

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

## 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, Nauru Fisheries and Marine Resources Authority (NFMRA) requested assistance from the Secretariat of the Pacific Community (SPC) to identify the key adaptations required to:

- capitalise on any opportunities presented by climate change to (1) increase the contributions that tuna resources make to government revenue, food security and livelihoods, and (2) culture milkfish and tilapia; and
- reduce the threats of climate change on the coastal fisheries.

Consultations were held between NFMRA, stakeholders from a wide range of government departments and development partners, and the Secretariat of the Pacific Community in January 2013 (Table 1) to identify these adaptations.

This document summarises the priority adaptations, assuming that NFMRA will:

- (i) support responsible management of the region's transboundary tuna stocks through Nauru's membership of the Forum Fisheries Agency (FFA), the Parties to the Nauru Agreement (PNA) and the Western and Central Pacific Fisheries Commission (WCPFC);
- (ii) institute sustainable management of reef-associated fish and invertebrates to maintain the replenishment potential of these coastal fisheries resources; and
- (iii) 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 ([www.spc.int/climate-change/fisheries/assessment/](http://www.spc.int/climate-change/fisheries/assessment/)), global warming is expected to affect tuna fisheries and brackishwater/freshwater aquaculture, and global warming and ocean acidification are likely to affect coastal fisheries, in Nauru as described below.

### ***Tuna fisheries***

Preliminary modelling indicates that catches of skipjack tuna in Nauru's exclusive economic zone (EEZ) could increase over the next few decades due to changes in sea surface temperature (SST) and the location of the prime feeding area for this species at the convergence of the Warm Pool and the western edge of the Pacific Equatorial Upwelling<sup>1</sup>. On the other hand, catches of bigeye tuna are expected to decrease. Greater abundances of skipjack tuna within its EEZ should provide Nauru 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 Nauru is projected to decline by 20% by 2050 due to both the direct effects of climate change, e.g. the impact of increased sea surface temperature (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 and ocean acidification. Nauru 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 also reduce the availability of reef fish. On the other hand, the nearshore pelagic fish component of coastal fisheries based on skipjack tuna could 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 increased rainfall and higher water temperatures. Farming of Nile tilapia is also expected to be facilitated by higher rainfall and warmer temperatures. Increased availability of freshwater may create more suitable conditions for hydroponic systems to grow vegetables and Nile tilapia.

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

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

### ***1. Vessel day scheme (VDS)***

The VDS administered by the Parties to the Nauru Agreement Office (PNAO) provides Nauru 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, (and yellowfin and bigeye) tuna at levels that should ensure sustainable future benefits;

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<sup>1</sup> More recent modelling suggests that there may be a slight decrease in skipjack biomass in Nauru's EEZ by 2035 but stocks of tuna are still expected to be abundant. Estimates of changes in skipjack biomass can be expected to continue to change as the tuna modelling improves.

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

(3) enable Nauru to receive some benefits from tuna resources during La Nina episodes when the fish are concentrated further to the west 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 past seven years, therefore, it is possible that Nauru could be allocated more fishing days over the next couple of decades as tuna move progressively east under climate change. Such allocations would provide Nauru 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, Nauru can purchase additional fishing days not required by other PNA members.

Action needed: Nauru should ensure that all fishing effort within 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 Nauru'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.

Collaborating agencies: NFMRA , PNAO and FFA

## ***2. Developing service industries for industrial fishing and transshipping vessels***

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

- Including facilities in the planned new port which will allow purse-seine vessels to come alongside a wharf for service, and provide space to repair nets etc;
- Improving the internet services available for industrial fishing and transshipping vessels to assist them to coordinate their operations, and for crew to communicate with friends and family;
- Supply fishing and transshipping vessels with fuel;
- Making arrangements via a shipping agent to provision vessels (e.g. supply salt, fresh vegetables and medical supplies, etc).

Any such activities that are assessed to be economically viable, and organised in ways to ensure that there is no risk to society from the presence of fishing crews while ashore<sup>2</sup>, are expected to be win-win adaptations because DWFN fleets are expected to operate more frequently in Nauru's waters in years to come due to greater catches of tuna within the EEZ.

