

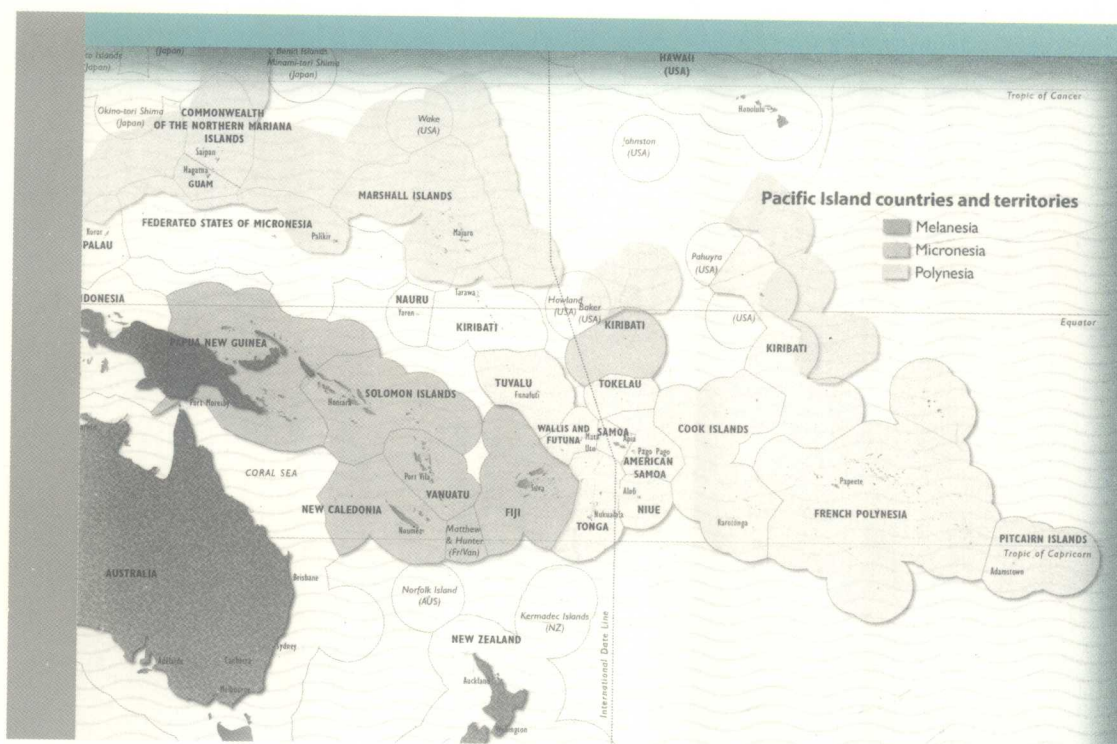
Priority adaptations to climate change for Pacific fisheries and aquaculture

Reducing risks and capitalizing on opportunities

FAO/Secretariat of the Pacific Community

5–8 June 2012

Noumea, New Caledonia



SPC
Secretariat
of the Pacific
Community



Priority adaptations to climate change for Pacific fisheries and aquaculture

Reducing risks and capitalizing on opportunities

FAO/Secretariat of the Pacific Community

5–8 June 2012

Noumea, New Caledonia

Johanna Johnson

Senior Scientist

C₂O Consulting

Coffs Harbour, Australia

Johann Bell

Principal Fisheries Scientist

Secretariat of the Pacific Community

Noumea, New Caledonia

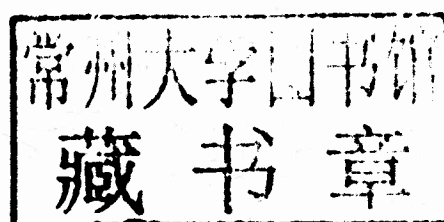
and

Cassandra De Young

Policy and Economics Division

FAO Fisheries and Aquaculture Department

Rome, Italy



The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views of FAO.

ISBN 978-92-5-107447-3

All rights reserved. FAO encourages reproduction and dissemination of material in this information product. Non-commercial uses will be authorized free of charge, upon request. Reproduction for resale or other commercial purposes, including educational purposes, may incur fees. Applications for permission to reproduce or disseminate FAO copyright materials, and all queries concerning rights and licences, should be addressed by e-mail to copyright@fao.org or to the Chief, Publishing Policy and Support Branch, Office of Knowledge Exchange, Research and Extension, FAO, Viale delle Terme di Caracalla, 00153 Rome, Italy.

