Priority adaptations to climate change for fisheries and aquaculture in Fiji: reducing risks and capitalising on opportunities

12-14 December 2012, Suva, Fiji

WORKSHOP SUMMARY AND OUTCOMES

Summary of activities each day

DAY 1: 12th December 2012

Today, we heard that the broad of aim of the workshop is to understand how climate change might affect the plans to derive benefits from fisheries and aquaculture. Ultimately, by the end of the workshop, we hope to have used this information to identify plans, policies and actions to assist the sector in Fiji adapt to climate change.

We heard from Masa Izumi about FAO's regional perspective, with a focus on strengthening collaborations, and then from Aisake Batibasaga from Fiji's Ministry of Fisheries and Forests on the different fisheries and aquaculture activities in Fiji. We learnt that Fiji has active oceanic, inshore and freshwater fisheries, as well as marine and freshwater aquaculture, and that all these activities are important for employment, the economy and food security.

We then moved to the results of the recent assessment of the vulnerability of tropical Pacific fisheries and aquaculture to cliamte change, co-ordinated by SPC (http://www.spc.int/climate-change/fisheries/assessment/) and heard first from Dr Janice Lough (Australian Institute of Marine Science) on how surface climate in the region and Fiji is projected to change. Janice told us that in Fiji both air and sea surface temperatures are becoming warmer, and that there will be more rainfall, compared to the subtropics which are becoming drier. In addition, extreme weather events, such as cyclones and storms, are predicted to become more intense although there may be fewer of them. The El Nino Southern Oscillation (ENSO) will continue to be a source of variability in the region. The breakout groups discussed related issues, such as the link between the global financial crisis and reductions in CO_2 emissions, and identified that climate change will affect 'how we do business' in terms of negotiating fisheries resource allocations and planning timeframes.

Dr Alex Sen Gupta (University of NSW) then spoke to us about how the tropical Pacific Ocean is projected to change. Alex also gave us an excellent overview of how global climate models work. Notably, he explained the processes driving the region's climate system; that some changes have already been observed – the ocean has warmed, sea level has risen and ocean pH has declined – but cautioned about the limitations of these models. He then outlined the projections for further ocean warming, reduced salinity, greater stratification, changes to ocean circulation (tides, eddies and currents), changes to nutrient availability, and changes to ocean chemistry (O_2 saturation and pH).

Importantly, he stressed that we need to remember that natural climate variation can make climate change difficult to detect. There was lots of interesting discussion in the breakout groups – participants found the projections interesting and relevant, particularly for MPAs and fisheries management and the effectiveness of MPAs.

We learnt from Dr Valerie Allain (SPC) that there are five ecological provinces (with different food webs) in the tropical Pacific Ocean that support tuna, and that these provinces are projected to change in surface area. We also learned about the projected weakening of upwelling, resulting in nutrient-poor surface waters and a decline in primary production and food resources for tuna. Sri Nandini (SPC intern) then described how tuna in the Pacific will be impacted by ocean warming, reduced O_2 and reduced ocean productivity. She explained the results of the preliminary SEAPODYM modelling, which indicate that skipjack tuna will move eastward; bigeye will also move east and decline in biomass, and albacore will contract in range and decline in biomass across the region. Bigeye and albacore tuna appear to be most at risk from climate change and require effective management to maintain their natural adaptive capacity to a changing ocean. Indeed, all tuna fisheries management regimes will need to take account of the projected climate-induced changes to stocks. Tuna is important in the region and to Fiji, and there was much discussion on the possible consequences of the projected changes in ocean productivity on tuna resources. In particular, there was much interest in the movement of skipjack tuna and how this might benefit Fiji as this species is redistributed progressively to the east.