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

Collaborating agencies: NFMRA, FFA, Department of Transport, Nauru Ports Authority (NPA), Nauru Utilities Corporation (NUC) and Department of Commerce, Industry and Environment (CIE)

### ***3. Improved reporting of tuna catches***

Projected changes to tuna catches within Nauru's EEZ are derived from models – the better the models, the more confidence Nauru 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. Nauru 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 agencies: NFMRA, Nauru Bureau of Statistics (NBS), FFA, SPC, PNAO and WCPFC

## **Adaptations for food security and livelihoods**

The priority actions needed to maintain the high traditional demand for fish in Nauru as its population grows, and as coral reefs and the associated coastal fisheries decline due to climate change, are described below.

### ***4. Supply sufficient tuna for the growing population***

Most of the fish required for good nutrition of the population of Nauru 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 are adequate during times when

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<sup>2</sup> In particular, strict regulations are needed to prevent any demand for prostitution and to avoid the risks of HIV.

industrial fleets may not be fishing much within Nauru's EEZ or when transshipping is not occurring.

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 high quality tuna (and other bycatch) are supplied to Nauru from industrial fishing vessels or transshipping vessels;
- (2) providing anchored inshore fish aggregating devices (FADs) for the local fishermen; and safety equipment and fishing gear at reduced 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 local fishermen or the industrial fleet;
- (4) Considering a co-operative fish marketing mechanism involving local fishermen to harmonise the sale of fish obtained from industrial fleets with tuna caught by local fishermen in a way that does not jeopardise their livelihoods;
- (5) Investigate systems for applying a levy to sales by the co-operative to create a fund for the deployment and maintenance of coastal FADs (to increase access to tuna for subsistence fishers) and for maintaining the small fishing vessels and motors of local fishermen.

See Figures 1 and 2 for the quantities of fish needed for food security and a summary of the main features of the key adaptations required to increase the supply of tuna (and other large pelagic fish).

These important actions are expected to be win-win adaptations because they will improve the supply of tuna now for the countries growing population , and because tuna could be more abundant in Nauru's waters in the next couple of decades.

Action needed: Establish a cross-sectoral committee to identify how best to increase the number of transshipping operations in Nauru. Gender-sensitive supply chain analysis and assessment of the benefits of establishing a co-operative involving local fishermen to harmonise the supplies of locally caught tuna with the supply of good quality tuna and bycatch from industrial vessels. To the greatest extent possible, this enterprise should use suitable existing infrastructure and be managed to: (1) provide access to fish at reasonable cost for the growing population, (2) maintain the livelihoods of local fishermen, and (3) create more livelihood opportunities for women in fish storage and sales.

Collaborating agencies: NFMRA, NPA, CIE, Nauru Fishers Cooperative (NFC – to be re-established)

## **5. Transfer more coastal fishing effort to FADs**

Because the productivity of coral reef fisheries is expected to progressively decline as coral reefs degrade under climate change, fishing communities 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 encourage increased use of FADs. FADs have the potential to be a win-win adaptation in the shorter term – they can provide better access to fish now, and tuna should be easier to catch around FADs if abundances in Nauru’s EEZ increase during the next two decades.

Consultations are needed with communities and SPC’s SOPAC Division to identify the best locations for FADs and to make arrangements for the harmonious use of FADs by 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 ‘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), NFMRA 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 this infrastructure and to improve site selection for FADs, and record changes in fishing effort on coral reefs and the effects of this reduced effort on reef biodiversity.

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

Action needed; Strengthen the existing NFMRA FAD programme. Key functions of the programme would be to (1) improve skills of NFMRA staff in all aspects of installing, maintaining and fishing effectively and safely around FADs through training from an SPC master fisherman, (2) pass on this training to 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; and (5) monitor the catches of fish made around FADs.

Collaborating agencies: NFMRA, Civil Society Organisation (CSO) and NFC

## **6. Ciguatera fish poisoning**

Inputs of nutrients to reef flats from point sources on land 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 industrial fishing and cargo vessels may 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: NFMRA should (1) consult with Ministry of Health to develop procedures to be used by the hospital to record the number of ciguatera cases (separately from other cases of food poisoning) to determine if the incidence of ciguatera 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 appropriate competent authority should implement regulations to prevent the discharge of effluent from vessels while anchored in Nauru, and ensure that ballast water taken on board by all cargo vessels from outside the region is exchanged completely prior to entering Nauru's EEZ to reduce the risk of introducing other species of toxic algae.