Cover map: This map is indicative only of agreed and potential maritime boundaries between Pacific Island countries and territories (PICTs). It does not reflect the claims of PICTs to offshore areas.
Courtesy: Bell *et al.* 2011b.

Copies of FAO publications can be requested from:

SALES AND MARKETING GROUP
Office of Knowledge Exchange, Research and Extension
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy

E-mail: publications-sales@fao.org

Fax: +39 06 57053360

Web site: www.fao.org

Preparation of this document

These Proceedings present the outcome of the Workshop “Priority adaptations to climate change for Pacific fisheries and aquaculture: reducing risks and capitalizing on opportunities”. The Workshop was hosted by the Secretariat of the Pacific Community (SPC) in Noumea, New Caledonia, from 5 to 8 June 2012. It was a special workshop for the SPC Heads of Fisheries jointly organized by FAO and the SPC and financed by support from AusAID and the Governments of New Caledonia, Japan and Sweden.

The contributed paper is reproduced as submitted.

Abstract

This publication includes: (i) a summary of the technical presentations provided to the Workshop participants on the implications of climate change for Pacific fisheries and aquaculture; and (ii) the outcomes of discussions by participants on the priority adaptations that Pacific island countries and territories (PICTs) can implement to reduce risks and take advantage of opportunities. The Workshop was hosted by the Secretariat of the Pacific Community (SPC) as the culmination of 3.5 years of work to assess the vulnerability of Pacific fisheries and aquaculture to climate change. It also formed part of a series of climate change awareness-raising and adaptation planning workshops around the globe financed through a Japanese-funded, and FAO-implemented, project “Climate Change, Fisheries and Aquaculture: Understanding the Consequences as a Basis for Planning and Implementing Suitable Responses and Adaptation Strategies” (GCP/INT/253/JPN). The technical presentations and range of possible adaptations and supporting policies presented were based on SPC publications. Discussions focused on priority adaptations for economic development and government revenue, food security and sustainable livelihoods for Melanesian, Micronesian and Polynesian nations. The adaptations identified reflect the different fisheries participation rates and importance of fish to economic development and as a source of local food and income in these different regions. The Workshop discussions recommended immediate action by all PICTs to manage fisheries resources sustainably now and into the future, to establish systems to minimize impacts of various drivers facing the sector now and from future climate change, and to capitalize on opportunities. Cooperation between PICTs and partnerships among governments, regional and international organizations and communities were highlighted as important ways to implement effective adaptation.

Johnson, J., Bell, J. & De Young, C. 2013.

Priority adaptations to climate change for Pacific fisheries and aquaculture: reducing risks and capitalizing on opportunities.

FAO/Secretariat of the Pacific Community Workshop, 5–8 June 2012, Noumea, New Caledonia.

FAO Fisheries and Aquaculture Proceedings No. 28. Rome, FAO. 109 pp.

Acknowledgements

The Secretariat of the Pacific Community (SPC) is thanked for hosting the Workshop and providing technical and administrative support. The invaluable contribution of the Workshop participants and the technical experts who contributed to the SPC vulnerability assessment is greatly acknowledged.

Abbreviations and acronyms

ADB	Asian Development Bank
AusAID	Australian Agency for International Development
CI	Conservation International
Code	Code of Conduct for Responsible Fisheries
DRM	disaster risk management
EAF/A	ecosystem approach to fisheries/aquaculture
EEZ	exclusive economic zone
EIA	environmental impact assessment
ENSO	El Niño-Southern Oscillation
FAD	fish aggregating device
FAO	Food and Agriculture Organization of the United Nations
FFA	Forum Fisheries Agency
GDP	gross domestic product
GEF	Global Environment Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit, (German Society for International Cooperation)
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
JNAP	joint national action plan
LDCF	Least Developed Countries Fund
LLMA	locally managed marine area
NAP	national adaptation plans
NAPA	national adaptation programme of action
NGO	non-governmental organization
PaCFA	Global Partnership on Climate, Fisheries and Aquaculture
PICTs	Pacific island countries and territories
PNA	Parties to the Nauru Agreement
SCCF	Special Climate Change Fund
SEAPODYM	Spatial Ecosystem and Population Dynamics Model
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
TNC	The Nature Conservancy
UNFCCC	United Nations Framework Convention on Climate Change
USP	University of the South Pacific

