Priority adaptations to climate change for the fisheries and aquaculture sector in Tuvalu

Based on consultations between the Tuvalu Department of Fisheries, key stakeholders and the Secretariat of the Pacific Community, September 2012

Introduction

Following the joint SPC/FAO regional workshop on 'Priority adaptations to climate change for Pacific fisheries and aquaculture: reducing risks and capitalising on opportunities' in June 2012, Tuvalu's Ministry of Natural Resources requested assistance from the Secretariat of the Pacific Community (SPC) to identify the key adaptations Tuvalu could make to:

(1) capitalise on any opportunities presented by climate change to increase the substantial contributions that fisheries make to government revenue, food security and livelihoods, and

(2) reduce the threats of climate change on the sector.

Consultations were held between the Tuvalu Ministry of Natural Resources, key stakeholders and the Secretariat of the Pacific Community, in September 2012 to identify these adaptations (Table 1).

This document summarises the priority adaptations assuming that the Ministry of Natural Resources and Ministry of Foreign Affairs, Environment and Labour, will continue to:

(1) support responsible management of the region's transboundary tuna stocks through Tuvalu's membership of the Forum Fisheries Agency, the Parties to the Nauru Agreement (PNA) and the Western and Central Pacific Fisheries Commission;

(2) manage stocks of reef-associated fish and small pelagic fish to maintain the replenishment potential of these coastal fisheries resources; and

(3) protect coral reefs from local activities that can directly damage these important fish habitats.

Impacts of climate change on fisheries and aquaculture

Based on the recent comprehensive assessment of the vulnerability of fisheries and aquaculture in the tropical Pacific to climate change (http://www.spc.int/climate-change/fisheries/assessment/), global warming and ocean acidification are expected to affect oceanic fisheries, coastal fisheries and aquaculture in Tuvalu, as described below.

Oceanic fisheries

Catches of skipjack and yellowfin tuna in Tuvalu's exclusive economic zone (EEZ) are projected to increase (by up to 35-40% in the case of skipjack tuna) over the coming

decades due to changes in sea surface temperature (SST) and the location of the prime feeding areas for these species at the convergence of the Warm Pool and the western edge of the Pacific Equatorial Upwelling. On the other hand, catches of bigeye tuna are eventually expected to decrease. Greater abundances of skipjack and yellowfin tuna within its EEZ should provide Tuvalu with opportunities to increase the contributions of licences fees from distant water fishing nations (DWFNs) to government revenue, and create other opportunities for local enterprises.

Coastal fisheries

The productivity for coral reef fish in Tuvalu is projected to decline by 20% by 2050 due to both the direct effects of climate change (e.g. the impact of increased SST on recruitment and reproduction of reef fish) and the indirect effects of climate change (particularly the degradation of coral reef fish habitats due higher SST, ocean acidification and more intense storms). Tuvalu faces further declines in the potential supply of reef fish per person due to the effects of population growth. Possible increased incidence of ciguatera fish poisoning could reduce the availability of reef fish in some islands even further. On the other hand, the nearshore pelagic fish component of coastal fisheries based on skipjack and yellowfin tuna is projected to increase for the reasons outlined above.

Aquaculture

The grow-out (and possibly supply) of wild juvenile milkfish in lagoons/ponds is expected to be favoured by higher water temperatures. Sea-level rise may also increase the number of sites suitable for collecting milkfish fry in some islands, e.g. Vaitupu. Higher water temperatures and increased ocean acidification may eventually reduce the efficiency of culturing giant clams but such effects should not preclude assessment of the possible benefits of developing giant clam farming over the next couple of decades. Higher rainfall may enable communities on northern islands to install hydroponic systems to grow vegetables and freshwater fish (Nile tilapia).

Adaptations for government revenue and economic development

The priority actions needed to capitalise on the projected increases in tuna within Tuvalu's EEZ are described below.

