

**ADAPTING TO CLIMATE CHANGE: THE ECOSYSTEM APPROACH TO
FISHERIES AND AQUACULTURE IN THE NEAR EAST AND NORTH
AFRICA REGION**

**Workshop Proceedings: FAO/WorldFish Workshop, Abbassa, Egypt
10–12 November 2009**



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Edited by

Lori Curtis
WorldFish Center

Malcolm Beveridge
WorldFish Center

Abdel Rahman el-Gamal
WorldFish Center

Piero Mannini
FAO

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PREPARATION OF THIS DOCUMENT

This project was initiated by FAO in order to address how the ecosystem approach to fisheries and aquaculture can be used to address the impacts of climate change to fisheries and aquaculture in the Near East and North Africa Region (RNEA).

A workshop was held in December 2009 with Member Countries and with the purpose of:

- developing awareness among Member Countries and stakeholders of the need for the ecosystem approach to fisheries and aquaculture and of its implementation on the basis of the best available knowledge and information;
- strengthening capacity among FAO RNEA Member Countries and the Regional Commission for Fisheries (RECOFI) constituents for planning and implementation of the ecosystem approach to fisheries and aquaculture;
- improving knowledge and awareness of the current and future implications of climate change for fisheries and aquaculture;
- providing guidance on best practices for adaptive planning and management, and adaptive strategies in general, for coping with climate change.

The document provides suggestions and recommendations made by the experts regarding the adoption of the ecosystem approach to fisheries and aquaculture that are considered to be important in helping adapt to climate change in the region. It also contains five technical review papers (climate change, the ecosystem-based approach to fisheries, the ecosystem-based approach to aquaculture, climate change and fisheries, and climate change and aquaculture) and four subregional reviews (Mauritania/Morocco, Mediterranean, Red Sea and Gulf of Aden, Persian Gulf and Sea of Oman) prepared as background material to the workshop. The report was prepared by the workshop secretariat.

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ABSTRACT

A workshop was held in December 2009 with Member Countries and with the purpose of: developing awareness among Member Countries and stakeholders of the need for the ecosystem approach to fisheries and aquaculture and of its implementation on the basis of the best available knowledge and information; strengthening capacity among the Near East and North Africa countries for planning and implementation of the ecosystem approach to fisheries and aquaculture; improving knowledge and awareness of the current and future implications of climate change for fisheries and aquaculture; and providing guidance on best practices for adaptive planning and management, and adaptive strategies in general, for coping with climate change.

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ABBREVIATIONS AND ACRONYMS

AOGCM	Atmosphere–Ocean General Circulation Model
AR	Assessment Report
BCLME	Benguela Current Large Marine Ecosystem
BMP	better management practice
CBD	Convention on Biological Diversity
CCLMRAR	Commission for the Conservation of Living Marine Resources of the Antarctic Region
Code	Code of Conduct for Responsible Fisheries
COFI	Committee on Fisheries (FAO)
CO ₂	carbon dioxide
CRU	Climatic Research Unit
DMN	Direction de la Météorologie Nationale (Morocco)
DPM	Département des Pêches Maritimes (Morocco)
DRM	disaster risk management
EA	ecosystem approach
EAA	ecosystem approach to aquaculture
EAF	ecosystem approach to fisheries
EAM	ecosystem approach to management
EBFM	ecosystem-based fisheries management
EEZ	economic exclusive zone
EIA	environmental impact assessment
ESD	ecologically sustainable development
EU	European Union
GDP	gross domestic product
GEF	Global Environment Facility
GFCM	General Fisheries Commission for the Mediterranean
GHCN	Global Historical Climatology Network
GHG	greenhouse gas
GIS	geographic information system
GRT	gross register tonnage
GWP	global warming potential
HCEFLD	High Commissioner for Water, Forests and Combating Desertification (Morocco)
HUFA	highly unsaturated fatty acids
IAA	Integrated Agriculture Aquaculture
IFRO	Iranian Fisheries Research Organisation
IM	integrated management
IMTA	integrated multitrophic aquaculture
INRH	Institut National de Recherche Halieutique, Morocco
INSTM	Institut National des Sciences et Technologies de la Mer, Tunisia
IPCC	Intergovernmental Panel on Climate Change
LCA	life cycle analysis
LME	large marine ecosystem
MCS	monitoring, control and surveillance
MDG	Millennium Development Goal
MEA	Millennium Ecosystem Assessment
MPA	marine protected area
NAO	North Atlantic Oscillation
NCDC	National Climatic Data Center (United States Department of Commerce)
NGO	non-governmental organization
NIVA	Norwegian Institute for Water Research
OIE	World Organization for Animal Health
ONP	Office Nationale des Pêches (Morocco)

OU	operating unit
PaCFA	Global Partnership Climate, Fisheries and Aquaculture
PERSGA	Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
PPP	Purchasing Power Parity
RECOFI	Regional Commission for Fisheries
RESGA	Red Sea and Gulf of Aden
RNEA	Near East and North Africa Region (FAO)
SAH	Sahara
SEM	Southern Europe and Mediterranean
SLA	sustainable livelihoods approach
SRES	Special Report on Emissions Scenarios
SST	sea surface temperature
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UN-REDD	The United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
VMS	vessel monitoring system
WTO	World Trade Organization

EXECUTIVE SUMMARY

The FAO/WorldFish workshop entitled “Adapting to Climate Change: the Ecosystem Approach to Fisheries and Aquaculture in the Near East and North Africa Region” took place in November 2009 to identify and address the impacts created by climate change in the Near East and North Africa Region (RNEA), and how the ecosystem approach (EA) can be utilized for the management and adaptation of fisheries and aquaculture in the face of these impacts.

The impacts of climate change will affect and change the industries of fisheries and aquaculture, and therefore affect food security and livelihoods in the Region. The predicted impacts are not standard or consistent across the Region; one country’s loss may be another country’s gain. Regardless of the specific losses and gains, food security, the stability of supply, availability, access and utilization will all be affected. Vulnerability arises from the combined effect of these impacts, the importance of fisheries and aquaculture with respect to food security and livelihoods, as well as a limited capacity for these industries to adapt.

The ecosystem approach to fisheries (EAF) and the ecosystem approach to aquaculture (EAA) are not new strategies. Rather, they pull together existing instruments and agreements, stressing holistic, integrated and participatory processes. The key features of the EAF/EAA are maintaining ecosystem integrity while improving human well-being and equity and promoting an enabling governance. Three objectives that must be at the core of the EA are: ensuring ecological well-being, ensuring human well-being, and ensuring the ability to achieve (governance and external factors).

