

- Planning of culture area, conducting rotation aquaculture and co-culture, and carrying out culture activities in suitable season-crops could facilitate sustainable production.
- Further research on culture species to find suitable species for this locality.
- Organisation of frequent aquaculture workshops in order to improve technical skills and environmental awareness of farmers.
- Application of environmental tax/fees on aquaculture activity to assist with prevention, remediation and fund response to emergencies such as disease outbreaks.

References

- Ngo, T. A. 2005. Impact assessment of commercial shrimp culture on Nai Lagoon environment. Master Thesis. Aquaculture Faculty, University of Fisheries – Nha Trang.
- Fishery Department of Ninh Thuan province, 2004. Situation of aquaculture development and results of fishery extension activities in the period of 2000 – 2005.
- Fishery Department of Ninh Thuan province, 2005. Assessment of implementing yearly plan of 2004, line and duty of 2005 yearly plan. Summary report.
- Nguyen, T. N. and Nguyen, T.K.V. 1999. Socio-economic survey of situation and potential of shrimp culture development at Nai Lagoon – Ninh Thuan province. In: Proceeding of scientific research. Volume IV. University of Fisheries, Nha Trang.
- Statistical Office of Ninh Thuan province, 2004. Statistical yearbook - Ninh Thuan province.
- Statistical Office of Ninh Hai District, 2004. Statistical yearbook - Ninh Hai district.
- Ta, K.T. et al., 2001. Solution for overcoming environmental and aquatic resources degradation in Nai Lagoon, Ninh Thuan province – Project report. University of Fisheries, Nha Trang.

Climate change impacts on fisheries and aquaculture

Sena De Silva, NACA Director General

Climate change is perhaps one of the most important issues confronting the global community and associated debates have intensified over the last decade, most recently with the submission of the final findings of the Inter Governmental Panel on Climate Change (IPCC, 2007). The time has come for development and food production sectors to take note of the above findings, based on a thorough scrutiny and synthesis of the scientific evidence on climate change, and to initiate adaptive and/or mitigating measures.

FAO has initiated many expert consultations on the impacts of climate change on different food production sectors, one of which was held on fisheries and aquaculture. Needless to say that the urgency of the problem has been further exacerbated by the emerging “food crisis” as well as by the potential channeling of food to produce biofuel.

The Expert Consultation on Climate Change Impacts on Fisheries and Aquaculture was held in Rome, 7-9 April, 2008. The consultation was based on three reviews that formed the background for the discussions and the preparation of an all encompassing document to be submitted to the Heads of Government Meetings on Climate change in Rome, July 2008. The three reviews that were provided the background for the consultation were:

- Physical and ecological impacts of climate change relevant to marine and inland capture fisheries and aquaculture (by Manuel Barange and Ian Perry).
- Climate change and capture fisheries – impacts, adaptation, mitigation, and the way forward (by Tim Daw, Neil Adger, Katrina Brown and Marie-Caroline Badjeck).
- Climate change and aquaculture (by Sena S De Silva and Doris Soto).

These reviews will be published as a FAO Fisheries Technical Paper in due course and are expected to provide a useful documentation regarding the potential impact of climate change

on fisheries and aquaculture, and recommendations regarding adaptive measures.

The “policy paper” on climate change on fisheries and aquaculture developed at the consultation is reproduced below. More information from the FAO High Level Conference on Climate Change and Fisheries and Aquaculture is available from the FAO website at: <http://www.fao.org/foodclimate/expert/em7.html>.

Workshop on Climate Change and Fisheries and Aquaculture: “Options for decision makers”

FAO Headquarters, Rome, 7-9 April 2008

Introduction

From local to global levels, fisheries and aquaculture have very important roles for food supply, food security and income generation. Some 42 million people work directly in the sector, with the great majority in developing countries. Adding those who work in associated processing, marketing, distribution and supply industries, and the sector supports several hundred million livelihoods. Aquatic foods have high nutritional quality, contributing 20 percent or more of average per capita animal protein intake for more than 2.8 billion people, mostly from developing countries. They are also the most widely traded foodstuffs and are essential components of export earnings for many poorer countries. The sector has particular significance for small island states. Climate change is projected to impact broadly across ecosystems, societies and economies, increasing pressure on all livelihoods and food supplies, including those in the fisheries and aquaculture sector. Food quality will have a more pivotal role as food resources come under greater pressure,

and the availability and access to fish supplies will become an increasingly critical development issue.

