

## Priority adaptations to climate change for fisheries and aquaculture in Cook Islands

This document summarises the outputs from a workshop held on 25 and 26 June in Rarotonga by the Cook Island's Ministry of Marine Resources and the Secretariat of the Pacific Community (SPC) with support from AusAID. The workshop was designed to complement the following aspects of the Cook Islands Joint National Action Plan for Disaster Risk Management and Climate Change Adaptation (JNAP) 2011-2015 (OPM 2012):

- Strategic Area 2 (Strategy 1) *Monitor and assess risks and vulnerabilities, including vulnerabilities to climate change* (see Appendix 1 for specific the specific sub-actions).
- Strategic Area 4 (Strategy 2:8) *'Strengthen and build resilience in the fisheries sector, ensuring a higher resilience to the impacts of climate change'* (see Appendix 2 for specific the specific sub-actions).

The specific purpose of the workshop was to assist stakeholders in fisheries and aquaculture to identify the best adaptations and supporting policies for minimising the risks posed by climate change to the plans that Cook Islands has to maximise the sustainable benefits from the sector. These plans aim to (1) maximise the sustainable benefits from tuna for economic development, (2) provide enough fish for food security, and (3) optimise the number of livelihoods that can be based on fisheries and aquaculture. Adaptations were also identified to capitalise on the opportunities expected to eventuate from climate change.

The plans to increase the economic benefits from tuna include (i) verifying whether up to 30,000 tonnes of skipjack tuna can be caught each year (subject to variation in catches due to ENSO events) within the northern part of Cook Islands' exclusive economic zone (EEZ); (ii) confirming that the longline fisheries for albacore, bigeye and yellowfin tuna can support up to 50 vessels; and (iii) providing incentives for more of the tuna caught within the EEZ to be landed in Rarotonga to increase fish supply for local exporters.

Plans to ensure that fisheries and aquaculture contribute their full potential to food security involve providing access to 35 kg of fish per person each year for the population on Rarotonga (as recommended by SPC's Public Health Division), average consumption of at least 60 kg per person per year on the outer islands, and sufficient fish to meet the needs of the large number of tourists visiting Cook Islands each year (Table 1).

**Table 1.** Quantity of fish needed to supply the needs of various user groups in Cook Islands.

User group	Number of people	Fish consumption	Fish needed (tonnes)
Rarotonga population	13,000	35 kg/year	455
Tourists (p.a.)	120,000	1 kg	120
Outer islands	3,000	60 kg/year	180
<b>Total</b>			<b>755</b>

The plans to increase the number of livelihoods derived from marine resources are based mainly on restoring the black pearl farming industry at Manihiki Atoll, where the number of people employed full or part-time has decreased from around 600 in 2000 to ~50 in 2012.

Wherever possible, the adaptations identified during the workshop were designed to address the ‘drivers’ influencing the management of fisheries and aquaculture in the shorter term (e.g. the large distances to outer islands and high costs in servicing these islands), and climate change in the longer term. Such measures are considered to be ‘win-win’ (W-W) adaptations. In some cases, ‘lose-win’ (L-W) adaptations were also recommended, i.e. adaptations involving costs in the shorter term to maintain any natural adaptive capacity of resources to cope with the changing climate.

The workshop also recognised that many of the adaptations to climate change are management actions that should already be in place to deliver sustainable benefits from the nation’s fisheries and aquaculture resources. A prime example is integrated coastal zone management, commonly called the ‘ridge to reef’ approach. The need for ridge to reef actions to maintain the health of coral reef habitats, and minimise the occurrence of ciguatera fish poisoning, has been recognised for many years and should help build resilience of coral reefs to climate change.

In addition to providing guidance about specific activities to be implemented as part of the JNAP 2011-2015, many of the specific management measures identified during the workshop address Priority Area 5 (Resilience) and Priority Area 6 (Ecological sustainability) of the Cook Islands National Sustainable Development Plan 2011-2015 (OPM 2011).

## **1. Adaptations for economic development and government revenue**

### **Determine the extent of skipjack stocks in the northern part of the EEZ**

The priority actions needed to capitalise on the projected increases in tuna within Cook Island’s EEZ (Lehodey et al. 2013, Bell et al. 2013) centre around continuing the arrangements made in 2012 to determine the size and consistency of commercially viable skipjack catches in the far

north of the EEZ. By allocating fishing days to US Tuna Treaty (USTT) vessels, and limited numbers of days to other vessels, (totalling approximately 1000 vessel days per year), MMR will be able to assess the potential to catch up to ~30,000 tonnes of skipjack tuna per year.