Contents

Preparation of this document	iii
Abstract	iv
Acknowledgements	vi
Abbreviations and acronyms	vii
Workshop summary	1
Opening of the meeting	1
Introduction to the Agenda and arrangement of the sessions	1
Background and objectives of the Workshop	2
Workshop objectives	2
Understanding the projected changes to surface climate and the Pacific Ocean	3
Understanding projected changes to tuna	3
Understanding projected changes to coastal fisheries	4
Understanding projected changes to aquaculture	5
Understanding projected changes to freshwater fisheries	5
Implications, adaptations and suggested policies	6
Climate-related disasters	7
National and sectoral climate change strategies	7
Climate change finance	8
Assistance from partners	8
Recommended priority adaptations identified by PICTs	9
Summary and recommendations	12
Closing of the Workshop	13
References	14
Annex 1 – List of participants	15
Annex 2 – Agenda	21
CONTRIBUTED PAPER	23
Vulnerability of fisheries and aquaculture to climate change in Pacific island countries and territories	25

Workshop summary

OPENING OF THE MEETING

On behalf of the Secretariat of the Pacific Community (SPC), Dr Mike Batty, Director, Division of Fisheries, Aquaculture and Marine Ecosystems welcomed the participants. He spoke of the importance of fisheries and aquaculture, particularly tuna, to economies and communities in the Pacific and of how climate change is expected to affect fisheries in the region. He highlighted how the SPC continues to work towards sustainable fisheries in the region, and to support Pacific island countries and territories (PICTs) to understand how climate change will affect their fisheries and take action. He spoke of the ultimate aim of the Workshop to help PICTs to understand how climate change may affect the plans outlined in “The Future of Pacific Island Fisheries” study commissioned by the Forum Fisheries Agency (FFA) and the SPC on behalf of their members to maintain or improve the benefits they derive from fisheries and aquaculture. He thanked the participants again for their attendance and emphasized that he felt the Workshop would be productive in identifying and discussing suitable adaptation measures for governments, enterprises, communities and other stakeholders to reduce the risks that climate change poses and to capitalize on opportunities.

On behalf of the Food and Agriculture Organization of the United Nations (FAO), Cassandra De Young again welcomed the participants and thanked them for their attendance. She outlined FAO’s perspective on the importance of fisheries and aquaculture globally and the issues facing the sector, including the strong emphasis that FAO places on linking science to policy and assisting countries to implement climate change adaptation strategies to reinforce ecological, economic and social resilience through: (i) adaptive management strategies within the ecosystem approach to fisheries and aquaculture and the Code of Conduct for Responsible Fisheries (the Code); (ii) available tools such as livelihood diversification, implementation of flexible use and management rights, finding the right mix of public and private insurance to spread risks; (iii) technological innovations, such as in vessel and port designs, availability of resistant species, information sharing mechanisms, post-harvest methods; and (iv) planning for adaptation and ensuring policy coherence across sectors including disaster preparedness. Ms De Young reminded the participants about the role the sector may play in greenhouse gas mitigation strategies by: (i) supporting the natural abilities of aquatic systems to remove and store greenhouse gas emissions; (ii) providing renewable aquatic biofuels to avoid emissions; and (iii) reducing the sector’s dependence on fossil fuels through increased energy efficiency. She noted the ongoing coordinated effort in addressing climate change in the fisheries sector through the Global Partnership on Climate, Fisheries and Aquaculture (PaCFA) and highlighted the overall importance of communication and cooperation in dealing with climate change.

INTRODUCTION TO THE AGENDA AND ARRANGEMENT OF THE SESSIONS

Dr Johann Bell, Principal Fisheries Scientist (Climate Change) at the SPC, outlined the objectives of the Workshop, introduced the facilitators for each day and provided an overview of the agenda (Annex 1); in particular, how each of the presentation and breakout sessions would run and the groups for the breakout sessions. He went on to provide background to the Workshop, summarizing the 3.5 year SPC-led project that assessed the vulnerability of fisheries and aquaculture to climate change in the 22 PICTs of the region (Bell, Johnson and Hobday, 2011; Bell *et al.*, 2011). He explained the

future scenarios and projections used for the assessment, and provided details on the scope of the findings.