1. Vessel day scheme (VDS)

The VDS administered by the Parties to the Nauru Agreement (PNA) provides Tuvalu with a practical 'cap and trade' fisheries management scheme to:

(1) limit the fishing effort of the industrial tuna fishing fleets to conserve stocks of skipjack, yellowfin and bigeye tuna at levels that should ensure sustainable future benefits;

(2) allow increased fishing in Tuvalu's EEZ when the fish are abundant there during El Nino events through the purchase of days from other PNA members;

(3) enable Tuvalu to receive some benefits from tuna resources during La Nina episodes when the fish are concentrated in the western Pacific 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 recent catches and, therefore, as tuna move progressively east under climate change Tuvalu can expect to be allocated more fishing days. Such allocations should provide Tuvalu with the opportunity to increase the contribution of licence fees from DWFNs to government revenue.

To establish records of the demand by industrial fleets to fish within its EEZ even when the allocated days for a particular year have all been used, Tuvalu can purchase additional fishing days not required by other PNA members. Existing arrangements for the VDS allow additional days to be purchased at short notice from other PNA members once all Tuvalu's allocated days for a given year have been used.

Action needed: Tuvalu should ensure that all fishing effort with its EEZ complies with the annual allocation of days from the VDS. During those years when all allocated days are used by DWFN fleets, and the fleets wish to continue fishing within Tuvalu's EEZ, the provisions of the 'cap and trade' facility of the VDS should be used to purchase additional days and establish the catch history needed for future reallocation of days under the VDS. All bilateral fishing arrangements should be phased out as soon as possible to establish the strongest possible record of PNA fishing effort within Tuvalu's EEZ.

Collaborating departments: Ministry of Natural Resources; Ministry of Foreign Affairs, Environment and Labour

2. Developing service industries for industrial fishing and transhipping vessels

The prospect of more purse-seine vessels fishing in Tuvalu's EEZ, and increased transhipping of tuna from Funafuti by fish cargo vessels, creates the opportunity for increased local economic activity through development of businesses to service the needs of fleets. Consideration should be given to:

- Expanding the existing port facilities so that purse-seine vessels can come alongside a wharf for service, and that space can be created to repair nets etc;
- Improving the internet services available for industrial fishing and transhipping vessels to assist them to coordinate their operations, and for crew to communicate with friends and family;
- Making arrangements via a shipping agent to pickup and return crew to vessels each day so that they can purchase supplies, e.g. salt, fresh vegetables and medical supplies, etc, and have rest and recreation ashore.

- Amending licence conditions for purse-seine vessels to specify that boats fishing in Tuvalu's EEZ are required to tranship their fish in Tuvalu and pick up observers from Funafuti.

Any such activities that are assessed to be economically and viable, and do not erode the high moral standards of Tuvalu's society[1], are expected to be win-win adaptations because DWFN fleets are expected to operate more frequently in Tuvalu's waters in years to come due to greater catches of tuna in nearby waters.

Action needed: Feasibility studies for the range of possible income earning opportunities based on consultations with ship captains, the private sector, the Funafuti Kaupule, relevant government departments and development partners.

Collaborating departments: Ministry of Finance and Economic Planning; Ministry of Natural Resources; Ministry of Foreign Affairs, Environment and Labour; Ministry of Health

3. Improved reporting of tuna catches

Projections of increased catches of tuna with Tuvalu's EEZ are derived from models – the better the models, the more confidence Tuvalu 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. Tuvalu and other PNA members can help overcome this limitation by changing the licence conditions for DWFNs to require all vessels fishing within the EEZs of PNA countries to report the actual locations where catches were made on the high seas (after an agreed time lag).

Action needed: Develop a joint position with all PNA members on the best protocols for reporting all tuna catches from the region.

Collaborating departments: Ministry of Natural Resources; Ministry of Foreign Affairs, Environment and Labour

Adaptations for food security and livelihoods

The priority actions needed to reduce the risks that fish supply to Funafuti and some outer islands may not be able to meet the high traditional demand for fish due to the effects of urbanisation/population growth, and/or degradation of coral reefs due to climate change, are described below.

4. Supply sufficient tuna for the growing population in Funafuti

Most of the fish required for good nutrition of the population in Funafuti needs to come from tuna. Supply chain analysis is needed to identify how best to provide access to this fish in ways that do not jeopardise the livelihoods of the commercial fishermen engaged in the local troll fishery; and ensure that supplies of tuna to Funafuti are adequate during La Nina

[1] In particular, strict guidelines are needed to avoid the risk of prostitution and HIV.

events when industrial fleets may not be fishing much with Tuvalu's EEZ or transhipping frequently at Funafuti.