In the event that such catches of skipjack tuna are made consistently for 5 years, MMR can then negotiate for Cook Islands to be included in the vessel day scheme (VDS) administered by the Parties to the Nauru Agreement Office (PNAO). In addition to the USTT arrangements, inclusion in the VDS would provide Cook Islands with a practical ‘cap and trade’ fisheries management scheme to:

- (1) limit the fishing effort of purse-seine vessels in the region to maintain stocks of skipjack tuna (and yellowfin and bigeye tuna) at levels that should ensure sustainable future benefits both for Cook Islands and other Pacific Island countries and territories;
- (2) allow increased fishing in Cook Islands’ EEZ when the fish are more abundant there during El Niño events, through the purchase of days from other PNA members;
- (3) enable Cook Islands to continue to receive benefits from the region’s skipjack tuna resources if abundances of this species in the EEZ decrease substantially during La Niña episodes through the sale of days to other PNA members.

In addition to providing a practical way of distributing benefits from tuna to PNA members during the variable climatic conditions that exist today, the VDS is also a good adaptation to climate change. The allocation of fishing days is adjusted regularly based on catches from the previous seven years. Therefore, if Cook Islands becomes a PNA member, it is possible that more fishing days could be allocated to the country over the next couple of decades as tuna move progressively east under climate change (Lehodey et al. 2013, Bell et al. 2013). Such allocations would provide Cook Islands with the opportunity to increase the contribution of licence fees from DWFNs to government revenue.

The prospect of more purse-seine vessels fishing in Cook Islands’ EEZ could create the opportunity for increased local economic activity through establishment of transshipping operations in Penrhyn Lagoon (e.g. by amending the licence conditions for purse-seine vessels owned by fishing companies that also operate fish cargo vessels). Benefits would include transshipping fees and opportunities for island residents to sell provisions like salt, fresh vegetables, etc) to vessels.

### **Improved reporting of tuna catches**

Projected changes to tuna catches within Cook Island’s EEZ are derived from models – the better the models, the more confidence MMR can have in the projected changes in catches. The existing models are constrained by poor reporting of the locations where tuna are caught on the high seas. PICTs can help overcome this limitation by encouraging PNAO to amend licence conditions for DWFNs to require all purse-seine and longline vessels fishing within the EEZs of

PNA members to report the actual locations where catches were made on the high seas (after an agreed time lag if this is required by the fleets).

### **Limiting tuna catches**

Full implementation of the conservation and management measures for all species of tuna recommended by regional management authorities by all Pacific Island countries, including Cook Islands, will help to maintain these transboundary stocks at healthy levels and make these valuable species more resilient to climate change.

## **2. Adaptations for food security**

The adaptations and suggested policies for maintaining the important role of fish for food security in Cook Islands focus on (1) maintaining the supplies of fish to Rarotonga from reef fisheries on those outer islands which permit export of reef fish (by implementing sound management practices and fostering effective inter-island transport) and from tuna longline vessels operating within the EEZ, (2) ensuring that land-based nutrients do not exacerbate the incidence of ciguatera fish poisoning, (3) developing systems for preventing ciguatoxic fish from being eaten or marketed, and (4) assessing the potential for aquaponics to increase the supply of fish in Rarotonga.

### **Facilitating delivery of fish to Rarotonga**

The existing arrangements to discount licence fees for longline vessels offloading a portion of their catch at Rarotonga should be continued. Such arrangements are likely to become more important in the future as production of reef fish declines due to the effects of more frequent coral bleaching and ocean acidification on coral reefs. In the meantime, further discounts on licence fees could be considered for longline vessels prepared to call in to outer islands to pick up reef fish caught by local fishermen, or milkfish grown in ponds, and deliver these fish to Rarotonga.

Regardless of the arrangements for delivering fish caught by local fishermen at outer islands to Rarotonga (inter-island shipping, air freight, chartered vessels, tuna vessels), communities on outer islands need to make commitments to fish sustainably and provide fish for Rarotonga regularly to foster the necessary transport links.