BACKGROUND AND OBJECTIVES OF THE WORKSHOP

Fisheries and aquaculture are vital to the development goals of the Pacific Islands region (see Contributed Paper section). Nowhere else in the world do so many countries and territories depend as heavily on benefits derived from catching or growing fish and shellfish. Industrial fish-processing operations and fishing fleets account for a substantial proportion of gross domestic product (GDP) in several countries and territories. Licence fees from distant-water fishing nations make even more significant contributions to government revenue, especially for small island States.

Fish is also a cornerstone of food security in the region. Fish consumption is at least two to four times greater than the global average in more than half of all PICTs. In rural areas, most animal protein and fish consumed (60–90 percent) comes from subsistence fishing.

Fisheries and aquaculture are also an important source of jobs and opportunities to earn income. More than 12 000 people are employed in tuna canneries or processing facilities, or on tuna fishing vessels, throughout the region. Fishing also makes important contributions to livelihoods in rural areas – an average of 47 percent of households in coastal communities across the region earn either their first or second income from fishing. In some remote atolls, pearl farming is an important source of employment, and in inland Papua New Guinea there are now more than 10 000 freshwater fish farms.

To maintain or improve the important contributions made by fisheries and aquaculture in the face of the many drivers affecting the sector, many PICTs are implementing the plans required to: (i) optimize the economic benefits derived from industrial tuna fisheries; (ii) provide sufficient fish for the food security for rapidly growing populations; and (iii) identify the number of livelihoods that can be sustained from coastal fisheries and aquaculture.

Climate variability and climate change are among these drivers, and climate change is expected to increase progressively in significance. The SPC and FAO are assisting PICTs to understand how climate change may affect their plans to maintain or improve the benefits they derive from fisheries and aquaculture. The SPC has coordinated a comprehensive assessment of the vulnerability of tropical Pacific fisheries and aquaculture to climate change (Bell, Johnson and Hobday, 2011; Bell *et al.*, 2011), and FAO has produced a global overview of the current scientific knowledge and adaptation and mitigation options for the sector (Cochrane *et al.*, 2009).

WORKSHOP OBJECTIVES

The objectives of the Workshop were to provide the heads of fisheries and national focal points for climate change and disaster risk management (DRM) from PICTs with a sound understanding of the main projected effects of existing climate variability, global warming and carbon dioxide emissions on the ecosystems supporting fisheries and aquaculture, the consequences for current and future production, food security and livelihoods, and the actions required to minimize the risks and maximize the opportunities.

An interactive format allowed representatives from PICTs to work closely with a broad range of technical experts to:

1. Understand the direct and indirect effects of climate change, including potential natural disasters, and ocean acidification on oceanic, coastal and freshwater fish stocks and aquaculture production.
2. Identify the implications of the projected changes to fisheries and aquaculture activities on economic development, food security and livelihoods.

3. Choose and prioritize the adaptations and policies needed to build the resilience of enterprises and communities to the projected threats and to equip them to take advantage of the potential opportunities.
4. Plan the actions needed to raise the support required to implement priority adaptations and monitor their success.

UNDERSTANDING THE PROJECTED CHANGES TO SURFACE CLIMATE AND THE PACIFIC OCEAN

Through presentations by Dr Janice Lough, Dr Alex Sen Gupta and Dr Alexandre Ganachaud, participants learned about projected changes to surface climate in the tropical Pacific, including warmer temperatures, increased rainfall in tropical areas, more extreme weather events, the possibility of more-severe but less-frequent cyclones, continued El Niño-Southern Oscillation (ENSO) variability, and the probability that these changes are likely to accelerate. Delegates also learned about observed changes to the tropical Pacific Ocean. In particular, the ocean has warmed, the sea level has risen, ocean pH has declined and low oxygen areas have expanded. The continued changes projected to occur this century include: further ocean warming, greater stratification of the water column, changes to major currents, decreased nutrient supply, reduced O₂ below the mixed layer, and the decline of aragonite concentration below critical thresholds. The presenters emphasized that climatic variability would continue to occur over and above projected climate change and that this variation would be noticed as extreme events became more extreme.

The breakout groups following these presentations, helped delegates strengthen their existing knowledge of climate change issues and reinforced the key messages with robust examples. These groups discussed the important issues of how to use the model projections at the local and/or country level (downscaling) and how to mainstream climate change into national and regional initiatives (e.g. the Micronesia Challenge). Participants acknowledged that they need to be prepared for the effects of climate change on fisheries and aquaculture because they are such important industries in the region. They also encouraged the meeting to realize that these messages need to incorporate traditional knowledge and be communicated appropriately at the grass-roots level using simple messages to raise awareness of vulnerability and the steps that can be implemented to adapt.