The fisheries sector differs from mainstream agriculture and has distinct interactions and needs with respect to climate change. Capture fisheries have unique features of natural resource harvesting linked with global ecosystem processes. Aquaculture complements and increasingly adds to supply and, though more similar to agriculture in its interactions, has important links with capture fisheries.

The demands of growing populations will require substantial increases in aquatic food supply in the next 20 to 30 years, during which climate change impacts are expected to widen and increase. In the face of these impacts and the existing development and management constraints, the primary challenge for the sector will be to deliver food supply, strengthen economic output and maintain and enhance food security while ensuring ecosystem resilience. This will require concerted, collaborative and determined action across all stakeholders, linking private sector, community and public sector agents.

Developing the knowledge base

The existing pressures of demand, and anticipated challenges, will require better multi-scale understanding of the impacts of climate change and of the interacting contribution of fisheries and aquaculture to food and livelihoods security. Climate change will increase uncertainties in the supply of fish from capture and culture. Such uncertainty will impose new challenges for risk assessment, which is commonly based on knowledge of probabilities from past events. Data for determining effects of past climate change at best cover no more than a few decades, and may no longer be an adequate guide to future expectations.

This means that in the future, planning for uncertainty will need to take into account the greater possibility of unforeseen events, such as the increasing frequency of extreme weather events and “surprises”. However, examples of past management practices in response to existing climate variability and extreme events relating to different regions and resources can provide useful lessons to design robust and

responsive adaptation systems, even though they will have to be placed in context of greater uncertainty.

While current knowledge is adequate in many instances to take appropriate action, better communication, application and feedback will be essential in knowledge-building. Action in the following areas will be needed to support mitigation and adaptation policies and programmes in fisheries and aquaculture:

Estimate production levels. Projections of future fisheries production levels at the global and regional scales will be driven by medium- and long-term probabilistic climate change predictions in the context of substantial ecological and management uncertainties.

Forecast impact levels. Detailed impact predictions on specific fisheries and aquaculture systems will be required to determine additional net positive or negative consequences for vulnerable resources and regions. This is particularly important for semi-arid countries with significant coastal or inland fisheries, as they are among the most vulnerable to climate change.

Develop tools for decision-making under uncertainty. Adaptive tools for the fisheries and aquaculture sectors will need to be refined, developed and implemented to guide decision making under uncertainty and address important cross linkages among the relevant sectors. The uncertainties decision-makers will face include i) the responses and adaptations of marine and freshwater production systems to gradual climate change, including critical thresholds and points of no return, ii) the synergistic interactions between climate change and other stressors such as water use, eutrophication, fishing, agriculture, alternative energy, and iii) the ability and resilience of aquatic production systems and related human communities to adapt and cope to multiple stresses.

Expand societal knowledge. Better knowledge will be required of who is or will be vulnerable with respect to climate change and food security impacts, how this arises and how it can be addressed. In this regard, gender and equity issues will need to be carefully considered.

Policy, legal and implementation frameworks at national, regional and international levels

Addressing the potential complexities of climate change interactions and their possible scale of impact requires mainstreaming of cross-sectoral responses into governance frameworks. Responses are likely to be more timely, relevant and effective if they are brought into the normal processes of development and engage people and agencies at all levels. This requires not only the recognition of climate-related vectors and processes, and their interaction with others, but also availability of sufficient information for effective decision-making and approaches that engage public and private sectors. All of these elements will be vital in providing the best possible conditions in which the aims of food security – quantity and timing of food supply, access and utilization – can be met.

