PART 2

SELECTED ISSUES IN FISHERIES AND AQUACULTURE

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Mainstreaming gender in fisheries and aquaculture: from recognition to reality

THE ISSUE

> "Gender mainstreaming is not only a question of social justice but is necessary for ensuring equitable and sustainable human development. The long-term outcome of gender mainstreaming will be the achievement of greater and more sustainable human development for all."[1]

In 1997, the United Nations Economic and Social Council (ECOSOC) adopted gender mainstreaming as the methodology by which the entire UN system would work towards the advancement of women and gender equality goals, noting that: "Mainstreaming a gender perspective is the process of assessing the implications for women and men of any planned action, including legislation, policies or programmes, in all areas and at all levels. It is a strategy for making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes in all political, economic and societal spheres so that women and men benefit equally and inequality is not perpetuated. The ultimate goal of mainstreaming is to achieve gender equality".[2]

In 2000, all 193 UN Member States and more than 23 international organizations agreed to the Millennium Development Goals (MDGs), and the issue of promoting gender equality and empowering women (MDG 3) was again highlighted on the international agenda. The objective was one of ensuring that, in whatever sector they may be working, men and women should have equal rights to participate in the development process, and their interests and needs should be protected.

Despite this, women tend to be marginalized in a variety of ways – and this is very much true for women in the fisheries and aquaculture sector. Thus, more than 30 years after the 1979 Convention on the Elimination of All Forms of Discrimination Against Women, some 15 years after the ECOSOC decision and more than a decade after the Millennium Declaration, and with only 3 years to go before the goal of achieving the MDGs by 2015, the issue at hand is how to ensure genuine and active mainstreaming of gender and the many facets of gender considerations in the fisheries and aquaculture sector.

Indeed, until recently, gender analysis in fishing communities focused mainly on the different occupational roles of men and women, i.e. that men usually do the actual fishing and women are to a large extent involved in post-harvest and marketing activities. While the role of women in the management and utilization of natural resources is generally acknowledged, their role does not carry the same weight as that of men. Given that production goals have tended to be the focus of research and policy, the predominantly male catching sector has remained the centre of attention.[3]

However, with the shift to a multidimensional and more holistic definition of poverty and the increased focus on reducing vulnerability, gender has become more central to fisheries policy and development practice. Fisheries resource management

is increasingly being linked to all levels of the so-called "deck to dish" fish value chain in which both men and women have important roles to play. With almost 45 million people worldwide directly engaged, full time or part time, in the fishery primary sector in 2008[4] and an additional estimated 135 million people employed in the secondary sector, including post-harvest activities, this is no simple task. Many involved in these sectors are recognizing that it is vital to look beyond the simplified picture of men as fishers and women as processors and to examine the more complex picture of multifaceted relationships between men and women as boat owners, processors, sellers, family members, community members and co-workers (Box 7).

Information provided to FAO from 86 countries indicates that, in 2008, 5.4 million women worked as fishers and fish farmers in the primary sector and represented 12 percent of the total. In two major producing countries, China and India, women represented 21 percent and 24 percent, respectively, of all fishers and fish farmers. Women make up at least 50 percent of the workforce in inland fisheries, while as much as 60 percent of seafood is marketed by women in Asia and West Africa. Moreover, although comprehensive data are not available on a sex-disaggregated basis, case studies suggest that women may comprise up to 30 percent of all those employed in fisheries, including primary and secondary activities.

Revealing hidden contributions

While reliable estimates are not available, a recent expert panel review paper[5] reported that women are probably more involved in aquaculture (Box 8) than in fisheries[6] but that studies of women and gender issues are more numerous for the fisheries sector than for the aquaculture sector. As the review paper points out, this relative lack of attention to gender in aquaculture may reflect the more recent history of aquaculture

Box 7

A gender baseline in the fisheries and aquaculture sector

Men and women engage in distinct and often complementary activities that are strongly influenced by the social, cultural and economic contexts in which they live. Male–female relations in the fisheries sector vary greatly and are based on economic status, power relations and access to resources.