UNDERSTANDING PROJECTED CHANGES TO TUNA

Building on the knowledge of the projected changes to the ocean, delegates heard a presentation from Dr Valerie Allain about the five provinces of the tropical Pacific Ocean, how they support different food webs for tuna, and the changes likely to occur to these provinces that are expected to alter these food webs. The projected changes to the provinces include contraction of the nutrient-rich equatorial upwelling and expansion of the Warm Pool to the east, together with greater stratification of the water column and corresponding decreases in food resources for tuna.

Dr Patrick Lehodey then explained the use of the Spatial Ecosystem and Population Dynamics Model (SEAPODYM) to project how tuna catches are expected to be affected by climate change. Participants learned how tuna are likely to be affected by ocean warming, reduced O₂ and the reduced primary production in the ocean. The distribution of skipjack tuna is projected to extend further eastward over time, with catches eventually decreasing in the west. The situation for bigeye tuna is expected to be different, with stocks eventually decreasing across the region. The meeting also heard new preliminary analyses for albacore, which is expected to contract in range and decline in biomass as oxygen levels are affected by climate change. Dr Lehodey concluded by outlining the steps needed to improve the models used to forecast the effects of climate change on tuna: better global climate models for the physical,

chemical and biological process in the tropical Pacific Ocean; and reporting of tuna catches from the high seas on much finer spatial scales. It was recognized that a better understanding of biological processes would depend on more observations (long-term monitoring) of the responses of food webs for tuna to climate change.

Within the breakout groups, participants found the description of stratification useful and how it affects the nutrients needed to support tuna food webs. They also identified the need for more information on implications of declines in primary productivity for coastal fisheries. There was also great interest in the projected changes to tuna catches, particularly in the reliability of the modelling, given the potential strong implications for changes in tuna distribution and abundance for the many locally based and foreign industrial fishing operations in the region and for national economies.

UNDERSTANDING PROJECTED CHANGES TO COASTAL FISHERIES

To inform the Workshop about the projected effects of climate change on coastal fisheries, Dr Janice Lough and Johanna Johnson began by making presentations on how the habitats supporting coastal fisheries (coral reefs, mangroves, seagrasses and intertidal flats) were likely to be affected. Delegates heard how coral reefs are vulnerable to climate change primarily through rising sea surface temperatures, ocean acidification, and more intense cyclones. Impacts have already been observed resulting from increases in sea surface temperature (e.g. mass coral bleaching, decreased coral diversity and reduced reef complexity). Although the combination of the projected impacts is not expected to cause reefs to disappear, the reefs of the future will be less complex systems that provide less structural habitat for fish and shellfish.

Participants also heard how seagrass, mangroves and intertidal flats are vulnerable to sea-level rise, rising sea surface temperatures, more intense cyclones and changing rainfall patterns. As a result, these habitats are projected to decline in area, although landward migration should be possible if there are no barriers to such migration. The speakers emphasized that good management of catchments, to ensure that all coastal habitats are not subject to increased runoff of sediments, nutrients and pollution, will help build resilience to climate change.

Professor Morgan Pratchett then informed the Workshop about the direct and indirect effects of climate change on the three main groups of coastal fisheries: demersal (bottom-dwelling) fish, nearshore pelagic fish and invertebrates. Demersal fish are most vulnerable to the indirect effects of habitat degradation, although changes in water temperature and ocean currents are also expected to have direct effects on the reproduction, dispersal and growth of these fish, and ocean acidification may affect the survival of larvae settling on reefs. The effects on nearshore pelagic fish are expected to be similar to those projected for tuna, although other nearshore pelagic species are likely to be influenced by local changes in coastal productivity related to nutrient supply. Many of the invertebrates are expected to be vulnerable mainly to ocean acidification and habitat degradation.