The subregions of the Mediterranean, Atlantic (Morocco/Mauritania), Red Sea and Gulf of Aden, and the area covered by RECOFI have different levels of fisheries and aquaculture development, as well as varying institutional, financial, willingness and human capacities for the implementation of EA strategies with respect to climate change adaptation. The purpose of this workshop was to develop awareness among workshop participants on the impacts of climate change and on how the EAF/EAA can be used, not only for adaptation but also for mitigation. The outcomes of this workshop demonstrated that there is a capacity and a will by Member Countries to address climate change with respect to fisheries and aquaculture, but there remain important challenges that must be addressed in order to prepare these sectors adequately for the impacts of climate change.

1. WORKSHOP

1.1 Introduction

1.1.1 *Opening speech on behalf of the Central Laboratory for Aquaculture Research in Egypt*

The workshop began with a speech delivered by Dr Gamal el-Naggar, Director of the Central Laboratory for Aquaculture Research in Egypt.

Climate change has moved to the forefront of the world's environmental agenda and rightly so. Scientific evidence that the activities of mankind have altered global climate to the extent that our very survival appears to be in jeopardy is incontrovertible. It must be emphasized that global climate change has been a matter of grave concern within the scientific community for some time and has been the subject of a large number of scientific investigations. The vast body of scientific knowledge that has been accumulated over the past 50 years is notable for its high level of agreement, and has been recently reviewed by a United Nations established Intergovernmental Panel on Climate Change (IPCC).

The IPCC projects that atmospheric temperatures will rise by 1.8–4.0 °C globally by 2100. This warming will be accompanied by rising sea temperatures, changing sea levels, increasing ocean acidification, altered rainfall patterns and river flows, and higher incidence of extreme weather events. The biological components of our environment have evolved in harmony with the physical and climatic surroundings. The presence, characteristics, structure and behaviour of both individual organisms and co-assemblages, or communities, of organisms are largely determined by climate. The ability of natural communities to adapt to changing climate and nature of community change is of utmost importance to the survival of man.

Approximately 520 million people (8 percent of the world's population) depend on fisheries and aquaculture as a principal source of protein, income or family stability. With over 400 million of the world's poorest depending on fish for food, it is essential that climate proofing fisheries and aquaculture is high on the agenda for climate change. Many fishery-dependent communities and aquaculture operations are in regions highly exposed to climate change. It is becoming increasingly clear that the impact of climate change will disproportionately hurt the poorest communities and those in small inland states.

Climate change will impact aquatic ecosystems and alter the distribution and production of fish. Fish migration routes, spawning and feeding grounds, and fishing seasons are likely to change and the impacts on fishing communities and harvests are uncertain. Vulnerability arises from the combined effect of predicted warming, the relative importance of fisheries to national economies and diets and limited capacities to adapt. Quality research is essential for climate-proofing our future and fish are a vital part of the future. High-quality research involves resource users, builds strong partnerships and harnesses political support, it is crucial for making fisheries and aquaculture systems more resilient to global climate change. Decisions informed by high-quality research will be key to securing a better future for the poor who depend on fisheries and aquaculture.

The task ahead of us is both urgent and complex. The consequence of non-action is potentially the end of civilization, as we know it, on this planet. These are some of the questions that you are invited to explore and discuss.

- i. What are the threats?
- ii. What can we do to alleviate these threats?
- iii. What can we do to aid the survival of our civilization?
- iv. Can humankind adapt to the changes in environment caused by global climate change?

1.1.2 Opening address on behalf of FAO Regional Office for the Near East and North Africa

This opening address was delivered by Dr Piero Mannini, Senior Fishery Officer on behalf of Dr Abdessalam Ould Ahmed, acting Assistant Director-General and Regional Representative for the Near East and North Africa FAO Regional Office for the Near East and North Africa. On behalf of the Food and Agriculture Organization of the United Nations, I wish to welcome you to the WorldFish Center Field Research Station in Abbassa, Egypt, and to participate in the FAO/WorldFish regional workshop Adapting to Climate Change: the Ecosystem Approach to Fisheries and Aquaculture in the Near East and North Africa Region.

The region covered by the FAO Regional Office for the Near East and North Africa encompasses a wide and dispersed geographical area of different marine and freshwater ecosystems and fisheries with different characteristics and complexity. This FAO Region extends from the East Central Atlantic Ocean on the west, to the Indian Ocean and Arabian Sea in the east. It includes regional seas (such as the southern and eastern Mediterranean Sea, Red Sea, Persian Gulf and Sea of Oman), national and regional rivers, lakes and other bodies of water.

The landing of marine capture fisheries in the region has been growing since the 1950s, from less than 500 000 tonnes to about 3 000 000 tonnes in 2006. Aquaculture production, which was almost non-existent till the 1980s, shows a significant increase that has been particularly remarkable from the late 1990s. Currently, its total production is more than 500 000 tonnes. Despite this positive trend of the total landing from capture fisheries, many of the most vulnerable species are overexploited and changes in ecosystem structure and fishery productivity are reported in some areas of the region. Moreover, fisheries in the region rely upon ecosystem services and goods that are often shared with other coastal countries. To ensure the responsible management and sustainable exploitation of the fisheries resources, the strengthening of regional cooperation is needed.

In most countries, lacking complete, up-to-date surveys and accurate and timely data on fish landings, it is difficult to estimate the state of stocks. Inland capture fisheries stocks are also under threat of declining catches, mostly due to overfishing, unmonitored stocks and exploitation, environmental degradation, plus poor statistical gathering to monitor status of stocks.

With the uncertain potential for increasing fish supply from marine and inland capture fisheries, the future supply of fish in the Region will most likely depend on aquaculture. However, there are environmental, technical, economic and legal constraints of varying degrees that need to be overcome in many countries of the Region if aquaculture is to develop.

The attainment of the goal of sustainable development and utilization is being constantly threatened by a multitude of factors internal and external to the fisheries and aquaculture sector. The world's dependence on the capture fisheries and aquaculture sector is threatened not only by misuse of these aquatic resources but also by factors external to the sector, such as climatic changes. Coastal populations, fishers and fish farmers are particularly vulnerable to the direct and indirect impacts of predicted climatic changes, including changes in physical environments and ecosystems, fish communities, infrastructure, fishing and aquaculture operations, and livelihoods.