Key components of the supply chains need to be identified and strengthened where they may be weak. Factors to be considered are:

(1) using licence conditions for DWFNs to ensure that the necessary amounts of small-sized tuna and bycatch are supplied to Funafuti from industrial fleets and that the fish is in good condition;

(2) providing fish aggregating devices (FADs) (with submerged buoys to avoid vandalism) for the local troll fishermen; and safety equipment and fishing gear at cost, to increase their catches and the safety and efficiency of their operations;

(3) Installing freezers to store tuna for release on the market when fresh fish is not available from the local troll fishery or industrial fleet;

(4) establishing enterprises for smoking and drying tuna to increase the shelf life of products; and

These important actions are expected to be win-win adaptations because they will increase the supply of fish to Funafuti's growing population now, and because tuna are projected to be more abundant in Tuvalu's waters in the future.

Action needed: Establish a cross-sectoral committee to identify how best to co-ordinate the boarding and inspection of purse-seine and transhipping vessels anchoring in Funafuti, and how best to use the bycatch available from purse-seine vessels. Evaluation of how best to use bycatch should include gender-sensitive supply chain analysis and assessment of the benefits of establishing a cooperative and a fish market operated by local fishermen to harmonise the supplies of locally caught tuna with the supply of bycatch from industrial vessels and the supply of reef fish from outer islands. To the greatest extent possible, this enterprise should use suitable existing infrastructure (e.g. facilities built by OFCF) and be managed to: (1) provide access to fish at reasonable cost for the growing population of Funafuti, (2) maintain the livelihoods of the commercial fishermen, and (3) create more direct selling opportunities and more livelihoods for local fishermen, and (4) establish more livelihood opportunities for women in fish storage and post-harvest processing.

Collaborating departments: Ministry of Finance and Economic Planning; Ministry of Natural Resources; Ministry of Foreign Affairs, Environment and Labour; Ministry of Health

5. Installation of FADs at outer islands

Because the productivity of coral reef fisheries is expected to progressively decline as coral reefs degrade under climate change, communities on outer islands will need to transfer some of their fishing effort from reef fish to nearshore pelagic fish, particularly tuna.

The most practical way to do this is to install FADs at all islands where reef fisheries do not presently meet the communities' needs for fish, or are not expected to yield enough fish to meet the traditional levels of fish consumption as the climate changes. FADs are a win-win adaptation – they can provide better access to fish now, and tuna should be easier to catch around FADs as the fish progressively move into Tuvalu's EEZ.

Consultations are needed with communities and SPC's SOPAC Division to identify the best locations for FADs at each island (which may include 'lagoonal FADs' in some islands with open lagoons), and to make arrangements for the harmonious use of FADs by all island communities. Wherever possible, FADs should be placed close enough to shore so that they can be reached by people paddling in canoes.

FADs should be regarded as a 'national infrastructure for food security'. Communities should receive training in how to fish safely around FADs and how to maintain them. Because FADs have a limited life (usually 2-3 years), the fisheries department should stockpile FAD materials and replace FADs as soon as they are lost.

Catches of fish made around FADs should be monitored to measure the cost:benefit of FADs and improve site selection.

Communities will also need to be made fully aware of the benefits of FADs (using brochures etc).

Action needed: Establish a new programme at the Fisheries Department dedicated to FADs. Key functions of the programme would be to (1) receive training in all aspects of installing, maintaining and fishing effectively and safely around FADs from an SPC master fisherman, (2) pass on this training to island communities; (3) maintain adequate stockpiles of equipment to replace lost FADs; (4) provide training in how to build canoes suitable for fishing safely around FADs; (5) maintain supplies of fishing gear needed to fish around FADs for sale to communities at cost price; and (6) monitor the catches of fish made around FADs.

The programme should be 'staged' by installing 2-3 FADs, and initiating the supporting activities, at the islands with the greatest needs in the first instance, i.e. islands without lagoons.

The existing 'Community fishing centres' should be refurbished to create 'Fisheries focal centres' where (1) training in all aspects of installing and fishing effectively and safely around FADs, and canoe building, can be conducted; (2) monitoring of catches from FADs can be co-ordinated; (3) equipment for replacing FADs can be stored, and (4) fishing gear can be purchased at cost.