Fisheries productivity of demersal fish and invertebrates is expected to decline, with decreases in demersal fish of about 20 percent by 2050 and 20–50 percent by 2100 under the Intergovernmental Panel on Climate Change (IPCC) A2 emissions scenario¹. However, it will be difficult to separate the effects of climate change from the effects of other stresses on habitats and stocks over the next two to three decades. Priority adaptations include protecting coastal fish habitats to build their resilience to climate change, diversifying coastal fisheries activities and including climate change implications into fisheries management. Because demersal fish, nearshore pelagic fish and invertebrates have different vulnerabilities to climate change, heads of fisheries heard how it will be important to collect separate catch information for these three groups of coastal fisheries resources in the future to help monitor the effects of climate change.

¹ For a description of the various IPCC emissions scenarios, see www.ipcc.ch/

The breakout groups were concerned about the vulnerability of coral reefs, mangroves and seagrasses and how this will affect fish and shellfish that are an important source of food for coastal communities. Delegates identified the need to raise political awareness about the importance of these habitats to fisheries, and to promote investments and supporting policies to protect these habitats to build resilience to climate change. Mangrove replanting was discussed as one viable adaptation strategy, and participants suggested better exchange of knowledge on replanting species among countries and territories.

UNDERSTANDING PROJECTED CHANGES TO AQUACULTURE

Dr Tim Pickering informed the Workshop about the value of mariculture (coastal aquaculture) and the projected changes due to climate change. Overall, this part of the sector is vulnerable to climate change in a number of ways, e.g. ocean acidification is expected to affect the efficiency of collecting the spat of pearl oysters and the quality of the nacre that forms pearls. Ocean acidification is also likely to affect the appearance and value of cultured shrimp, whereas higher water temperatures will exacerbate stratification within ponds and increase the loss of shrimp crops through deoxygenation of the water. Higher rainfall will reduce the number of sites suitable for growing seaweed and increase the incidence of seaweed diseases. Participants learned that the location of mariculture facilities affects the vulnerability of some farming operations to higher temperatures, inundation and/or storm damage. Adaptations include moving pearl farms into deeper cooler waters, appropriate site selection (or relocation of sites) for seaweed farms and raising the wall and floor height of shrimp ponds so that they continue to drain as the sea level rises.

During a second presentation by Dr Pickering, the Workshop learned that, whereas climate change was likely to decrease the efficiency of mariculture, the productivity of freshwater aquaculture is expected to be enhanced by higher water temperatures and greater rainfall. Such changes will allow tilapia and milkfish to grow faster in ponds and for ponds to be built in more areas, including at higher elevations in the case of tilapia farming. *Macrobrachium* prawn aquaculture is also likely to benefit in the short term, but increasing temperatures are likely to have negative effects on prawn farming in the longer term. The breakout group discussions were interested in the range of potential impacts to mariculture and the implications for their future plans and opportunities for diversifying livelihoods away from coastal fisheries and into mariculture. Participants discussed the great potential benefit of enhanced freshwater aquaculture for inland communities in Papua New Guinea, Solomon Islands and Fiji, but also the opportunities it provides for low-lying countries expected to receive more rainfall. In this regard, participants thought that milkfish has real expansion potential (and is amenable to low-cost, capture-culture aquaculture methods). For higher islands, tilapia is the only viable option for efficient expansion of freshwater aquaculture, but the meeting agreed that care was needed to reconcile the production of these fish for food security with biodiversity conservation. Participants were encouraged to follow the policies related to this issue set out in the background publications for the Workshop.

UNDERSTANDING PROJECTED CHANGES TO FRESHWATER FISHERIES

The implications of climate change for freshwater habitats and fisheries were addressed by Dr Peter Gehrke. His presentation highlighted the importance of freshwater fisheries to inland communities in the Pacific, particularly Papua New Guinea, Fiji and Solomon Islands. Increased rainfall is very likely to increase freshwater habitat availability and, therefore, fishery productivity. However, Dr Gehrke warned that in catchments that have been disturbed by unregulated mining, forestry and agriculture these benefits will be restricted. He stressed that good management of catchments and freshwater fish stocks, and prevention of unwanted invasive fish species, are important

strategies to harness the future potential for increased production from freshwater fisheries. Capitalizing on the potential benefits will also eventually require more efficient methods for catching freshwater fish from expanded floodplain habitats.

Although not all countries and territories have freshwater fisheries, the breakout groups recognized their value to several members, and the discussion focused on the joint benefits to both freshwater and coastal fisheries of maintaining good vegetation in catchments to protect the habitats on which these fisheries depend.