DAY 2: 13th December 2012

Today we continued to discuss the results of the SPC coordinated vulnerability assessment, focussing on coastal habitats, coastal fisheries, coastal and freshwater aquaculture and freshwater fisheries. Dr Janice Lough presented information on the vulnerability of coral reefs to climate change, a key habitat for many species of fish and shellfish supporting subsistence and artisanal fisheries. Coral reefs are particularly vulnerable to rising sea temperatures, ocean acidification and more intense cyclones, and impacts have already been observed. These impacts include mass coral bleaching as a result of warm water events, and reduced coral diversity and reef complexity in PNG where there CO_2 seeps naturally from the seafloor. Building resilience of coral reefs by reducing other pressures is an important management strategy. Ultimately, reefs will not disappear due to climate change but are predicted to become less diverse and provide less structural habitat for fish and shellfish. The breakout groups were interested in the 'natural laboratory' in PNG, and were concerned about the multiple pressures on reefs. The discussion groups concluded that addressing present-day pressures that degrade reefs was an important way of keeping reefs healthy now and building their resilience to climate change.

Johanna Johnson (C_2O consulting and Southern Cross University) then spoke about the implications of climate change for mangroves, seagrasses and intertidal flats, and their vulnerability to increasing sea temperatures, sea-level rise, changing rainfall patterns (delivering land-based pollutants), and more intense cyclones and storms. These habitats support many species of fish and shellfish that are important for subsistence and artisanal fisheries, and any degradation will have flow-on effects to coastal fisheries. Again, reducing other pressures on these habitats is an important management strategy for building their resilience to climate change. Breakout groups discussed mangrove replanting, the possibility of seagrass replanting, and the future value of these habitats as blue carbon sinks. The need to increase awareness of the importance of mangroves and seagrasses to coastal fisheries species (e.g. mangrove jack and trevally) and green turtles was identified. Such actions should also improve awareness about the value of these habitats and help protect them by providing context (or caution) for

many development decisions that currently result in large areas of these habitats being cleared or damaged.

Professor Morgan Pratchett (James Cook University) then outlined the importance of coastal fisheries in the Pacific, the different types of species that are targeted and their vulnerability to climate change. Demersal (bottom-dwelling) fish are most vulnerable to habitat degradation; nearshore pelagic fish to changes in coastal productivity; and invertebrates to habitat loss and ocean acidification. Climate-induced habitat degradation was identified as the greatest threat to demersal fish and invertebrates. As a result, coastal fisheries production is predicted to decline for demersal fish and invertebrates in Fiji but productivity of nearshore pelagic fish (mainly tuna) is expected to increase, particularly in the short- to medium-term. Priority adaptations include protecting coastal habitats, building habitat resilience, diversifying coastal fisheries, collecting better information on species catches and integrating climate change implications into fisheries management. Breakout groups discussed how catch records could be improved over time, and considered adaptation options, e.g. changing fishing practices after disturbances to coral reefs such as bleaching.

Dr Tim Pickering then provided an overview of the commodities and value of mariculture and freshwater aquaculture, future plans for these activities and climate change implications. Vulnerability of mariculture products is variable, with pearls and shrimp likely to respond in different ways to different drivers. For example, pearl farming is vulnerable to declining pH and increasing temperatures but not other variables, whereas shrimp farming in Fiji might benefit from increasing temperature through faster growth rates but be impacted by rising sea levels and higher risks from pathogens due to increases in pond temperatures. Other aquaculture commodities, like seaweed and cultured giant clams and corals, are eventually expected to be negatively affected.

Dr Pickering also explained that the location of mariculture facilities is important, with coastal ponds being vulnerable to extreme events. Future plans for expansion of mariculture may be at risk in the medium- to long-term, particularly if production efficiency declines due to climate change. Adaptations include moving sea-cages into deeper water, appropriate site selection (or relocation), and changes to production activities.

We also heard how climate change is likely to present opportunities for expansion of freshwater (or inland) aquaculture, based on Nile tilapia and freshwater prawn. Indeed, the scope for increased freshwater aquaculture production is likely to be an adaptation to maintain the contributions of aquatic resources to food security and livelihoods in Fiji as coastal fisheries decline. The breakout groups concluded that it is important to continue the work to improve the understanding of climate change impacts on mariculture and to improve biosecurity protocols. There was much interest in the prospect that freshwater aquaculture would be a 'winner' under climate change and provide opportunities to increase fish supply. The issues of investigating whether any of the indigenous freshwater species had potential for aquaculture, and current limitations to expansion of pond aquaculture, were also discussed.