Climate change is modifying the distribution of marine and freshwater species. In general, species are being displaced toward the poles and are experiencing changes in the size and productivity of their habitats and seasonality of biological processes. Sea-level rise, glacier melting, ocean acidification and changes in precipitation, groundwater and river flows will significantly affect many ecosystems, including coral reefs, wetlands, rivers, lakes and estuaries.

Climate change will have potentially significant impacts on the four dimensions of food security: availability of aquatic foods will vary through changes in habitats, stocks and species distribution; stability of supply will be impacted by changes in seasonality, increased variance in ecosystem productivity and increased supply variability and risks; access to aquatic foods will be affected by changes in livelihoods and catching or

farming opportunities; utilization of aquatic products will also be impacted and, for example, some societies and communities will need to adjust to species not traditionally consumed.

Not all climate change impacts will necessarily be negative. Redistribution of fish stocks may mean that one country's loss is another's gain. The world's fishing fleet is mobile, markets for many fishery products are global and management systems such as access agreements and internationally traded quotas increasingly facilitate adaptation. In this dynamic context, countries and firms with greater resources and adaptive capacity will gain most from positive changes. Poorer countries and people might still be vulnerable to missing out on benefits of positive change.

It has been increasingly recognized that reducing the vulnerability of fishing communities as a whole can help address poverty and resource degradation, and enhance adaptive capacity to a range of shocks, including those resulting from climate variability and extreme events. The need for adaptation is a feature of all livelihoods dependent on natural resource utilization but projected climate change poses multiple additional risks to fishery dependent communities. Options to increase resilience and adaptability include the adoption, as standard practice, of adaptive and precautionary management within an ecosystem approach to fisheries (EAF) and an ecosystem approach to aquaculture (EAA).

The FAO EAF has been adopted by the Committee on Fisheries (COFI) as the most appropriate management framework and is explicitly indicated as the target framework by the World Summit on Sustainable Development (2002). The EAF principles are the same as those of the Code of Conduct for Responsible Fisheries (the Code) and provide a framework for implementing these in a more holistic and structured way. The EAF and EAA apply the precautionary approach, are embedded within integrated management across all sectors, have the potential to increase ecosystem and community resilience, and are valuable frameworks for dealing with climate change.

The EAF and EAA are comprehensive approaches to fisheries management and aquaculture development that envisage participatory approaches and consideration of a broader set of issues that include the broader impacts of fisheries on the ecosystem in addition to those on target species. Furthermore, social, economic and governance considerations that are important components of sustainability are also taken into consideration. The EAF/EAA recognizes that decisions have to be made with the information available, that it is not possible to wait to have a complete understanding of all the processes and that decisions made must deal with trade-offs between stakeholders as well as between the various components of sustainability.

In line with the indication given at the COFI 2007 and 2009 sessions, and to take action with respect for the concerns expressed at the 29th Regional Conference for the Near East (2008) on the impact of climate change, FAO in partnership with the WorldFish Center has conceived the present regional multidisciplinary workshop on Adapting to Climate Change: the Ecosystem Approach to Fisheries and Aquaculture in the Near East and North Africa Region.

The objectives of the workshop are to: 1) develop awareness among Member Countries and stakeholders of the need for an ecosystem approach to fisheries and aquaculture and of its implementation on the basis of the best available knowledge and information; 2) strengthen capacity among FAO Member Countries for planning and implementation of the Ecosystem Approach to Fisheries and Aquaculture; 3) improve knowledge and awareness of the current and future implications of climate change for fisheries and aquaculture; and 4) provide guidance on best practices for adaptive planning and management, and adaptive strategies in general, for coping with climate change.

Distinguished participants and colleagues, 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: national, regional and international.

1.2 Background presentations

The workshop was divided into two main activities: background presentations, and working group sessions. The presentations were given to summarize the main issues from the background papers, written on topics relevant to the workshop, and were designed to facilitate a knowledge base for the working group discussions that would follow. These presentations were divided into background information of a twofold nature: technical summaries by experts from the WorldFish Center and FAO; and subregional reviews by fisheries and aquaculture experts from the bodies of water covered by the Regional Commission for Fisheries (referred to as the RECOFI region), the Red Sea and Gulf of Aden (RESGA), the Atlantic and the Mediterranean subregions. Below is a brief summary of the background papers, which constitute Sections 2 and 3.

1.2.1 Technical papers

Climate change in the Near East and North Africa Region, by H. Kanamaru (FAO)

The African continental surface temperature has risen since 1900, and it is predicted that the global surface temperature will continue to rise. This is also predicted specifically for the region of the Near East and North Africa. This is combined with predictions of decreased rainfall in the region, up to a decrease of 20 percent in the North Africa region. The estimates for an increased frequency and degree in extreme weather events globally are predicted as between very likely and virtually certain to occur. In warm climates, agricultural yields are expected to decrease. Sea-level has been rising and will create both physical and socio-economic losses. While the global impacts of climate change are clear, regional and subregional climate change and its effects on natural and human environments are difficult to determine and are being recognized only recently. This is due to greater natural climate variability at regional scales, local non-climate factors and limited spatial coverage and short time scales of many studies.

Plenary discussion

Regarding weather and precipitation, it is difficult to see regional trends based on country or individual weather stations, as stations can be heavily influenced by topography. It is necessary to look at the bigger picture for trends in order to understand where there will be increases or decreases in precipitation.

While there is projected to be a decrease in precipitation in North Africa, what impacts will the increase in Central African precipitation cause, particularly with regard to the Nile River?

The increase may bring positive impacts on the flow of the Nile River; however, it is difficult to predict how the water will be used, or where it will be lost as a result of the change.

The ecosystem approach to aquaculture: challenges and opportunities under climate change scenarios, by D. Soto (FAO) and P. White (NIVA)

Aquaculture has been increasing in its share of global food-fish supply since 1970, and could potentially contribute 50 percent by 2011. As aquaculture, unlike capture fisheries, is a production process, a systems consideration of how much is coming in and how much is going out is required early in the planning process. The EAA is a strategy that integrates aquaculture within the wider ecosystem, strengthening the resilience of interlinked socio-ecological systems. Three objectives that must be at the core of any EAA are: ensuring ecological well-being, ensuring human well-being, and ensuring the ability to achieve (governance and external factors). Contained within the EAA is the recognition that trade-offs must be made in order to reconcile different objectives. Stakeholders must identify, prioritize and address issues, considering the impacts of both the inputs and outputs of aquaculture. In order to address climate change issues using EAA, it is necessary to begin by identifying the physical aspects in order to understand the ecological impacts and the resulting social consequences on the sector.