In most regions, women have rarely participated in commercial offshore and long-distance capture fishing. Ocean-going boats for offshore deep-sea fishing have male crews – not only because of the vigorous work involved, but also because of women's domestic responsibilities and/or social norms.

More commonly, in coastal artisanal fishing communities, women manage the smaller boats and canoes that go out fishing. Women are also involved in gathering shells, sea cucumbers and aquatic plants in the intertidal zone. They also contribute as entrepreneurs and provide labour before, during and after the catch in both artisanal and commercial fisheries. In addition, they are often responsible for skilled and time-consuming onshore tasks, such as net making and mending, processing and marketing catches, and providing auxiliary services to the boats.

However, gender issues in the fisheries and aquaculture sector have seldom been examined, and the important role women that play has often been overlooked and, thus, not taken into account in decision-making processes and outcomes, thereby hindering development.

and academic interest in the complex sociology and anthropology of fishing communities and practices.

However, it is known that there are vital differences in the power positions of men and women (Box 9); as a result, women generally have less control over the value chain, their activities are less profitable, and they have access to fish of poorer quality. Women

Box 8

The contribution of women in the aquaculture sector

FAO's National Aquaculture Sector Overview[1] provides insights into the roles and contributions of women in the aquaculture sector in countries around the globe:

- In Bangladesh, women's non-governmental organizations and other entrepreneurs have encouraged women to participate in aquaculture activities.
- In Belize, most workers involved in processing are women from rural communities where unemployment levels are high and poverty is greatest.
- In Cuba, female workers constitute 27 percent of the aquaculture workforce (19 percent are intermediate and higher education technicians; 11 percent have attended higher education institutions).
- In Estonia, the gender ratio of the aquaculture workforce is 1:1.
- In Israel, the workforce is a skilled one because of the highly technical nature of aquaculture in the country. In a sector where women make up about 95 percent of the workforce, most workers have a high school diploma while a high percentage have a degree (Bachelor of Science or Master of Science).
- In Jamaica, about 8–11 percent of fish farmers are women who own and operate fish farms; and in processing plants, women dominate the workforce.
- In Malaysia, women account for about 10 percent of the total aquaculture workforce, and they are mostly involved in freshwater aquaculture and hatchery operations for marine fish, shrimp and freshwater fish.
- In Panama, 80 percent of the workforce in processing plants are women, but in the production sector only 7 percent of workers are women.
- In Sri Lanka, women constitute 5 percent of the workforce in shrimp aquaculture and 30 percent of those engaged in the production and breeding of ornamental fish.

Information such as this provides a starting point for learning about the differences between men and women in these situations and about whether there are similar opportunities, wages and benefits – or whether there are policy, governance and operational gaps that need to be addressed in order to really mainstream gender in the sector.

[1] FAO. 2012. National Aquaculture Sector Overview. NASO Fact Sheets. In: *FAO Fisheries and Aquaculture Department* [online]. Rome. [Cited 20 March 2012]. www.fao.org/fishery/naso/search/en

Box 9

Differences in power lead to different opportunities

Artisanal fisherwomen's relatively insecure access to fish resources and, hence, to fish leads to different opportunities for women and men. When fish business activities are being upscaled in response to increasing globalization, local women risk being forced out of the business and, therefore, not benefiting from development and market opportunities in the sector in which they were previously extensively involved. Examples are:

- In India in the early 1980s, shrimp marketing was initially largely in the hands of women. However, when shrimp became a higher-priced commodity, male traders arrived on bicycles and later in motorized transport, eventually forcing the fisherwomen out of this trade (Bay of Bengal Programme).
- In Cotonou, Benin, urban-based male and female traders entered the fish trade, forcing women from the fishing villages out of business and making their access to fish more difficult (Programme for the Integrated Development of Artisanal Fisheries in West Africa).
- In Senegal, as fishermen change gear and the focus of their effort in response to changing profit opportunities in their fishery (e.g. shifting from harvesting pelagic fish to cephalopods) and switch from selling into local to export markets, the local post-harvest sector can suffer (Network on Fishery Policies in West Africa).

tend to be excluded from the most profitable markets and enterprises, and from highly paid posts in fish-processing factories even though they make up the majority of workers in the post-harvest sector. Compared with men, they are often greater losers from increasing market globalization, and they are more vulnerable to poor services and catch declines.