Finally, Dr Peter Gehrke (SMEC) provided an overview of freshwater habitats and fisheries, highlighting the importance of freshwater fisheries to communities in Fiji. We heard about the importance of river flow ("the maestro") for these habitats and how the expected effects of climate change are different to those for coastal habitats. Higher rainfall will increase available freshwater habitat and therefore fisheries productivity. However, in disturbed catchments these benefits will be constrained, making good catchment management a critical strategy at local and regional scales. Capitalising on the opportunities will require more flexible fishing arrangements, as well as more data on the status of stocks and a focus on biosecurity to avoid issues with invasive species. The breakout groups discussed

the importance of effective catchment management, particularly as recent floods might be a sign of what is the come, with more rainfall likely to increase sediment runoff to freshwater systems unless catchment vegetation is maintained.

DAY 3: 14th December 2012

Day 3 was dedicated to looking at what climate change means for the contributions from fisheries and aquaculture to economic development, food security and livelihoods in the Pacific, and the possible adaptations and policies to reduce the risks and capitalise on the opportunities. Dr Johann Bell (SPC) reminded us about how the distribution of tuna is estimated to change and then explained how the projected alterations in catches are likely to affect island economies. The smaller island nations in the central-eastern Pacific which already receive a substantial proportion of their government revenue from tuna fishing licences fees are expected to have the opportunity to increase these benefits in the longer-term. He then described some of the main 'win-win' adaptations available, such as fishing effort schemes which take account of climatic variability now and can be adjusted to climate change in the future; maintaining trade preferences (e.g. economic partnership agreements with the EU), and conservation measures for tuna to sustain catches. He also stressed that integrating the supporting policies into national plans and strategies is important for enabling adaptation. Breakout groups discussed the importance of adapting to current climate variability, managing purse-seine and longline fishing to maintain the replenishment potential for all four species of tuna in the region, and improving data collection and reporting.

Johann then talked about the implications of the projected changes on coastal fisheries for food security and livelihoods, and emphasised that much of the fish and shellfish consumed in the region comes from coastal fisheries. In Fiji, people currently eat ~40 kg of fish per person per year, which is above the recommended 35 kg. However, as the population of Fiji grows and reefs degrade due to climate change, providing access to enough fish to maintain fish consumption levels at 35 kg per person per year will be a challenge for Fiji. Eventually, a gap will emerge between the sustainable harvests from well managed coastal fisheries and the fish required for good nutrition of the nation. Strategies for filling this gap will have to focus on increasing access to other sources of fish, such as tuna and Nile tilapia produced by pond aquaculture. Win-win adaptations for food security and livelihoods include integrated coastal zone management to protect coastal and freshwater fish habitats and stocks to minimise the gap; increased use of inshore anchored FADs to allow coastal subsistence and artisanal fishers to catch more tuna; and expansion of freshwater pond aquaculture. These adaptations will need to be supported by cross-sectoral governance and policies that allocate more of the national tuna catch for food. The breakout groups discussed opportunities for increasing access to fish for food, such as inshore anchored FADs, developing small-scale pelagic fisheries, and pond aquaculture, and the fact that these adaptations are expected to be favoured by the changing climate. The groups also discussed the importance of inter-agency cooperation and multi-sector planning to successfully implement these adaptations.

We then heard from Waisea Vosa and Kirstie Meheux about the national policy and strategies for climate change and disaster risk management, including Fiji's *National Climate Change Policy* launched in March 2012. This is a multi-sector policy and it is hoped there will be greater input from the Ministry of Fisheries and Forests. The national plan provides a platform for climate change mitigation and adaptation, and is underpinned by policy principles, objectives and strategies, such as mainstreaming climate change, awareness raising and adaptation. We learned about the regional frameworks for climate change adaptation and disaster risk management, and how these guide the development of regional and national policy, such as joint national action plans for climate change and disaster risk

management (JNAPs). Kirstie explained how there is a roadmap to integrate the separate regional strategies for climate change, and for disaster risk management, by 2015. The rationale for integrating the two strategies from a fisheries perspective is that they both involve reducing risk to major climatic events (cyclones and floods) that affect fish habitats, fish stocks and communities and industries involved in fisheries and aquaculture.