¹ The Regional Commission for Fisheries (RECOFI) carries out its functions and responsibilities in the region, bounded in the south by the following rhomb lines: from Ras Dhabat Ali at 16°39'N, 53°3'30"E to 16°00'N, 53°25'E, then to 17°00'N, 56°30'E, then to 20°30'N, 60°00'E, then to Ras Al-Fasteh at 25°04'N, 61°25'E. Membership includes: Bahrain, Iran (Islamic Republic of), Iraq, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

Plenary discussion

What is the role in stock enhancement for helping to minimize risk?

It is necessary to first do a risk assessment and be clear about objectives. In many cases, stock enhancement has been successful. There are success stories with tilapia, but there are negative impacts, which must be taken into account and all stock enhancement must be taken on a case-by-case basis.

What lessons learned in agriculture can be applied to aquaculture management?

Several studies have investigated this. We are putting more effort into integrated aquaculture and integrated planning and trying to avoid the mistakes of agriculture, but this is not an easy task. Many of the lessons learned from agriculture are applied in aquaculture. Attempts to lower inputs and decrease intensity are examples of this.

Adapting to climate change: the ecosystem approach to fisheries and aquaculture in the Near East and North Africa Region, by C. De Young (FAO), G. Bianchi (FAO), and Y. Ye (FAO)

The EAF is the realization of sustainable development in fisheries, stressing holistic, integrated and participatory processes. The purpose of an EAF is to plan, develop and manage fisheries in a manner that addresses the dynamic nature of societies' needs in a way that ensures the sustainability of aquatic ecosystems. The EAF is based on principles that pull together existing instruments and agreements in order to realize sustainable development in fisheries, stressing holistic, integrated and participatory processes. The key features of the EAF are maintaining ecosystem integrity while improving human well-being and equity and promoting an enabling governance.

The need for an EAF stems from a number of factors, including: poor performance of current management practices; degradation of fishery resources and the marine environment; and recognition of a wide range of societal interests in aquatic ecosystems and the need to reconcile these.

Key principles that should be considered in practice are: apply the precautionary approach; use best available knowledge; acknowledge multiple objectives and values of ecosystem services; embrace adaptive management; broaden stakeholder participation; understand and use a whole suite of management measures; and promote sectoral integration and interdisciplinarity.

Plenary discussion

Is the application of the EAF feasible only at a regional level, or can it also be applied at a local or small-scale level?

Generally, community-based and comanagement-styled approaches use elements of the EAF already, but it is called something different. Depending on the level, we may not have all the information required, but the EAF is about using what information is available in the best possible way, thus the EAF can be applied at different scales. The EAF is primarily about decision-making for achieving well-defined objectives, based on the best available knowledge. Potential effects and consequences at the systems level of management decisions must be considered. However, even simple models of systems' functions can establish a plausible subset of potential outcomes and improve transparency in decision-making. At higher levels, for example, the large marine ecosystem (LME) level, implementation may be blocked by a perceived need for further information, whereas at a smaller level we can often go ahead.

Climate change and fisheries, by M.C. Badjeck (WorldFish) and E.A. Allison (WorldFish)

The fisheries industry comprises 8 percent of global employment and has a global trade value of almost USD80 billion. In Mauritania, Morocco and Yemen, fisheries exports comprise over 1 percent of exports, as high as 15.8 percent in Mauritania. Climate change will affect fisheries in a variety of ways, including production ecology, fishing operations, communities and livelihoods, as well as wider society and the economy. Different models show that the biomass of certain fish species will shift, and different countries will experience changes with regard to the species in their waters. Countries have different levels of vulnerability to the impacts of climate change on the fisheries sector, and it is necessary to conduct vulnerability assessments to determine the drivers of change in the sector, as well as the adaptive capacity, the coping mechanisms, and resilience to future climate change. Additionally, the opportunities brought by

climate change must be capitalized on, combined with adopting a multisectoral approach in order to address the conflicts and synergies between adaptation strategies.

Plenary discussion

What components are used to determine national-level vulnerability to climate change?

To determine vulnerability, exposure, sensitivity, potential impacts and adaptive capacity were all analysed.

Are there positive opportunities? How can we take advantage?

Through migration and changes in movements of various species, some will lose, some will gain. Also, species will migrate within countries. In order to take advantage of these changes, it is necessary to gain an understanding of where these changes will occur and develop a strategy to adapt to them.

Aquaculture and climate change, by M.C.M. Beveridge (WorldFish), M.J. Phillips (WorldFish) and A.R. el-Gamal (WorldFish)

Over the past two decades, aquaculture has consistently been the fastest-growing food production sector in the world, and now accounts for half of all fish consumed (FAO, 2009).

Worldwide, it generates tens of millions of jobs, directly and indirectly. As the evidence that the climate of the earth is changing profoundly grows stronger, it becomes necessary to address how aquaculture will be affected. Climate-change–aquaculture interactions are two-way – aquaculture contributes to climate change, and climate change affects aquaculture. The impact of the interactions on linked social-ecological systems, however, must be considered in the context of other pressures: changes in population size and demographics, environmental degradation, market, globalization, energy prices, health and economic recession. The impacts of climate change on aquaculture include: distribution, productivity, species availability, growing season, feed and seed costs, cash flows and profitability, pond flooding, hazardous working environments, damage to assets, increased insurance costs and planning.

Plenary discussion

One obstacle for aquaculture development is the financial crisis and energy cost. In the RNEA, shouldn't European Union companies invest in offshore cage aquaculture in order to reduce costs and develop technology?

Unless there is a market, investment in these areas will not occur. If you can produce what the market demands, for the right price, then investment will occur. There is a comparative value missing from this analysis. Of course, it is necessary to understand the impacts of fishing/aquaculture, but also to make a comparison with meat and vegetables. People need to know the impacts of their choices not just on the environment but also on livelihoods.