The most significant role played by women in both artisanal and industrial fisheries is at the processing and marketing stages. Active in all regions of the world, in some countries, women have become significant entrepreneurs in fish processing. In fact, most fish processing is performed by women, either in their own household-level industries or as wage labourers in the large-scale processing industry. For example, in West Africa, women play a major role – they usually own capital and are directly and vigorously involved in the coordination of the fisheries chain, from production to the sale of fish.

Some of the factors that weaken women's capabilities in terms of participation in decision-making are:

- lower literacy and education levels;
- time burdens and constraints;
- mobility burdens and constraints;
- participation in less-formal organizations that are, as a result, weaker organizations;
- fewer or reduced organizational skills in the sense that women frequently associate in less-formal organizations and, where part of formal organizations, frequently do not hold leadership roles such as president and secretary because of poor literacy skills.

Very importantly, the absence of women from most post-harvest statistics means that it is extremely difficult to quantify the number of women and the extent of the value addition and contribution their work makes to economies. Nonetheless, inequalities are beginning to be quantified and publicized.

POSSIBLE SOLUTIONS

Women's participation as equal and productive partners in the fisheries and aquaculture sector has significant impacts on households' nutrition and living standards. If fisheries and aquaculture projects generate the data for and, potentially, include analyses of, all gender aspects (livelihood factors, relationships, actions and results), they can contribute to gender equality and promote women's participation as active agents for change in the sector (Box 10).

Data solutions

Comprehensive and accurate sex-disaggregated statistics are lacking, and this gap must be filled as one of the first steps in gender mainstreaming at the policy level. Quantitative and qualitative gender-sensitive indicators can be formulated with fishing communities to see how well policies and associated development projects satisfy the practical and strategic needs of men and women, and to help reduce existing gender gaps.

At the more macro level, statistical censuses should focus more attention on areas in which women are relatively more active. They should collect sex-disaggregated data on ownership of, access to and control over productive resources such as land, water, equipment, inputs, information and credit.

Macro-level policy solutions

As in other sectors, women's empowerment in fisheries requires examination of the means of production, gender relationships, and how to create equalities. New institutional arrangements are being created in response to climate change, resource depletion, aquaculture development and global trade. All these factors are increasingly affecting the sector, and it is vital that gender considerations are built into the new

Box 10

Quantifying inequalities

A study conducted for the United States Agency for International Development on the Bangladesh shrimp value chain[1] revealed differences in earnings between women and men (see table), a finding that created a starting point for addressing gender-related discrepancies.

Relative earnings of women compared with those of male counterparts

Activity	Percentage
Catching, sorting fry	64
Repairing ponds, undertaking casual agricultural labour	82
Processing plants – packing section	72
Processing plants – cooking/breading section	60

[1] Development & Training Services, Inc. 2006. *A pro-poor analysis of the shrimp sector in Bangladesh* [online]. USAID. [Cited 21 May 2012]. www.usaid.gov/our_work/cross-cutting_programs/wid/pubs/Bangladesh_Shrimp_Value_Chain_Feb_2006.pdf

arrangements. Increasingly, practical manuals for gender mainstreaming and gender analysis are being produced to facilitate just such changes.[7]

Responsible governance of tenure and tenure security, especially of access to natural resources, are issues where mainstreaming gender can have a marked effect. Providing policies that create the opportunities for ensuring equitable resource access rights, access to markets, benefits from aquaculture and codes of conduct for the industry – especially for the most marginalized and poorest categories of men and women – can empower people to become more equal stakeholders. However, where governance and policies are developed without a strategic assessment of the relative roles of the men and women involved, the effect can be to disempower stakeholders.