Collaborating agencies: NFMRA, NMA, NPA, Health Department and DCG

## **7. Re-invigorate milkfish and Nile tilapia farming**

Milkfish and Nile tilapia farming, which are expected to be enhanced by faster fish growth rates as water temperatures increase, should be promoted by creating more places to grow these species, and identifying how to obtain regular supplies of the fry and feeds needed for profitable farming operations. The national aquaculture plan can be modified to make investments in (1) making Nauru's freshwater lagoon more suitable for growing milkfish species through regular netting (by high school science students) to remove Mossambique tilapia (which can be used as pig feed); (2) constructing more ponds for milkfish and Nile tilapia by draining freshwater lying on the road after heavy rainfall; and (3) converting existing depressions and unused pools/ponds to grow-out facilities (using plastic lining where necessary). During droughts, water levels in milkfish ponds near the main road could be maintained using portable equipment to pump seawater into ponds.

Traditional knowledge on the best locations and seasons for collecting milkfish fry needs to be recorded before it is lost and regular surveys (involving high school science students) are needed to confirm where sufficient fry for grow-out operations can be collected. Sources of fry from other countries should also be investigated, together with the feasibility of delivering these fry using the transshipping vessels due to come to Nauru from Asia (ensuring that the necessary biosecurity and quarantine procedures are followed).

Action needed: Cross-sectoral planning is needed to identify areas where ponds can be constructed in keeping with the need to set land aside for the growing population and establishment of other amenities. Community members and high school students can be

encouraged to adopt some aspects of milkfish farming as a permanent project, e.g. regular netting of the lagoon and the milkfish fry surveys.

Collaborating agencies: NFMRA, NAQUA, SPC, FAO, ROC Taiwan and Education Department

### ***8. 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 Nauru justifies changes to the HIES (and the census if practical) to include key questions on fish sale and consumption.

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

Collaborating agencies: NFMRA, SPC, NBS and CIE

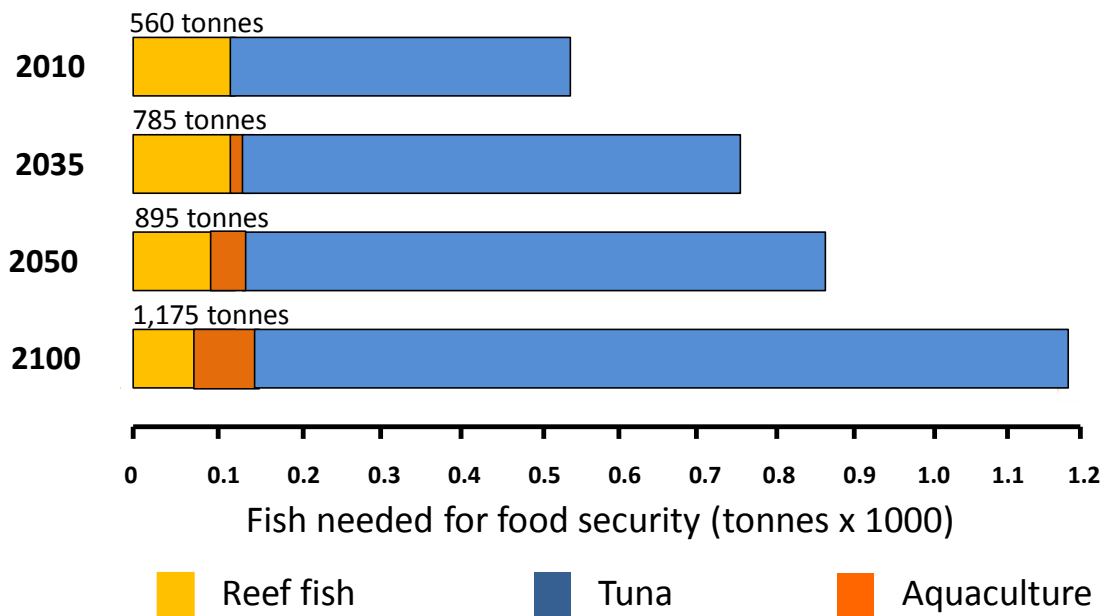
### **Next steps**

The relevant priority adaptations to climate change for the fisheries and aquaculture sector described here should will be incorporated in the National Tuna Development Plan and RONAdapt.

Discuss with the SPC/GIZ CCCPIR programme the possibility of providing a consultant to develop a fully costed implementation plan to launch the recommended adaptations for the fisheries and aquaculture sector in collaboration with NFMRA and SPC's Fisheries, Aquaculture and Marine Ecosystems Division. The implementation plan will include analysis of the financial resources and additional staff needed to launch and manage the priority adaptations described above.