The working groups then identified priority adaptations for economic development, food security and livelihoods in Fiji, in preparation for detailed discussion between the Climate Change Unit of the Ministry of Foreign Affairs and International Cooperation, the Ministry of Fisheries and Forests, and other government departments in March 2013, where decisions will be made about integration these adaptations into national strategies and plans. This was a particularly valuable session, and resulted in many practical adaptations (see below).

The workshop concluded with the important issues of 'localising' vulnerability assessments so that communities can do assessments with limited assistance and at low cost, and communicating climate change concepts to communities. Excellent and practical guidance on these issues was provided by Johanna Johnson and Etuati Ropeti (SPC). Breakout group discussions identified the critical role of community champions and traditional knowledge in these processes, and the need for coordination of climate change adaptations for the various sectors at the community level.

Summary of priority actions and adaptations identified by workshop participants

Actions and adaptations for economic development (based on tuna)

- Improved modelling of yellowfin, albacore and bigeye tuna to provide more precise estimates of changes to catches expected to be made by the longline fishery in Fiji's exclusive economic zone (EEZ).

- Improved modelling of the projected increase in skipjack tuna abundance in Fiji's EEZ to help assess the feasibility of reinstating an industrial fishery for skipjack tuna to supply national cannery facilities; including a cost:benefit analysis of the economic viability of pole and line fishing given the strong niche markets for pole and line-caught fish.

- Continual improvement of regional and national management plans and industry development plans for tuna to ensure on-going sustainable harvests, and to ensure that any opportunities for increased tuna catches arising from climate change can be harnessed.

- Development of a vessel day scheme for the longline fishery to help distribute benefits regardless of climate variability due to ENSO events, and to provide flexible fishing arrangements as the climate changes.

- Adopt more on-board digital technology for observing longline fishing operations and collecting and processing catch data.

- Strengthen post-harvest processing to improve product quality for export markets as a way of adding value to the longline fishery without increasing catch.

- Development of methods to supply baitfish in ways that do not damage coral reefs and affect coastal fisheries for food security (in the event that a cost:benefit analysis indicates that pole and line fishing may be economically viable).

- Reduce the cost of bait for the longline fishery by farming milkfish in ponds, which is expected to be more efficient under the future climate.

- Energy audits to identify how to reduce the use of fuel for routine tuna fishing operations, followed by energy efficiency programmes to implement these savings, to increase the economic efficiency of fleets in both the near and long term.

- Evaluate the economic, social and environmental benefits of coconut oil and other biofuels to ascertain whether they can be a viable alternative energy source for locally-based industrial fishing fleets once the lubrication qualities of biofuels fuels are improved.

- Re-assessment of safety-at-sea provisions/regulations/ practices to ensure that industrial vessels are able to cope with more-severe weather and sea conditions.

- Upgrading port facilities to support changes in the number and types of vessels and post-harvest processing operations, and to provide services to vessels from neighbouring countries. Consider sea level rise and increased severity of cyclones when designing new facilities or upgrading existing facilities.

Actions and adaptations for food security and livelihoods

Coastal fisheries (including nearshore pelagic fish)

- Improved coordination, adoption and implementation of Integrated Coastal Zone Management (ICZM) and watershed (= catchment) management principles to reduce the negative effects of sedimentation, nutrients and pollution on coastal fish habitats and increase their resilience to climate change.

- Improved integration of development plans for tourism with fisheries and aquaculture, ICZM and catchment management to ensure sustainable and complementary growth of all sectors dependent on the coastal zone. Raising awareness of the potential for cross-sectoral interactions with stakeholders in each sector will be needed to develop shared goals.

- Consider biodiversity offsets, wherein the first principle is to prevent habitat loss when designing and approving economic development projects. But if habitat loss cannot be avoided, then offsets can be purchased (or funded) by the developer in the form of paying for increased protection of a greater area of equivalent habitats, or potentially establishing a greater area of revegetated catchment to promote recovery of damaged habitats.

- Better management of coral reefs, mangroves and seagrasses to reduce activities that may damage these important fish habitats and reduce their resilience to climate change.

- Marine Management Areas (including MPAs) to help safeguard coastal fish habitats, supported by awareness programs and adequate resources to staff MPAs to ensure compliance with regulations.