### **Inshore fish aggregating devices (FADs)**

Increased use of FADs (SPC 2012) anchored close to the coast will help increase the supply of tuna and other pelagic fish around Rarotonga. FADs will also increase access to fish on outer islands, by reducing the travel costs and make it easier for the communities to export fish to Rarotonga when additional fish are needed there. Other advantages of FADs are that they

increase the probability of catching tuna and yield fish that are free from ciguatera poisoning. As such, FADs should be regarded as part of the national infrastructure for food security. FADs are a key ‘win-win’ adaptation to climate change because they can help increase the supply of fish now, and they should work even more effectively as the climate changes and tuna are redistributed further east. Inshore FAD programmes in Cook Islands should be based on:

- use of bathymetric maps, local knowledge of tuna movements and eddies to identify the best places for FADs around each of the populated islands;
- submerged designs to increase the working life of FADs;
- regular maintenance of surface components;
- storage of adequate materials so that lost FADs can be replaced quickly; and
- monitoring of catches around FADs to better inform local managers about the best locations for FADs and the numbers required.
- Devolving responsibility for obtaining and managing the funds needed for FADs, and deploying and maintaining FADs, to the fishing associations on outer islands, with support from MMR and Island Councils where needed.

### **Improved post-harvest methods**

Better technology for smoking and drying fish caught around FADs on outer islands will help increase the availability of fish products for Rarotonga, and fish for food security on the islands at times when it is not possible to fish, or when catches are low. The potential for using solar-powered driers to process fish needs to be assessed. This technology needs to be transferred to communities on outer islands interested in creating businesses for adding value to marine products. The Fisheries Facility Fund should be considered as a possible source of support for assisting small business startups and to subsidize the first two years of operations if necessary.

### **Ridge to reef management**

The full range of reasons for the high incidence of ciguatera fish poisoning at Rarotonga remains to be identified. However, disturbance to coral cover by cyclones, leading to increases in the preferred seaweed substrates for the toxic microalgae which cause the fish poisoning, appears to be an important factor determining the incidence of ciguatera. It is possible that the addition of nutrients to the lagoon also improves conditions for the both the seaweed on which the toxic microalgae live, and the microalgae themselves.

Maintenance of catchment vegetation, controlled use of agricultural fertilizers, and effective treatment of wastewater from residences and hotels to strip out nutrients (SPC 2010, Bell et al. 2011) will be needed to reduce disturbances to the lagoon. This adaptation is expected to help minimise the environmental conditions conducive to the growth of seaweed and toxic

microalgae, and promote the conditions needed for good growth of coral. Government- funded programmes are needed to monitor the levels of toxic algae on reefs and the incidence of ciguatera to identify the main environmental causes of this fish poisoning. Community education and awareness programmes will be needed to promote the ‘do’s’ and ‘don’ts’ involved in reducing ciguatera fish poisoning. Such programmes, which should include ‘Lagoon Day’ and ‘Environment Day’, can be championed by government, business and communities.

### **Monitoring ciguatera**

Although ciguatera fish poisoning does not presently occur at many of the outer islands, it will be important to test those fish species known to acquire the toxin on these islands to ensure that contaminated fish are not delivered to Rarotonga. Until a cost-effective test exists to determine whether a fish has ciguatera poisoning, this will have to be done through a public awareness campaign urging people to report cases of fish poisoning quickly so that the source of the contaminated fish can be identified.

This may be done most easily by establishing a website open to the public so that cases which are not serious enough to be reported at the hospital or clinic can be recorded. The advantage of such a database is that it can be monitored by MMR in near real time and allow the source of poisoned fish to be traced quickly.

Funds for regular advertisements to promote online reporting will be needed to ensure that ciguatera cases are well recorded.

Consideration should also be given to establishing a government- funded ‘Food, Health and Safety Laboratory’, especially if an inexpensive test for detecting ciguatera poisoning in fish flesh is developed by other agencies.

### **Aquaponics**

Farming of Nile tilapia in freshwater is recognised as a practical way to increase the supply of fish in many PICTs (Pickering et al. 2011). Because access to land for constructing fish ponds on Rarotonga is limited, herbs and fresh vegetables are in demand from the tourist trade, and rainfall in the southern group can be expected to be more variable as the climate changes, producing tilapia in aquaponic culture systems has potential to support small enterprises and provide more fish.