National

Action plans at the national level can have as their bases the Code of Conduct for Responsible Fisheries and related International Plans of Action (IPOAs), as well as appropriately linked policy and legal frameworks and management plans. Responses will need to employ integrated ecosystem-based approaches to fisheries and aquaculture (EAFs and EAAs) for the national fisheries and aquaculture sector throughout the entire resource extraction, supply and value chain. The future implications of climate change will intensify the justification for finding policy consensus to reform capture fisheries while respecting national sector characteristics.

Requirements include:

- Actions will be needed that focus on key issues such as adjusting fleet and infrastructure capacity and flexibility, identifying management systems that offer negotiated balances between efficiency and access, and creating alternative employment and livelihood opportunities.
- Policy and legal regulatory frameworks will be required for aquaculture to expand along sustainable and equitable development paths.

- Links will need to be improved among fisheries, aquaculture and other sectors that share or compete for resources, production processes or market position, in order to manage conflicts and ensure that food security aims can be maintained.
- Links will be required among national climate change adaptation policies and programmes as well as national cross-sectoral policy frameworks such as those for food security, poverty reduction, emergency preparedness and response, insurance and social safety schemes, agricultural and rural development, and trade policies.

Regional

The potential for spatial displacement of aquatic resources and people as a result of climate change impacts, and the greater variability characteristics of transboundary resources will require existing regional structures and processes to be strengthened or given more specific focus. Policy and legal mechanisms that address these issues will need to be developed or enhanced. Regional market and trading mechanisms are also likely to be more important in linking and buffering supply variability and maintaining sectoral value and investment.

Requirements include:

- Regional fisheries organizations and other regional bodies should be strengthened. They should place climate change awareness and response preparedness clearly on their agendas and link more closely with related regional bodies.
- Fisheries and aquaculture will need to be addressed adequately in cross-sectoral and transboundary resource use planning and in intra-regional markets and trade. In this vein, the potential effects of climate change stressors on regional issues will have to be considered as part of any provisions for action.
- Common platforms are needed for research and data gathering approaches, sharing of best practices in identifying and responding to climate change-related impacts and developing response mechanisms.

International

As sectoral trade and competition issues link with climate change mitigation and adaptation activities, they are likely to become more important, with the potential to define many areas of economic potential and constraint. As a small and often politically weak sector, fisheries and aquaculture may be particularly vulnerable in such competition and conflicts. This increases the importance of having fishery sector representation in policy and legal development processes related to climate change mitigation and adaptation.

Requirements include:

- Fisheries and aquaculture need to be adequately addressed in climate change policies and programmes dealing with global commons, food security and trade.
- Common platforms are needed for international data and research approaches, sharing best practices in identifying and responding to climate change-related impacts and developing response mechanisms.
- Fishery sector responses should be incorporated into processes and decisions related to climate change in the other major sectors (e.g. water) to which fishery issues are linked.
- International fishery agreements and conventions should be more vigorously applied, and strengthened if necessary, to accommodate and support climate change-related activities.
- Cooperation and partnerships should be enhanced for dealing with NGOs, civil society organizations, intergovernmental organizations, including the 1-UN approach, and donor co-ordinated initiatives.

Capacity building: technical and organizational structures

Policy-making and action planning in response to climate change involves not only the technically concerned line agencies such as departments responsible for fisheries, interior affairs, science and education, but also those for national development planning and finance. These institutions, as well as community or political representatives at subnational and national levels, should

also be identified to receive targeted information and capacity building. Partnerships would also need to be built and strengthened among public, private, civil society and NGO sectors.

Requirements include:

- Nationally, information gaps and capacity-building requirements need to be identified and addressed through networks of research, training and academic agencies.
- Internationally, networks should be created or developed that encourage and enable regional or global exchanges of information and experiences, linking fishery issues with other those of other sectors such as water management, community development, trade and food security.
- Existing management plans for the fisheries and aquaculture sectors, coastal zones and watersheds need to be reviewed and, if needed, further developed to ensure they cover potential climate change impacts, mitigations and adaptation responses. Connections to wider planning and strategic processes also need to be identified and adjusted.
- Communication and information processes that reach all stakeholders will be essential elements in sectoral response. This will require focused application by communication specialists to ensure that the information is accessible and usable –presenting diverse and complex issues in a form that is targeted and understandable for each audience.