1.2.2 Regional papers

Climate change and the ecosystem-based approach to fisheries and marine aquaculture for Mauritania and Morocco, by A. Orbi (INRH), S. Zizah (INRH), K. Hilmi (INRH) and M.Y. Allaroussi (Ministry of Agriculture and Fisheries, Morocco)

The Mauritanian and Moroccan waters are part of the Canary Current Large Marine Ecosystem (CCLME), which hosts high productivity due to a key eastern boundary upwelling ecosystem. In both countries, there is a wide variety of small pelagic species, with significant variability in their biomass and distribution. The fisheries sector in Morocco contributes between 2 and 3 percent of gross domestic product (GDP), directly creates 170 000 jobs (1.5 percent of the workforce) and 490 000 jobs indirectly. Capture fisheries annual production is 1 million tonnes, and while Morocco is developing its aquaculture sector, it is still very marginal. In September 2009, the Government of Morocco adopted a new fisheries strategy, Halieutis, which includes sustainability and the recognition of aquaculture as a strong driver of growth in its key objectives.

The fisheries sector in Mauritania accounts for 6–10 percent of GDP, and provides approximately 30 000 jobs, or 36 percent of modern sector employment in the country. The overall volume of exports has been declining in recent years, and many high-value species are in a state of overexploitation. The fisheries sector is experiencing increased pressure due to illegal fleet fishing in prohibited areas, intensified competition between artisanal fisheries and industrial fisheries, as well as the use of prohibited fishing gear.

In 2006, Mauritania adopted a new fisheries strategy, which includes the optimization of the contribution of the sector to the economy, sustainable management of resources, and safeguarding of the maritime environment.

In the new fisheries strategies of both countries, vulnerability assessments were not conducted, and so the vulnerability to climate change must be estimated from general climate-change impact studies.

Plenary discussion

What regional cooperation between Mauritania and Morocco currently exists?

There is currently close cooperation between Mauritania and Morocco, in both an administrative sense as well as meetings within the private sector on issues that overlap. With respect to Morocco's new strategy, the objective is to fill knowledge gaps with a sustainable use of resources. The Ministry of Fisheries is trying to convert scientific issues into practicable issues through consultation with stakeholders; it is adaptable to address emerging issues.

The ecosystem-based approach to fisheries and aquaculture for the Southern and Eastern Mediterranean, by M. Belhassen (INSTM, Tunisia)

In general, the subregion is under the influence of a Mediterranean climate, characterized by mild wet winters and by warm to hot, dry summers. Because of its latitude, the Mediterranean Sea is located in a transitional zone where both mid-latitude and tropical variability are important and compete against each other. Freshwater resources are very limited and are under increasing pressure in terms of both quantity and quality, with the exception of Egypt. The seawater is characterized by limited productivity, but it hosts one of the richest biodiversities in the world. An important feature of this subregion is the emergence of highly populated societies, with an estimated 140 million people.

The fishing activity is characterized by the dominance of an artisanal (coastal) sector, the slight growth of an industrial sector, and by a large dispersion of fishing and marketing along the coast. The fisheries of the region are based on relatively poor resources and often exploited by individuals with low-cost vessels and simple gear. In the southern and eastern Mediterranean Sea, fisheries and aquaculture fishing have had significant effects on livelihoods, employment opportunities and foreign exchange earnings to the countries of the region. With regard to aquaculture, there are significant differences in aquaculture quantities produced by countries, Egypt being at the forefront of aquaculture activity in the subregion.

The subregion appears as one of the most threatened regions in the world by climatic change. The countries in the subregion have limited levels of services, technological and economical resources, which are likely to result in very restricted adaptation capabilities to environmental and climate changes.

Plenary discussion

With regard to species distribution, is this being observed or monitored between the Mediterranean and the Red Sea?

The environment is changing, which will impact migration, but this is relatively new and while there have been observations of species having moved, there is not a formal monitoring system in place.

There are a lot of fish imports in this subregion, why can't that gap be filled with aquaculture?

In general, prices for aquaculture in the North Africa region are not competitive, as the aquaculture sector is only developed in certain countries. However, this is an issue that could use further exploration in order to understand further what role the development of aquaculture could play in reducing fish imports.

The ecosystem-based approach to fisheries and aquaculture for the Red Sea and Gulf of Aden, by M.M.A. Zaid (Al-Azhar University, Egypt)

The RESGA subregion includes the coastal areas of seven different countries, of which four are the focus for this workshop; Egypt, Jordan, Saudi Arabia and Yemen, representing approximately 96 percent of regional production. Fishing in the RESGA subregion is dominated by small-scale, artisanal activities. According to the available information about these countries, the artisanal and industrial fisheries produced approximately 30 269 tonnes of invertebrate species and 261 842 tonnes of finfishes in 2007. The subregional artisanal fleet

operating in the area is comprised of approximately 54 500 fishers and about 15 500 vessels of different types, while the industrial fleet is comprised of about 12 057 fishers and 1 600 industrial vessels. The marine aquaculture in the area is mainly limited to Saudi Arabia and Egypt, with aquaculture representing 14 percent of total fish production in Saudi Arabia. In the RESGA subregion, climate change is an additional pressure on top of the many (fishing pressure, loss of habitat, pollution, disturbance, etc.) that the marine environment already experiences. This means that the impact of climate change must be evaluated in the context of other anthropogenic pressures, which often have a much greater and more immediate effect.

Plenary discussion

As far as the introduction of new species is concerned, has there been any link between species composition and water quality levels?

It is difficult to evaluate new species in the RESGA subregion, as there is a lack of proper fisheries data, and a lack of coordination between countries, despite the presence of the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA). This all makes it difficult in the discovery of new species in the area.

Does this impact the reliability of the data on fisheries catches in the RESGA subregion?

Reliability of catch data is an important problem, particularly as it is common with small-scale, artisanal fisheries, and these are the activities that dominate the subregion.

Adapting to climate change in the RECOFI subregion, by H. Negarestan (IFRO, Iran [Islamic Republic of])

The RECOFI is a regional fishery body covering a body of water with the membership of eight countries, including Bahrain, Iran (Islamic Republic of), Iraq, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. The climate is of a subtropical nature. Salinity is high compared with neighbouring marine environments. Freshwater input is low and is only from the Arwand River, which collects water from the Karoun, Euphrates and Tigris Rivers.

Artisanal fisheries are of great importance in the RECOFI area, including a large number of fishers with small incomes. Modern fisheries of various types are also present in the subregion, however, not at a high intensity level. Aquaculture is limited to land-based shrimp culture, and an extensive cage culture of marine species. However, it is developing quickly and has increased almost five times during the last decade.