Collaborating departments: Ministry of Finance and Economic Planning; Ministry of Natural Resources; Ministry of Home Affairs

6. Improving post-harvest methods

To enable island communities to derive more benefits from increased fish catches around FADs, training will be needed to improve the methods traditionally used to smoke and dry fish to maximise the quality and shelflife of the products. Such techniques will allow remote island communities to store fish for times when it is too rough to fish around FADs and fish cannot be caught easily from coral reef and lagoon habitats.

Action needed: Organise training in practical fish post-harvest methods for island communities at the fisheries focal centres; investigate the potential for producing sea salt on each island.

Collaborating departments: Ministry of Finance and Economic Planning; Ministry of Natural Resources; Ministry of Home Affairs

7. Ciguatera fish poisoning

Inputs of nutrients to reef flats and into lagoons from pig farms, hotels and households can promote the growth of harmful algal blooms including the toxic dinoflagellate algae, *Gambierdiscus* spp, which cause this type of fish poisoning. There is also concern that effluent from the industrial fishing and transhipping vessels which anchor in the lagoon at Funafuti may also promote the growth of the toxic algae. The increase in dead coral and proliferation of seaweed on reefs expected to occur during climate change is also likely to increase the habitat for *Gambierdiscus*.

Action needed: The Ministry of Natural Resources should (1) consult with Ministry of Health to develop procedures to be used by all hospitals/clinics in the country to record the number of ciguatera cases (separately from other cases of food poisoning) to determine if the incidence of ciguatera fish poisoning increases over time and identify the main species of fish involved (SPC has a suitable form for recording this information); (2) map existing and recent ciguatera events based on data already available; (3) set up algae monitoring stations to determine any increases in the density of *Gambierdiscus* over time and identify the dominant strains; (4) set up a database to store all records and allow easy access and updating of the information; (5) and inform communities about the possibility that ciguatera could increase in the future. Importantly, the Ministry of Foreign Affairs, Environment and Labour should implement regulations to prevent the discharge of effluent from vessels while they are in the lagoon, and ensure that ballast water taken on board by all cargo vessels from outside the region is exchanged completely prior to entering Tuvalu's EEZ to reduce the risk of introducing other species of toxic algae.

Collaborating departments: Ministry of Natural Resources; Ministry of Health; Ministry of Foreign Affairs, Environment and Labour

8. Re-orientate milkfish farming practices

Plans to develop milkfish farming, which are expected to be enhanced by faster fish growth rates as water temperatures increase, should be amended to (1) simplify the aquaculture methods, and (2) deliver the potential benefits to more people. The focus of the existing project should be shifted to increasing the number of juvenile milkfish in the lagoon at Vaitupu Island by transferring wild juveniles recruiting to shallow intertidal pools near the mangroves where they are likely to be exposed an die at low tide to deeper parts of the lagoon (where they may need to be contained and fed until they reach a size where the risk of being stranded at low tide is reduced).

During the season when larger milkfish usually leave the lagoon for the open sea, nets or fish traps with a mesh size small enough to catch milkfish but large enough to allow other species to pass through should be placed across the channel to prevent this from happening so that the investments in 'culturing' milkfish are not lost.

Action needed: Community members and high school students at Vaitupu should be invited to assist with the movement of the fry from the mangrove area to the deeper parts of the lagoon.

Collaborating departments: Ministry of Natural Resources; Ministry of Home Affairs; Government of Taiwan milkfish farming project

9. Protect coastal fish habitat during infrastructure projects

Population growth and sea-level rise may require new infrastructure, e.g. causeways to link 'motus' on atolls. The Ministry of Natural Resources ensure that the possible effects of any such infrastructure on fisheries are considered during all cross-sectoral planning. For example, causeways between motus should always be constructed with wide culverts to allow water to flow between the sea and the lagoon.

Environmental Impact Assessments (EIA) for construction of any coastal infrastructure should include full consideration of possible effects on fisheries and aquaculture.

Excavation of sand (presumably from the deeper areas of the lagoon) for building materials and to fill 'borrow pits' on Funafuti to create more space for housing and agriculture should be done with the advice of SPC's SOPAC Division.