IMPLICATIONS, ADAPTATIONS AND SUGGESTED POLICIES

Armed with the best estimates of projected changes in oceanic, coastal and freshwater fisheries and aquaculture production, the Workshop was able to consider the implications for economic development, food security and livelihoods. Mr Mike Batty noted that tuna is a very important sector in the Pacific for government revenue and GDP, with many economies having a high dependence on tuna (e.g. canneries in American Samoa, Fiji, Papua New Guinea and Solomon Islands, and the contributions of licence fees in Kiribati, Nauru and Tuvalu). The projected changes in the distribution of tuna are expected to have proportional effects on government revenues and GDP, with the smaller nations with a high dependence on tuna in the east having the potential for increased benefits. In the west, where tuna catches are eventually expected to decline, the negative effects are expected to have a low impact on national economies owing to the relatively modest contribution of tuna fishing and processing to GDP. However, there is concern that, unless steps are taken to maintain the supply of fish to canneries as tuna are redistributed east, jobs could be lost in canneries.

Mr Batty then outlined the adaptations and policies needed to reduce the risks and capitalize on the opportunities for national economies, stressing that no future benefits will be available unless tuna stocks continue to be managed responsibly to maintain their capacity for replenishment. Wherever possible, these adaptations should be “win-win”, i.e. they should address important drivers facing the sector now, and build resilience to climate change in the future. The key adaptations and supporting policies were explained, and participants were encouraged to use the summary volume for the vulnerability assessment (Bell *et al.*, 2011) to study the recommended actions in detail in order to decide which ones were relevant for national priorities and contexts.

The breakout group discussions following Mr Batty’s presentation focused on the vital role of the vessel day scheme in distributing the benefits from tuna to members of the Parties to the Nauru Agreement (PNA) during ENSO events and on the flexible features of the scheme that will enable it to continue to be a practical adaptation to climate change. Participants also stressed the need for immediate reduction in fishing effort on bigeye tuna and considered the benefits of operating other fishing effort schemes and other ways of continuing the supply of fish to canneries in the future. Advantages were seen in implementing energy audits of fishing vessels, both to mitigate emissions but also to assist the marketing of tuna from the region.

The Workshop then heard presentations from Dr Johann Bell on the implications for food security and livelihoods, and the appropriate adaptations and policies to maintain the vital roles of fish in the diets of Pacific island people. This message stressed that it is not only the effects of reduced coastal fisheries production that threatened the availability of fish for food security – rapid population growth is also reducing the supply of fish per person in many countries. In fact, population growth is expected to have a greater effect than climate change for several of the larger countries in the region, especially Fiji, Papua New Guinea, Solomon Islands and Vanuatu. By 2035, a substantial gap is expected to emerge between the fish needed to supply the 35 kg of fish per person per year recommended for good nutrition and the fish available from coastal fisheries associated with coral reefs for many of these countries. Filling this gap will require diversifying coastal fisheries to make larger catches of nearshore pelagic

fish (mainly tuna but also small pelagic species) and developing freshwater pond aquaculture. However, the Workshop heard that the majority of the gap will need to be filled by tuna and that countries will need to allocate progressively more of their tuna resources for this purpose (Papua New Guinea is the exception because providing access to this quantity of fish will not be possible for the large inland populations).

The key adaptations and supporting policies for maintaining the important role of fish for food security were also presented and participants were once again encouraged to use the summary volume for the vulnerability assessment (Bell *et al.*, 2011) to study the recommended actions in detail in order to decide which ones were relevant for national priorities and contexts. Participants were encouraged to think of the adaptations and policies in two ways: (i) those needed to reduce the size of the emerging gap between the fish available and the fish needed for food security through good management of coastal habitats and fish stocks; and (ii) those required to increase alternative supplies of fish to fill the gap.

Discussions by participants of the key adaptations for minimizing the size of the fish supply gap to be filled to help provide food security centred on improved management of vegetation in catchments to maintain fish habitats and “primary fisheries management” based on an ecosystem approach to keep coastal fish stocks within sustainable bounds. Both adaptations depend on effective cross-sectoral management. To help fill the gap, participants agreed that redistributing low-value tuna landed by industrial fleets at major ports to urban communities at low cost would be of great assistance to food security of the urban poor. Inshore fish aggregating devices (FADs) were also seen as the main way that coastal communities can have better access to the tuna they will need for food security in the future.