Fisheries management is practised separately in each country. The present approach to solving fish stock problems is based on concentrating on fishes grouped according to fishing gear. Some species have been given special attention. While there is little evidence that climate change has caused any change to the fisheries sector so far, the RECOFI subregion is highly sensitive to possible fluctuations caused by climate change in the future, particularly as there is a predominance of low-income artisanal fishers in the subregion. In recent decades, the subregion has experienced rapid development in the coastal zone and a loss of potential to sustain coastal and marine populations of fish. An integrated EAF in the subregion is necessary.

Plenary discussion

There was a large fish kill in 2005 in Kuwait, and it was suspected this was from humidity and high sea temperatures, the most affected fish was the mullet. While there are no answers as to why, is it not possible this subregion is already feeling the effects of climate change?

Some people say it was from a high amount of sewage in the area. However, this is not a phenomenon that is occurring in isolation, the sewage was there for years. As things change in the subregion, and with the combination of anthropogenic changes with climatic changes, unpredictable impacts will result.

1.3 Working group sessions

The working group sessions were divided into three main topic areas:

- identifying climate change impacts on fisheries and aquaculture;
- identification of adaptation/management strategies for priority impacts/issues;
- understanding regional and subregional capacity for the implementation of adaptation strategies.

The first two working group sessions were divided by expertise with regard to either capture fisheries or aquaculture, while the third working group session was divided by subregion. The working group sessions were designed to incorporate the EAF and EAA into the discussions. This ensured that the biophysical well-being, social and economic well-being, as well as governance and ability to achieve were all considered in the sessions.

1.3.1 Working Group Session 1: Identifying climate change impacts on fisheries and aquaculture

The participants were divided into two working groups, capture fisheries and aquaculture. The working groups used the EA to identify climate change impacts and how they would create issues for ecological well-being, human well-being, and governance and the ability to achieve. Once the impacts and issues were identified and discussed, the working groups prioritized these issues, voting in each category. The outputs of the working groups are detailed in Tables 1.1 and 1.2. These reflect the discussions for identifying the impacts as well as the prioritization through voting. The key for these tables is below.

Capture fisheries

The capture fisheries working group recognized that freshwater systems will be affected by climate change; however, it decided to focus on marine fisheries, as each type warrants its own investigation and the time did not allow for an exploration of both. A variety of issues created by the effects of climate change were raised and discussed for each component of the EAF. However, the voting revealed a clear preference for the prioritization of certain key issues over the others (Table 1.1).

In the category of ecological well-being, the two main priorities selected were recruitment and life cycle, as well as changes in habitat structure. Where recruitment and lifecycle encompass a more macro-level issue, changes in habitat structure will address biotic and abiotic factors on the environment. These two issues were priorities in each of the four subregions represented in the group.

In the category of social and economic well-being (human well-being), employment and factors relating to livelihood (revenue change) were highlighted as the key issues. This is reflected in the issues raised in this category – of the eight raised, seven were focused on livelihoods, and only one on the demand side of this industry.

The governance and ability to achieve voting revealed that socio-economic instability relating to unemployment, as well as access rights, were the priorities when compared with the other issues raised by the working group. This again reflects the emphasis that livelihood development and secure employment plays in the capture fisheries industry.

Table 1.1 Identification of climate change impacts on capture fisheries

Marine capture fisheries					
Identification of climate change impacts					
Ecological well-being	Priority	Human well-being	Priority	Governance and ability to achieve	Priority
Recruitment and life cycle		Production: asset distribution conflicts		Conflict between communities	
Species distribution and composition (biodiversity)		Revenue changes		Change in community level management, access rights	
Nutrients and red tide		Changes in fishing areas (migration)		Government instability (socio-economic)	
Changes in habitat structure		Livelihood changes, no jobs		Conflict between countries	
Increase in sedimentation		Property destruction		Loss of coastal protection	
		Changes in demand (quality issues and health)		Fishing regulation legislation	
		Reduction (GDP)		Fishing licence control	
		Overall employment		Ability to provide jobs and compensation (livelihood options)	

Key:

Highest no. of votes	Middle range of votes	Low no. of votes	No votes

Table 1.2 Identification of climate change impacts on aquaculture

Aquaculture					
Identification of climate change impacts					
Ecological well-being	Priority	Human well-being	Priority	Governance and ability to achieve	Priority
Water quality		Social conflict over resources		Climate-change-proofing policies, planning and implementation for aquaculture	
Climate events		Change in production costs		Lack of intersectoral coordination	
Feeding		Limited availability of sites		Lack of adequate integrated monitoring and warning systems	
Red tide		Job losses		Coastal zone management planning adequate for aquaculture under climate change threats	
Freshwater limitation		Loss of essential infrastructure		Climate change information, dissemination and training	
Sea level rising		Food safety		Long-term investment threatened	
Fish mortality, diseases		Markets and prices		Insurance	
Less wild feed		Food security			

Key:

Highest no. of votes	Middle range of votes	Low no. of votes	No votes

Aquaculture

The working group focusing on aquaculture revealed slightly different results from the capture fisheries working group. The voting was not as clearly in agreement for two priorities in each component of the EAA, and the selected priority issues revealed a different focus. While in the ecosystem/biophysical well-being category, water quality emerged as the priority, climate events, red tide, freshwater limitation and fish mortality diseases are all of concern (Table 1.2).

The issues prioritized with respect to social and economic well-being reflected a more demand-determined approach, with food security and food safety raised as key, with job losses as one of the least important of those raised. Compared with capture fisheries, the issues raised in aquaculture more evenly reflect different components of the production process. In addition, the issues raised in the component on governance and ability to achieve are of a more technical nature for the development of aquaculture.

Discussion

The plenary discussions focused on two main topics: employment, and the degree and type of impacts. Employment was ranked as the top priority in capture fisheries, but did not receive any votes in the aquaculture working group.

Possible reasons identified include:

- Aquaculture is based on technology, so may have a higher adaptive capacity. Capture fishers are generally quite poor and have lower resilience, adaptive capacity.
- All countries in the region have a strong tradition of capture fishing, so a larger number of people rely on capture fishing. Aquaculture is only developed in some of the countries in the region.
- Contrary to this, capture fishers are accustomed to migrating to other locations when weather patterns change, while aquaculture is fixed in one place, raising the point that capture fisheries may be less vulnerable than aquaculture.