Collaborating departments: Ministry of Natural Resources; Ministry of Public Works, Water and Energy

10. Mapping seagrass and intertidal flat habitat

Some coastal fisheries use habitats other than coral reefs. In particular, sea cucumbers and milkfish depend on intertidal lagoon flats and seagrass beds. Basic information is needed on the extent of these habitats in Tuvalu to estimate their contributions to coastal fisheries.

Much of the mapping can be done with satellite images and ground-truthing in collaboration with SPC's FAME and SOPAC Divisions. The database can then be used to estimate and monitor the effects of sea-level rise on the contribution of these habitats to coastal fisheries used for food security.

Action needed: Train a staff member from the Fisheries Department in remote sensing and habitat mapping to complete the analysis for every island.

Collaborating departments: Ministry of Natural Resources; Ministry of Foreign Affairs, Environment and Labour

11. Removal of seaweed from beaches

Periodically, large quantities of seaweed wash ashore from the lagoon on Funafuti. Seaweed is expected to grow more profusely on reefs as the climate changes. Plans are needed to collect seaweed from beaches when it washes ashore in large quantities and to use it to make compost for growing vegetables.

Action needed: Experiments to identify the best ways to store seaweed while it decomposes into compost to improve agriculture on the island.

Collaborating departments: Ministry of Natural Resources; Ministry of Foreign Affairs, Environment and Labour; Ministry of Public Works, Water and Energy;
Government of Taiwan agriculture project

12. Monitoring reef fish reproductive cycles

Island communities in Tuvalu have long traditions of prohibiting fishing for certain species during their spawning seasons. Climate change is likely to alter the time of year when many reef fish species reproduce. Unless these changes are studied the traditional closures implemented by Kaupule may become less effective.

Consideration should also be given to adding a lagoon site within Tuvalu to the sites SPC is setting up to monitor the effects of climate change on coral reef habitats across the region in the long term.

Action needed: Scientists from the Fisheries Department should begin a programme to sample the reproductive condition (gonad maturity stage) of key coastal fish species to monitor the duration of their spawning seasons and advise the Kaupule of any need to alter the dates of fishing closures to help maintain good numbers of spawning fish.

Collaborating departments: Ministry of Natural Resources; Ministry of Home Affairs

13. Measuring effectiveness of adaptations

The effectiveness of the recommended adaptations to increase or maintain the important contributions of the fisheries sector to economic development, food security and livelihoods need to be evaluated regularly to determine whether they are having the desired results, and to adjust them if needed. This can be done by including additional questions in Household Income and Expenditure Surveys (HIES) to assess changes in fish consumption and the species of fish bought, sold and eaten by communities.

The great significance of the fisheries sector to the formal and informal economy in Tuvalu justifies changes to the HIES (and the census if practical) to include key questions on fish sale and consumption. Consideration should also be given to conducting the HIES every 5 years so that trends in the contribution of fish to local formal and informal economies can be monitored more closely.

Action required: Consult with the Statistics for Development Division and FAME Division at SPC to design the additional questions needed for HIES for the fisheries sector.

Collaborating departments: Ministry of Finance and Economic Planning; Ministry of Natural Resources

Synergies with other plans and projects

Many of the adaptations described here have also been identified as priority actions in the 'National Master Plan for Fisheries Development 2008 – 2011' and UNDP GEF NAPA 2 activities. The overlap in adaptations/actions among these three intiativies are shown in the table below.

Activity	Priority adaptations	Master plan	NAPA 2
Vessel day scheme (full implementation)	X	X	
Developing service industries for vessels in Funafuti	X		
Improved reporting of tuna catches on high seas	X		
Cooperative and market to harmonise fish supplies	X	X	
Installation of FADs at Funafuti and outer islands	X	X	X
Refurbish Community Fishing Centres	X	X	X
Training in fishing around FADs and canoe building	X		X
Facilitate sale of safety equipment and fishing gear	X	X	

Training in post-harvest	X		X
Addressing ciguatera fish poisoning	X		
Re-orientate milfish farming	X		
Fish habitat and infrastructure projects	X		
Mapping seagrass and intertidal flats	X		
Removal of seaweed from beaches	X		
Monitoring fish reporductive cycles	X		
Measuring effectiveness of adaptations	X		