Resource control and access

In addition to the responsible governance of tenure, the broader issue of women's access to and control over resources is an important gender consideration. For women to have a real impact on their economic situation and their position in society, it is essential that they have access to and control over aquatic resources as well as appropriate information that enables them to use such resources wisely.[8]

Development arena solutions

Gendered value-chain approaches can be used to recognize and value women's roles and contributions to agriculture and fisheries. To mainstream gender equality in development cooperation programmes and related activities, a number of steps are essential:[9]

- Require that programmes and related activities generate or obtain sex-disaggregated statistics (not only at the level of project and/or programme beneficiary, but also at both middle and macro levels of policy and governance) and qualitative information on the situation of women and men for the population in question. This information is required.
- Conduct a gender analysis with regard to: the gendered division of labour; access to and control over material and non-material resources; the legal basis for gender equality/inequality; political commitments with respect to gender equality; and the culture, attitudes and stereotypes that affect all preceding issues. Gender analyses should be conducted at the micro, meso and macro levels.
- Conduct a gender analysis of a programme or project concept to reveal whether gender equality objectives are articulated in the initial idea, whether or not the planned activity will contribute to or challenge existing inequalities, and whether there are any gender issues that have not been addressed.
- During the identification and formulation phases, ensure that the gender analysis contributes to the identification of entry points for actions that will be needed in order to meet gender equality objectives.
- Strengthen the participatory and organizational capacity of stakeholders at various levels so that they are better able to translate gender concerns into actions. This includes strengthening female umbrella organizations that can participate in debates and in project and programme processes.
- Put in place a gender-sensitive monitoring and evaluation system from the design phase onwards, including the establishment of indicators to measure the extent to which gender equality objectives are met and changes in gender relations are achieved.

On the ground – closing the gap in social capital

Building women's social capital can be an effective way to improve information exchange and resource distribution, to pool risks and to ensure that women's voices are heard in decision-making at all levels. This includes strengthening women's organizational abilities and roles and developing the capacity of women to take on leadership positions and engage with decision-makers and other stakeholders.

Functioning as production cooperatives, savings associations and marketing groups, women's groups can promote production and help women maintain control over the additional income they earn, as has been demonstrated by a project based around polyculture fish production in Bangladesh. As the project proved successful in providing additional incomes, the position of women within the household and community was also strengthened.[10] Indeed, in communities with a high level of gender segregation, single-sex groups may lead to more desirable outcomes for women.[11]

However, excluding men can sometimes generate unnecessary obstacles. A project to introducing the new livelihood strategy of mud-crab production to supply hotels on Unguja Island, United Republic of Tanzania, excluded men. The resultant anger among the men added transaction and input costs as women had to rely on a small number of male fishers for seedstock and feedstuffs.[12]

The clear message here is that interventions within the local sociocultural dynamics should base their interventions on the specific context – including the gender segregation within a community – and the underlying problem.

RECENT ACTIONS

The issues of women, gender and fisheries have been highlighted in a series of international and now global symposiums and other related initiatives:[13]

- The Global Conference on Aquaculture 2010 delivered the Phuket Consensus and responded to the recommendations of Expert Panel VI.3 (Sustainable Aquaculture by Developing Human Capacity and Enhancing Opportunities for Women Development) by including a recommended action to: "Support gender sensitive policies and implement programmes in line with globally accepted principles of gender equality and women's empowerment."
- The 2011 Special Workshop on Future Directions for Gender in Aquaculture and Fisheries Action, Research and Development (Shanghai, China)[14] prepared a working draft of a working vision statement for mainstreaming gender in the aquaculture and fisheries sectors: "To promote and achieve gender equity in the aquaculture and fisheries sector in support of responsible and sustainable use of resources and services for food and nutrition security, quality of life of all stakeholders, primarily women, children, vulnerable and marginalized groups/communities."