The degree and type of impacts were raised mainly in discussion with respect to aquaculture. Aquaculture is extremely dependent on freshwater and the increased salinization of water will create challenges to the operation of aquaculture. In addition, aquaculture planning is not prevalent in government climate change adaptation strategies; it is often not considered as much as capture fisheries, as there is such high employment in capture fisheries.

It was also pointed out that it is important to recognize that climate change impacts will result in changes, but they will not all be negative. The exact impacts with respect to fisheries have not been identified, and there will be winners and losers as a result of the changes. The impacts and issues addressed in the working group discussions reflected this, as it was recognized that an issue identified as a change could be either positive or negative.

1.3.2 Working Group Session 2: Identification of adaptation strategies for priority issues

The working groups remained the same as in the first working group session, divided into aquaculture and capture fisheries. One or two of the priority issues identified in the first working group session for ecological well-being, human well-being and ability to achieve were used for the discussion for possible adaptation strategies. Possible adaptation strategies were discussed, and a number of strategies were highlighted as effective for implementation on different scales. While issues such as expense, ease of government change, and availability of technical expertise were raised in the discussion of these options, the overall capacity for the implementation of these strategies was not a primary factor for choosing them, and the topic was reserved for the following session. In the capture fisheries working group, the most appropriate levels for implementation were identified as local, national and regional, while for aquaculture the levels were identified as farm, watershed and national. It was noted that regional was not an appropriate scale of management for aquaculture. However, the watershed is often transboundary and the relevant international body would participate in the implementation of any watershed management strategy. The results of the working group discussions for capture fisheries and aquaculture are highlighted in Tables 1.3 and 1.4.

Capture fisheries

The capture fisheries working group first dealt with the adaptation strategies which would most effectively address each of the priority issues, and then with the level at which they would most effectively be applied. The levels for the application of adaptation strategies for marine fisheries were defined as local, regional and national. The strategies raised and discussed were of a holistic nature, which not only addressed the issue on its own but involved assessments and strategies that explored the nature of the issue itself. The options explored (see Table 1.3) also addressed the need to gain a comprehensive understanding of the problems; develop a more robust knowledge of the issues; as well as to adopt a precautionary approach with respect to any management strategies.

Aquaculture

The working group initially defined that the most appropriate levels for adaptation strategies would be at the farm level, watershed level, and country level. The adaptation strategies discussed are detailed in Table 1.4. The discussion focused on how adaptation strategies could be applied at one level while being enhanced at further levels, e.g. better management practices (BMPs) applied at the farm level, enhanced at the watershed level and again at the national level.

Also, the importance of setting standards in one country while recognizing the impacts of standard setting by another country necessitated the application of actions/strategies at the regional level. A difficulty is that standards are often set by other countries, and so standard setting is seen as an action/strategy at the regional level.

Discussion

While the working group discussions were mainly focused on what can be seen in Tables 1.3 and 1.4, in each group the notion was raised that the ways in which these two sectors interact with other sectors must be considered. The working group focusing on aquaculture found that, with increasing competition for resources, in some countries poultry and fish often substitute for one another, so that when changes occur in one, this often has significant impacts on demand for the other.

The interaction and integration of aquaculture and capture fisheries was also addressed. In the Islamic Republic of Iran, tuna capture fisheries are often complemented by tuna aquaculture, so that aquaculture often enhances the incomes of tuna fisheries, instead of creating competition for jobs. In other countries, however, those most adept at aquaculture were farmers, not fishers, and so aquaculture cannot be viewed in all cases as a replacement for unemployment in the capture fisheries industry. In some cases, it is found that there is a greater role for women in aquaculture than fishermen, creating an interesting gender dynamic when analysing the two industries. While the role of women in the fisheries sector varies from country to country, and between the fisheries and aquaculture sector, they are generally a vulnerable group in the industry, and training to increase the adaptive capacity of all vulnerable groups must be considered.

The role of the government in most of the strategies adopted above appears to be quite strong, in both aquaculture and capture fisheries, and throughout the region. While it was discussed and is recognized that many of these strategies will be best implemented at the community level, there is a tendency within the region to involve the government in all levels of management implementation. Implementation solely at the community level will take time for both the communities and the governments to become comfortable. As long as governments play a role in the implementation of these strategies, the effectiveness will be limited by government strategies overall, as well as by competition between sectors for government resources. Moving towards comanagement and the private sector could also relieve some of the financial pressures on government, particularly in the technology-intensive aquaculture industry, where the private sector has a greater role. The capture fishery business is more traditional and less competitive, so it makes more sense that the government plays a larger role.

Table 1.3 Adaptation strategies for capture fisheries

Marine capture fisheries								
Identification of adaptation and management strategies for priority impacts								
Ecological well-being			Human well-being			Governance and ability to achieve		
Priority impact	Adaptation strategy	Scale for implementation	Priority impact	Adaptation strategy	Scale for implementation	Priority impact	Adaptation strategy	Scale for implementation
Recruitment and life cycle	Life cycle assessment	Regional	Livelihood changes AND revenue changes	Develop and enhance aquaculture practices	National	Government Instability	Capacity building inside the sector to increase the ability to cope with change	Local and national
Changes in habitat structure	Responsible stock enhancement	Local		Explore and implement livelihoods diversification	Local and national		Explore and implement incentive mechanisms for increasing efficiency and increasing livelihood diversification	Local and national
	Coastal habitat restoration	Local		Optimizing the harvest sector	National	Changes in community-level management (access rights)	Establish comanagement systems within legal and policy framework	Local and national
				Adaptive post-harvest and marketing strategies	National and regional			

Table 1.4 Adaptation strategies for aquaculture

Aquaculture								
Identification of adaptation and management strategies for priority impacts								
Ecological well-being			Human well-being			Governance and ability to achieve		
Priority impact	Adaptation strategy	Scale for implementation	Priority impact	Adaptation strategy	Scale for implementation	Priority impact	Adaptation strategy	Scale for implementation
Water quality change	Monitoring system and early warning system	Farm, watershed and national level	Food security	Integrated agriculture aquaculture and development of integrated multitrophic aquaculture (IMTA)	Farm	Climate-change-proofing policies, planning and implementation for aquaculture	Government investment in research to improve aquaculture adaptation and/or facilitate research and information to climate-change-proof aquaculture	National
	Set up a biosecurity framework	Watershed		Raise awareness about integrated aquaculture to improve food security including IMTA	Watershed			
Extreme climate events	Preparedness of the farmers to improve farming systems, face extreme events.	Watershed	Research and experimentation with new species	National	Farmers organized are better prepared. Enhance farmers associations		Watershed	
		Watershed	Incentives for diversification, new markets and new species promotion	National				
	Set up a biosecurity framework	Watershed	Better management practices, including training and incentives for training	Farm, watershed, country	Governments should facilitate the production of local vulnerability maps and risk maps		National	
	Use local knowledge and local logistics to disseminate information	Watershed	Standards setting	National				
	Ensure the provision and access of early warnings by farmers.	National	Food Safety	Food safety controls created by public-private cooperation, governments facilitate transparency	Watershed and national		Government institutions could be improved to enhance cross-sectoral cooperation and coordination	National
	Facilitate education and readiness	National		Toxics monitoring, classifying areas for different kinds of farming, i.e. red tides and other pollutants	Watershed (but facilitated by national governments)		Make efforts to develop a country aquaculture strategy and plan considering climate change	National
		Sharing information in the region	Watershed (but facilitated by national governments)					