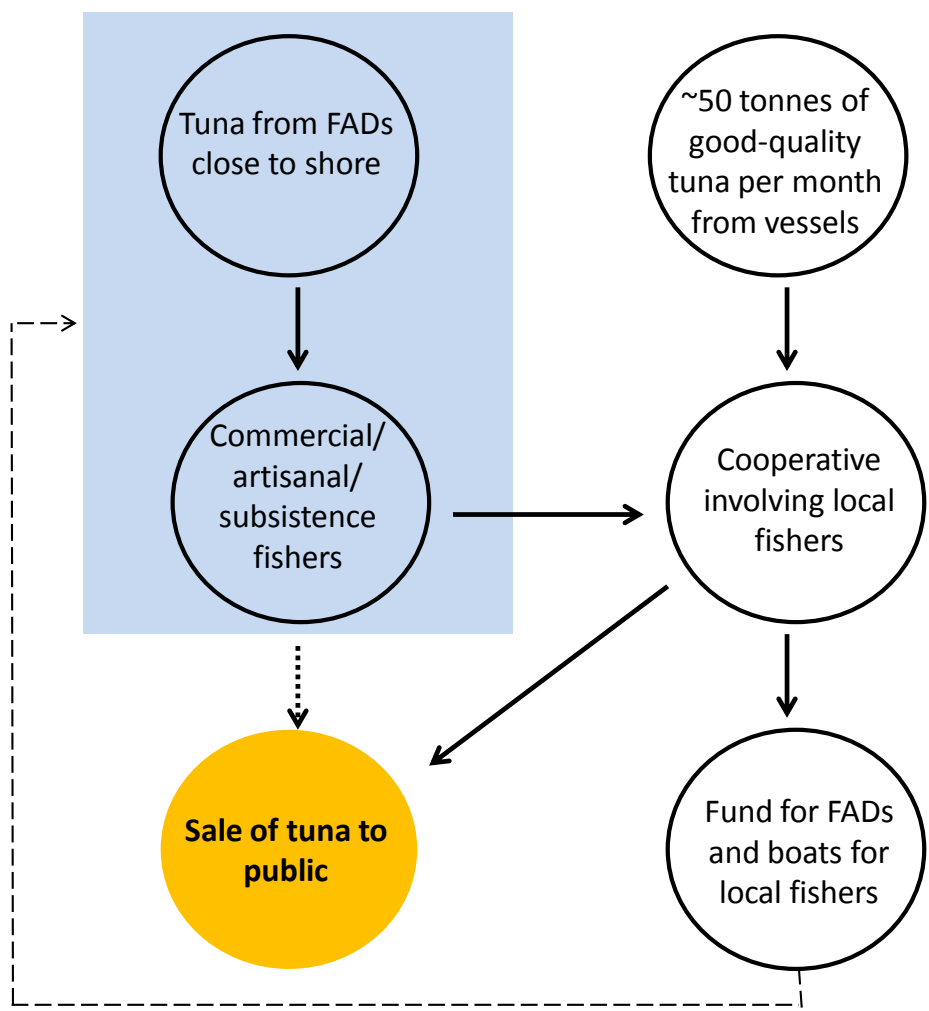
**Figure 1** The quantities of fish needed (in tonnes) to supply Nauru with enough fish to maintain the traditional levels of fish consumption (56 kg per person per year) until 2100. The main sources of fish available are also indicated but note that the contributions of reef fish (including invertebrates) are estimated as ~120 tonnes per year, derived from Trujillo et al. (2011)<sup>3</sup>, because the sustainable harvests of these coastal resources have not yet been identified. Nevertheless, declines in these resources of 20% in 2050 and 35% in 2100 have been represented.



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Trujillo, P., Harper, S. and Zeller, D. (2011) Reconstruction of Nauru's fisheries catches: 1950-2008. pp. 63-71. In: Harper, S. and Zeller, D. (eds.) Fisheries catch reconstructions: Islands, Part II. Fisheries Centre Research Reports 19(4). Fisheries Centre, University of British Columbia [ISSN 1198-6727].

**Figure 2** Key adaptations for use of tuna for food security in Nauru, designed to supply ~50 tonnes of fish per month. These adaptations are based on regular landings of good-quality tuna and bycatch from transshipping vessels or purse-seine vessels, and increased fishing by local fishers around anchored inshore fish aggregating devices (FADs), supported by a fund from the sales of tuna from the cooperative coordinating the supply of all tuna to the market.



**Table 1** Participants attending the workshop in Nauru on 16 January 2013 to develop priority adaptations to climate change for the fisheries sector

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