Cook Islands is leading the region in the assessment of the potential for aquaponics. Development of this possible adaptation will depend on further assessment of the cost-benefit of aquaponic systems. If these systems prove to be economically viable, investments will also be needed to obtain fast-growing Nile tilapia from overseas, for quarantine of these fish, and to formulate cost-effective diets based on local ingredients.

### **3. Adaptations for livelihoods**

Although the adaptations to help maintain livelihoods in Cook Islands are based mainly on interventions to restore and maintain pearl production at Manihiki, they also include actions to maintain the attractiveness of coral reefs frequented by tourists, and to encourage the population of Rarotonga (especially children) to eat the recommended level of fish per person per year (35 kg) to create more jobs in fish supply chains and reduce non communicable diseases.

#### **Adaptations for pearl farming**

- Reduce stresses to pearl oysters by regulating stocking densities on farms to match the carrying capacity of the lagoon, and mapping and locating farm boundaries to avoid areas with high disease risk.
- Promote good husbandry practices to minimize stress and the triggers for diseases in the lagoon during adverse environmental conditions.
- Monitor environmental conditions within the lagoon using in situ equipment and online forecasts ([www.bom.gov.au/climate/pacific/projects](http://www.bom.gov.au/climate/pacific/projects)) to alert pearl farmers about events likely to be harmful or lethal to pearl oysters so that appropriate management action can be taken.
- Raise awareness of ENSO events and their influence on the ocean to better inform sound farming practices.
- Remove old lines fouled with encrusting shellfish and other invertebrates to reduce oxygen demand in the lagoon.
- Minimise stress to the shells during cleaning operations and remove all rubbish from cleaning etc from the water.
- Identify sites where conditions for nacre growth may be better, e.g. areas of lagoons with dense algal or seagrass beds capable of absorbing carbon dioxide. Training and awareness to educate the farming community and public to understand the science and business of pearl farming
- Increase curriculum in the schools
- Progressively switch to hatchery production of spat. This will allow selection of pearl oysters with greater resistance to ocean acidification, warmer water temperatures and lower dissolved oxygen levels, and help to maintain adequate rates of growth and survival of oysters, and deposition of high-quality nacre, as the climate changes. The

hatchery on Aitutaki could be used for preliminary hatchery production trials and selective breeding.

- Lower pearl oysters into deeper, cooler waters (provided oxygen levels are adequate) to ensure that the final deposition of nacre produces high-quality pearls.

### **Adaptations to retain the appeal of coral reefs for tourists**

- Maintain coral cover, e.g. by moving coral colonies more resilient to coral bleaching and ocean acidification to areas where tourists snorkel and SCUBA dive.

Assess damage to reefs from coral bleaching events or cyclones and rehabilitate reefs to whatever extent possible after disturbances (GBRMPA 2007), e.g. by repositioning overturned coral to fast-track reef recovery.

- Enhance reef resilience by maintaining good populations of herbivorous fish, and other herbivores (e.g. sea urchins), to limit the overgrowth of corals by algae.
- Remove crown of thorns starfish when they threaten the attractiveness of reefs important to the tourist industry, and to help maintain any natural capacity of corals to adapt to higher sea surface temperatures
- Encourage hotels and tour guides to engage in reef maintenance, including transplanting/farming of corals.
- Strengthen Ra'ui regulation and legislation, and promote local awareness and education about the steps to be taken to maintain reefs (with the assistance of champions).
- Promote private sector investment in coastal tourism designed to cope with climate change, particularly the projected changes in sea level, storm surge and changes to coral reefs and other coastal habitats.

### **Adaptations to create more jobs in fish supply chains**

- Develop media to inform the population of Rarotonga about the benefits of eating fish to combat non communicable diseases, and include this information in school curricula and community programs.
- Improve the marketing and packaging of fish sold in Rarotonga to attract more buyers.
- Install energy efficient freezers on outer islands where communities commit to providing regular supplies of fish for Rarotonga.



- Develop milkfish farming on Penrhyn Atoll to supply live bait for longline vessels and consider adjusting licence conditions to specify minimum purchases of live bait by these vessels.
- Provide post-harvest training in how to add value to fish and other marine products for communities on outer islands and in Rarotonga.