CLIMATE-RELATED DISASTERS

The Workshop recognized the great similarities in adaptations to climate change required in the fisheries sector and the adaptations needed to reduce the risk of disasters resulting from cyclones and floods. Tagaloa Cooper and Florence Poulain presented regional and global perspectives and initiatives in this important area. Participants heard how FAO is working towards integrating DRM and climate change adaptation for fisheries, fish farms and their communities. FAO emphasized that disasters are a significant threat to fisheries and aquaculture, with developing countries being the most affected and the slowest to recover. Building resilience to disaster risks is more cost-effective than responding after a disaster has occurred. Within the region, the Workshop noted that the SPC and Secretariat of the Pacific Regional Environment Programme are working towards mainstreaming DRM and climate change adaptation. The Pacific Islands Framework on Climate Change provides an overarching regional framework for this initiative.

NATIONAL AND SECTORAL CLIMATE CHANGE STRATEGIES

The Workshop participants were provided with an overview of the different mechanisms and processes in place to formulate national climate change and DRM strategies. In relation to climate change, Pepetua Latasi and Brian Dawson introduced the meeting to the processes of developing national adaptation programmes of action (NAPAs)² that have been supported in the five Pacific island least-developed countries under support for the United Nations Framework Convention on Climate Change (UNFCCC) Least Developed Countries Fund (LDCF). These documents set out the national approach to adaptation for the country as a whole and identified specific short-term and urgent adaptation priorities. Other processes for identifying national climate change priorities

² To access submitted NAPAs, see http://unfccc.int/cooperation_support/least_developed_countries_portal/submitted_napas/items/4585.php

include the national communications to the UNFCCC,³ and developing countries will soon embark on formulating national adaptation plans (NAPs). These initiatives set out national adaptation priorities and are used as a roadmap for national responses to climate change.

The processes underpinning the development of national DRM plans and the similarities and crossover with climate change adaptation processes provide a strong justification for combining the climate change adaptation and disaster risk planning processes to formulate joint national action plans (JNAPs). Several countries have already developed JNAPs (e.g. the Cook Islands, Federated States of Micronesia, Fiji and Tonga) and several more are in the pipeline (e.g. Nauru). Brian Dawson highlighted that many of the national plans lacked sufficient detail on the actual priorities and actions that could be implemented at the sector level, and the Workshop participants were encouraged to develop more specific sector adaptation and DRM plans that could feed upwards into the national strategy documents.

CLIMATE CHANGE FINANCE

The Workshop participants were given a brief overview of the international climate change finance situation and the modalities through which climate change finance could be delivered by Brian Dawson.

Information was provided on the international commitments in place to ensure a continued increase in the amount of finance available to developing countries to support adaptation and mitigation actions. By 2020, up to US\$100 billion per year could be provided to support climate change response measures. The main modalities included support to project-based activities through the UNFCCC (Green Climate Fund, Adaptation Fund, LDCF and Special Climate Change Fund), multilateral processes (via the Australian Agency for International Development [AusAID], Asian Development Bank, European Union [Member Organization], Global Environment Fund, the German Society for International Cooperation, World Bank and UN Agencies), and bilateral and non-governmental organization (NGO) sources. Apart from the well-established mechanisms for supporting project-based approaches, a range of new financing mechanisms is emerging. These mechanisms include: regional climate funds, national trust funds, direct budget support and sector-wide approaches. Many of these mechanisms are at an early stage and it is likely to be some years before they will be fully operational in the region.

The Workshop participants were also informed about the complexities and constraints in accessing funds through these different modalities and were urged to be well aware of the need to have in place the appropriate documentation and due diligence procedures required to access climate change funds. Participants were also encouraged to adopt a systematic and well-structured approach to developing fishery sector plans and project proposals that could be submitted to development partners for funding. The SPC, FAO and other agencies in the region are available to support country efforts in developing these sector-based plans and funding proposals.

ASSISTANCE FROM PARTNERS

Presentations from Conservation International, the International Union for the Conservation of Nature, the Locally-managed Marine Areas Network, the Nature Conservancy, and the University of the South Pacific provided participants with a broad understanding of the array of initiatives underway by NGOs and regional organizations that can provide support for countries and communities to build the resilience of fish habitats (coral reefs, mangroves and seagrasses) and fish stocks to climate change. The long history that many of these organizations have in working with

³ For countries' national communications, see http://unfccc.int/national_reports/items/1408.php