, Elizabeth Munro	National Environment Service	Rarotonga
Pio Ravarua, Mama Tiere, Levi Walewaoa	Pukapuka Island Administration	Pukapuka
Jane Kaina, Angela Tobias	Manihiki Island Administration	Manihiki
Nga Takai, Una Banaba, Neti Tarau	Rakahanga Island Administration	Rakahanga
Bill T Marsters, Mary Taira Tom, Marconi Marsters	Palmerston Island Administration	Palmerston
Anthony Whyte, Marion Harry, Teremoana Atariki	Mangaia Island Administration	Mangaia
Royston Jones, Tekura Tura Vaine Aberahama	Mauke Island Administration	Mauke
Charlie Rani, Tuaine Ngametua	Mitiaro Island Administration	Mitiaro
Maara Tairi, Rangi Tatuava, Ina Mokoroa	Atiu Island Administration	Atiu
Tuaine George, Ina Maramatoa, Tekura Bishop	Aitutaki Island Administration	Aitutaki

ANNEX THREE: INDIVIDUAL TECHNICAL WORKING GROUP MEMBER TECHNOLOGY SCORE SHEET

Individual TWG Member Technology Score sheet

TWG Member Name: _____ ***Date:***_____

TECHNOLOGY:							
CRITERIA	**GUIDANCE**				**CRITERIA SCORE**	**WEIGHTING**	**TOTAL SCORE**
	Points	**0-35%**	**36-65%**	**66-100%**			
Technology availability	• Is the technology developed and proven, • Is the technology available in-country • Is training required to use the technology	Technology untested, training required	Technology in use elsewhere, minimal training required	Technology available in-country, no training required		15%	
Implementation	• how easy or difficult will the project be to implement, • can the project be implemented with local resources, • is it part of an existing project • are there any resource access issues	Overseas agency to implement, no project approval	Project approved but not begun	Local capacity to implement, project begun		15%	
Socio-Economic Impact	• Does the technology influence income generation, • Are there adverse health and cultural impacts • Are there any negative or positive gender considerations	No new income generation, adverse health/cultural impacts, gender inequitable	Limited income generation, minimal health impacts, culturally neutral, gender appropriate	stimulate income opportunities, positive health impacts, gender equitable, cultural significance		15%	
Cost	• Can the full cost of the Technology be met by the TNA, • If part of larger project is the relevant project funding approved • Is co-financing available?	Technology partially funded by TNA, no project funding approval	Technology mostly funded by TNA, project funding approved	Technology fully funded by TNA, project funding approved, co-financing available		15%	
Climate Change Rationale	• How much does it reduce vulnerability or build resilience	Minimal vulnerability reduction and resilience building	Moderate vulnerability reduction and resilience building	Significantly reduces vulnerability and builds resilience		20%	
Environmental Impact	• How significant are the environmental impacts, • biodiversity protections,	Negative impact on environment and biodiversity	No impacts on environment and biodiversity	Positive impact on environment and biodiversity		20%	
					Technology Total Weighted Score		

ANNEX FOUR: TECHNICAL WORKING GROUPS

Coastal Protection and Restoration Technical Working Group Members

NAME	ORGANISATION
Valentino Wichman	Policy and Planning Unit
Teava Iro	Private Business Owner
Alanna Smith	Taporoporoanga Ipukarea Society
Vavia Tangatataia	National Environment Service
Mii Kauvai	Muri Action Group

Agriculture and Ecosystem-based Adaptation Technical Working Group Members

NAME	ORGANISATION
William Wigmore	Ministry of Agriculture
Pasha Carruthers	Climate Change Expert
Elizabeth Munro	National Environment Service
Mata Hetland	Muri Action Group

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