## References

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**Appendix 1.** Strategic Area 2 (Strategy 1), Cook Islands Joint National Action Plan for Disaster Risk Management and Climate Change Adaptation (JNAP) 2011-2015.

<b>STRATEGIC AREA 2 MONITORING</b>				
<b>STRATEGY 1: MONITOR AND ASSESS RISKS AND VULNERABILITIES, INCLUDING VULNERABILITIES TO CLIMATE CHANGE</b>				
<b>ACTIONS</b>	<b>INDICATIVE SUB-ACTIONS</b>	<b>KEY PERFORMANCE INDICATORS</b>	<b>LEAD &amp; SUPPORT AGENCIES</b>	<b>STRATEGIC PARTNERS</b>
1. Monitor and assess geophysical and climate change risks and incorporate into development planning	1. Strengthen use of spatial mapping technologies and extend the development of risk exposure databases, taking into account the risks related to climate change	1. Spatial location of risk is mapped	EMCI with MOIP and NES	SOPAC, World Bank
	2. Monitor and assess climate change impacts in near-shore, coastal and terrestrial ecosystems (incl. agriculture and fisheries)	2. Monitoring systems in place	CCCI with NES, MOA and MMR	USP, SOPAC, SPREP, SPC, WHO, FAO, UNDP
	3. Establish an on-going research & monitoring programme on climate related risks leading to disease outbreaks, transmission & distribution	3. Health and climate change research and monitoring systems in place	MOH	USP, WHO, SPC
	4. Conduct climate and sea-surge modelling for areas at risk and to inform new coastal developments	4. Risk modelling and projections used in project planning	MOIP with EMCI, CCCI and CIIC	SOPAC, NIWA
	5. Strengthen system of weather data collection and monitoring on all islands	5. Good quality data at all times	CIMS with Island Administrations	WMO, UNDP
	6. Monitor water quality on all islands (seawater, ground water, surface water)	6. Good water quality data at all times	NES with MMR, MOH, INTAFF, CIRC and Island Administrations	SOPAC, WHO
	7. Monitor of target fish species, problem species, keystone species and other marine organisms	7. Monitoring systems in place	MMR	USP, SPREP
	8. Monitor the impacts and distribution of ciguatera	8. Monitoring systems in place	MMR with MOH and NES	USP, WHO, SPREP
	9. Build capacity for participatory monitoring	9. Communities actively participate in monitoring climate change	CCCI with EMCI, NES, MOA, MMR, MOA and INTAFF	UNDP, USP, SPC, SPREP

**Appendix 2.** Strategic Area 4 (Strategy 2:8), Cook Islands Joint National Action Plan for Disaster Risk Management and Climate Change Adaptation (JNAP) 2011-2015.

**STRATEGIC AREA 4 RISK REDUCTION AND CLIMATE CHANGE ADAPTATION**

<b>STRATEGY 2: STRENGTHEN ECONOMIC DEVELOPMENT AND LIVELIHOOD SYSTEMS IN KEY SECTORS</b>				
<b>ACTIONS</b>	<b>INDICATIVE SUB-ACTIONS</b>	<b>KEY PERFORMANCE INDICATORS</b>	<b>LEAD &amp; SUPPORT AGENCIES</b>	<b>STRATEGIC PARTNERS</b>
8. Strengthen and build resilience in the fisheries sector, ensuring a higher resilience to the impacts of climate change.	<ol style="list-style-type: none"> <li>1. Participate in regional research programmes on monitoring migratory fish species, including the impacts of climate change.</li> <li>2. Develop management plans for lagoons and target fish species, taking into account the impacts of climate change.</li> <li>3. Implement management plans and guidelines for the aquaculture sector</li> <li>4. Strengthen and expand the system of ra'ui protected marine areas, to strengthen resilience against climate change impacts</li> </ol>	<ol style="list-style-type: none"> <li>1. Active participation in research programmes</li> <li>2. Management plans in place</li> <li>3. Aquaculture management plans in place and implemented</li> <li>4. Ra'ui protected areas strengthened and expanded</li> </ol>	<p>MMR</p> <p>MMRwith NES</p> <p>MMR</p> <p>MMR with CLO and Aronga Mana</p>	<p>SPC, USP, SPREP</p> <p>SPC, USP, SPREP</p> <p>SPC, USP, SPREP</p>