- Complete the mapping of all fish habitats and implement regular monitoring of the area of habitats.

- Replant mangroves in areas where they have been lost and in low-lying coastal areas that become suitable as sea level rises.

- Restocking of giant clams where overfishing has occurred and where local concentrations of aragonite will be high enough to promote good shell growth.

- Improved monitoring of coastal fish stocks using methods suitable for multispecies fisheries (e.g. indicators) to evaluate the effectiveness of management strategies and to support the development of an adaptive management approach for continual improvement.

- Increased use of FADs to improve access for coastal communities and artisanal fisheries to large pelagic species (including tuna) as coral reef fishes decline under climate change. A stockpile of materials to replace lost or damaged FADs should be maintained by the Ministry of Fisheries and Forests so that FADs can become part of the national infrastructure for food security. Costs can be reduced by using coconut palm fronds as the 'attractor' below surface floats.

- Monitor the catches made around FADs to evaluate the social and economic benefits and better inform the number, design, placement, maintenance, and replacement of FADs.

- Develop fisheries for small pelagic species, both as food fish and for livelihoods in the event that a pole and line fishery for skipjack tuna is re-established.

- Improved post-harvest technology for large pelagic fish caught around FADs and small pelagic fish to increase the availability of fish for food security at times when it is not possible to fish or catches are low.

Freshwater fisheries

- Improve management of catchment vegetation, and agricultural and forestry land use, through strengthened cross-sectoral interactions to avoid soil erosion and protect freshwater fish habitats, and to maximise the positive benefits of climate change. Establishing riparian buffer zones of the appropriate width along rivers is an important part of this adaptation.

- Provide fish passage for migratory fish species at man-made barriers to allow fish to complete their life cycles, and to overcome potential reduction in freshwater habitat areas in lower river reaches as rising sea level allows salt water to penetrate further inland.

- Harmonise opportunities for increased freshwater fish production from floodplains due to higher rainfall and greater river flows with protection of agricultural land and infrastructure from inundation.

- Improve management of introduced species, including development and implementation of strong guidelines for importation on non-native species based on an import risk analysis.

- Promote research on the relationship between rainfall, river flow, habitat area and catches for the main species of fish and invertebrates harvested from freshwater to improve the understanding of how climate change may enhance production of freshwater fisheries.

Mariculture

- Include the mariculture sector in ICZM approaches to ensure that water quality and essential habitats are maintained for farming operations and not compromised by other uses of the coastal zone.

- Ensure any land-based mariculture conforms to ICZM and habitat protection guidelines, and that there is appropriate treatment of effluent water to avoid degradation of receiving environments. Develop education and awareness programmes for mariculture operators.

- Increase the resilience of seaweed farming by importing new varieties with greater resistance to warmer water temperatures and by identifying new sites where problems associated with reduced salinities from higher rainfall will be minimised.

- Monitor water temperature and pH at existing and prospective pearl farming sites to identify areas where conditions are likely to remain suitable for producing high-quality pearls.

- Progressively transfer the production of pearl oyster spat from wild collection to production of spat derived from oysters selected for resistance to ocean acidification.

- Monitor the availability and abundance of wild milkfish fry.

- Explore options for greater use of species expected to perform well under the projected changes to local conditions.

Freshwater pond aquaculture

- Identify sites for freshwater fish farming likely to be favoured by higher rainfall and warmer temperatures to progressively expand production of Nile tilapia, but exclude sites with unacceptable risks of flooding.

- Evaluate aquaculture opportunities in water supply and hydro-electricity lakes.

- Train present and prospective fish farmers in the best aquaculture practices, site selection, pond construction, farm management, and business and marketing skills.

- Develop an efficient system for maintaining genetically selected, fast growing Nile tilapia, and for distributing them to all growing areas.

- Investigate methods for reducing any potential impact of Nile tilapia on freshwater biodiversity, e.g. production of sterile fingerlings to avoid reproduction of fish that escape to the wild.

- Assess the potential for species other than Nile tilapia, carps and milkfish to be grown in ponds profitably in Fiji, including indigenous species (e.g. orange-spotted grunter, large gudgeons, flagtails, and mullets).