Enabling financial mechanisms: embodying food security concerns in existing and new financial mechanisms

The full potential of existing financial mechanisms will be needed to tackle the issue of climate change. Innovative approaches may also be needed to target financial instruments and create effective incentives and disincentives. The public sector will have an important role in leveraging and integrating private sector investment, interacting through market mechanisms to meet sectoral aims for climate change response and food security. Many of these approaches are new and will need to be tested in the sector.

At the national level:

- Producers, distributors and processors should be able to increase self protection through financial mechanisms. This is particularly relevant for aquaculture (e.g. cluster insurance) but financial services could also be used to promote emergency funds more widely through the sector.
- Investment in the sector, especially in infrastructure, will need to consider climate change which will require developing better information on the costs and benefits of protection.
- Transfer or spread of sector-related risk – from individuals and communities to the state through contingency plans – will be based on specific fiscal provisions but also may be tied to innovations in resource manage-

ment through which the insured accept responsibilities in exchange for protection.

- Financial instruments that can promote risk reduction and prevention practices include initiatives such as relocation allowances from low lying areas and disincentives for misuse of water in aquaculture.
- Existing and new initiatives for improving equity and economic access, such as microcredit, should be linked to climate change adaptation responses such as livelihood diversification.
- Mitigation options can include fiscal incentives for reducing the sector's carbon footprint, developing more efficient processes and sector agreements, and providing payment for environmental services, particularly offering additional livelihood options to poorer communities.

At the international level:

- Funding agencies can “climate proof” their approaches and, at the same time, take advantage of new opportunities in the fisheries and aquaculture sector by jointly promoting food security, reducing negative impacts of climate variability and change, and improving resource management.
- Donors should be made more aware of the importance of the fisheries and aquaculture sector in terms of food security and its sensitivity to climate change, and of effective ways in which the sector could become part of cross-sectoral investment strategies.
- Private sector investors should be encouraged to incorporate “climate proof” approaches into international sourcing, trade and market development, and into broader corporate responsibility areas, including delivery of local benefits and inclusion of smaller scale producers.

New initiatives in fisheries extension

H.K. De¹, G.S. Saha¹, R. Srichandan¹ and V.P. Vipinkumar²

1. Central Institute of Freshwater Aquaculture, Bhubaneswar, Orissa 751 002;
2. Central Marine Fisheries Research Institute, Cochin, Kerala, India.

Improved communication and information access is directly related to social and economic development. However, the rural population still have difficulty in accessing crucial information in forms they can understand in order to make timely decisions. There is a concern that the gap between the information rich and information poor is getting wider. New information and communication technologies are generating possibilities to solve problems of rural poverty, inequality and giving an opportunity to bridge the gap between information-rich and information-poor and to support sustainable development in rural and agricultural communities. However remote rural communities still lack basic communication infrastructure. The challenge is not only to improve the accessibility of communication technology to the rural population but also to improve the relevance of information to local

development. The article focuses on innovations in technology dissemination with particular focus on aquaculture.

Public sector initiatives

Single window delivery system

In an information age, the role of appropriate information package and its dissemination is of crucial significance. It is not enough to generate information but it is also essential to ensure that the required information is delivered to the end-users at the earliest and with the least dissemination loss. The establishment of agricultural technology information centers (ATIC) can forge a better interaction between researcher and technology users. This serves as a single window system with an objective to help the farmers and other stakeholders both to provide solution

to their location-specific problems and to make available all the technological information along with technology inputs and products for testing and use by them. Such information is useful for:

- Farmers;
- Farmer-entrepreneurs;
- Extension workers and development agencies;
- NGOs; and
- Private sector organisations.

ATICs facilitate direct access to the farmers to the institutional resources that are available in terms of technology, advice and products, thereby reducing technology dissemination losses. Under the National Agricultural Technology Project (NATP) the Indian Council