1.3.3 Working Group Session 3: Understanding regional and subregional capacity for adaptation strategies

The final working group session addressed the capacity of the subregions to implement effectively the adaptation strategies from the previous working group session. The working groups were divided into subregions, the Mediterranean and Atlantic forming one working group, the RESGA and RECOFI forming the second working group. The working groups voted on adaptation strategies and then assessed the subregional capacity for implementation of these strategies using the following indicators:

- institutional capacity
- financial capacity
- human capacity
- willingness

The adaptation strategy was assessed based on each of the above criteria, and then an analysis was undertaken in the plenary discussion to determine where capacity strengths and weaknesses exist in the subregions.

Mediterranean and Atlantic subregions

The assessments in this working group were based on a percentage system. Each participant voted on one option strategy for each component of the EA. Then, the capacity for each option was ranked using: 1 = non-existent, 2 = moderate 3 = good. Following this, the overall capacity for each indicator was assessed using a grading system:

80–100 percent = very good

60–79 percent = good

40–59 percent = average

0–39 percent = poor

The results of this working group session for the Mediterranean and Atlantic subregions are detailed in Tables 1.5 and 1.6, respectively.

Table 1.5 The capacity for implementation of adaptation strategies in the Mediterranean

Mediterranean						
Indicators	Capacity for strategy implementation					
	Ecological well-being		Human well-being		Governance & ability to achieve	
	Life-cycle assessment	Monitoring and early warning	Optimizing the harvest sector	Integrating aquaculture and agriculture	Capacity building inside the sector	Planning aquaculture
Institutional	Good	Good	Good	Good	Very good	Good
Financial	Good	Average	Good	Average	Good	Good
Human	Average	Average	Average	Average	Good	Good
Willingness	Good	Good	Good	Good	Very good	Very good

Table 1.6 The capacity for implementation of adaptation strategies in the Atlantic

Atlantic						
Indicators	Capacity for strategy implementation					
	Ecological well-being		Human well-being		Governance & ability to achieve	
	Life-cycle assessment	Monitoring and early warning	Optimizing the harvest sector	Integrating aquaculture and agriculture	Capacity building inside the sector	Planning aquaculture
Institutional	Very good	Average	Good	Good	Good	Good
Financial	Average	Poor	Average	Poor	Good	Poor
Human	Good	Average	Average	Poor	Average	Average
Willingness	Very good	Average	Good	Good	Good	Good

The RECOFI and RESGA

The working group for the RECOFI and RESGA subregions chose adaptation strategies that could be applied to both aquaculture and fisheries throughout the two subregions. The three strategies selected, as well as the capacity for the implementation of these strategies, is detailed in Table 1.7. The capacity assessment criteria chosen were: not present, being established and established. Where there was variance between countries, a range was stated.

Table 1.7 The capacity for implementation of adaptation strategies in the RECOFI and RESGA

RESGA and RECOFI			
Indicators	Capacity for strategy implementation		
	Ecological well-being	Human well-being	Governance and ability to achieve
	Ecosystem monitoring system with early warning system	Creating and enhancing adaptive fisheries and aquaculture practices	Country fisheries and aquaculture strategies and supporting plans of action to consider climate change
Institutional	Established	Being established	Being Established
Financial	Varies between not present and established	Not present	Being Established
Human	Varies between being established and established	Varies among countries from not present to being established	Being Established
Willingness	Being established	Being established	Varies between being established and established

Discussion

Aquaculture varies among countries in the same region, making it difficult to cast an overall vote on issues, and initiatives and planning for the integration of aquaculture and other sectors were limited to specific countries and non-existent in others.

At the regional level, there seems to be a willingness to implement capacity building in the fisheries sector, while there is a lack of assessment of the effectiveness of the capacity building actions already implemented in the area.

Institutional capacity in all subregions is quite good, encompassing research, administration, policy and legal frameworks. However, operational capacity (finance and human) is moderate to low in all subregions, and this is something that will pose an important challenge that must be considered when designing adaptation strategies.

1.3.4 Conclusions and recommendations

Climate change impacts bring increasing pressure on the fisheries and aquaculture sectors in much of the Region and are understood to be an additional pressure on fisheries that are not adequately managed. While reducing the vulnerability of capture fisheries and aquaculture is an objective of some strategies in the region, it has yet to be effectively implemented. Regarding capture fisheries, the Region as a whole, as well as the subregions specifically, is not prepared to cope adequately with the additional pressures that climate change will create. It is clear that the fisheries and aquaculture industries must adopt adaptation strategies on a variety of levels in order to prepare adequately for the impacts of climate change. While it is generally acknowledged throughout the Region that preparation for climate change is necessary, the required capacity to implement the appropriate strategies effectively still needs to be developed. Information and experience sharing between countries and subregions could reduce the negative impacts of this gap in capacity in certain countries.

A common understanding of the EAF and EAA concepts is developing, and an effort is now being made to incorporate the principles of EAF and EAA in policies at the national level in certain countries. However, there is still much to do to make these principles operational in the practical management of fisheries. Lack of institutional, financial, human and willingness capacity for implementation at the local, national and regional (including watershed) levels must be recognized and addressed in order for the successful implementation of the EAF and EAA in the subregions.

There is a general lack of reliable data in the capture fisheries industry. This issue needs to be addressed in order for the implementation of effective management strategies in general, as well as climate-change adaptation strategies. Developing strategies to adapt to climate change will not only minimize the effects experienced from climate change impacts, but can also reduce vulnerability to other changes and increase the resilience of the industry.