Other ongoing initiatives that have contributed to increasing attention on gender issues in fisheries and aquaculture include:

- the triennial symposia on women and gender in fisheries and aquaculture organized by the Asian Fisheries Society;
- the Women in Fisheries publications of the Secretariat of the Pacific Community, and *Yemaya* (published by the International Collective in Support of Fishworkers);
- the Asia–Europe Meeting Aquaculture Platform (AqASEM09) project work on Empowering Vulnerable Stakeholder Groups.

OUTLOOK

No single blueprint exists for closing the gender gap as yet, but some basic principles are universal,[15] and its seems plausible that governments, the international community and civil society will work together to:

- eliminate discrimination under the law, improving women's endowments, opportunities and agency to help shape more positive outcomes for the next generation;
- promote equal access to resources and opportunities, reducing barriers to more efficient allocation of women's skills and talents and helping to generate large (and growing) productivity gains;
- ensure that policies and programmes are gender-aware, increasing women's individual and collective agency to produce better outcomes, institutions and policy choices;
- make women's voices heard as equal partners for sustainable development.[16]

In addition to helping to achieve the MDG of promoting gender equality and empowering women, mainstreaming gender is an essential component of alleviating poverty, achieving greater food and nutrition security, and enabling sustainable development of fisheries and aquaculture resources.

Gender considerations should be firmly placed on all fisheries and aquaculture policy agendas at all geographical and institutional scales. Attention to gender is needed in order to help improve women's productivity and enhance human justice. Increasing awareness on gender and being gender-sensitive are no longer sufficient. A coalition of gender champions, informed researchers, expert networks and policy advocates will be necessary.[17]

An opportunity to alleviate poverty and ensure greater food and nutrition security

Women who are offered and provided with the best circumstances to enhance their socio-economic empowerment will also be able to contribute meaningfully to food security, poverty alleviation and improved well-being for themselves, their families and their communities. In short, they will help to create a world in which responsible and sustainable use of fisheries and aquaculture resources can make an appreciable contribution to human well-being, food security and poverty alleviation.

An opportunity for economic empowerment

Economic empowerment should be the end goal of a road map on gender in fisheries and aquaculture. Economic empowerment is not narrowly focused on the financial component but rather on having the ability to recognize and exploit opportunities to make wealth and to make the right decisions, which means having the capacity for analytical thinking – and this boils down to having a good education (formal or informal) and appropriate human capacity development.

An opportunity to contribute fully

By mainstreaming gender in the fisheries and aquaculture sector, women will be given a chance to recognize and appropriately exploit opportunities to generate wealth and to make the right decisions in terms of more responsible fisheries and aquaculture practices and sustainable development.

Improved preparedness for and effective response to disasters in fisheries and aquaculture

THE ISSUE

Fishers, fish farmers and their communities around the world tend to be particularly vulnerable to disasters. This is because of their location, the characteristics of their livelihood activities, and their overall high levels of exposure to natural hazards, livelihood shocks and climate change impacts. Exposure and vulnerability to these hazards is increasing. For example, in the past century, there has been an increasing trend in the number of natural disasters reported around the world (Figure 36).

The social, economic and environmental impact of these disasters is significant, with disproportionate effects in developing countries and on vulnerable groups. Between 2000 and 2004, of the 262 million people affected annually by disasters related to weather and climate, more than 98 percent lived in developing countries and the vast majority were dependent mainly on agriculture and fisheries for their livelihoods.[18] Loss of life from such events is more prevalent in developing countries – from 1970 to 2008, more than 95 percent of deaths from natural disasters were in developing countries.[19] In 2010 alone, a total of 385 natural disasters killed more than 297 000 people worldwide, affected more than 217 million others and caused almost US$124 billion of economic damages.[20] It is acknowledged that the poor will be most affected by such hazards in the future and that this is likely to undermine progress

toward poverty reduction.[21] While total economic damage from disasters tends to be higher in developed countries, as a percentage of gross domestic product it is higher in developing countries.[22]

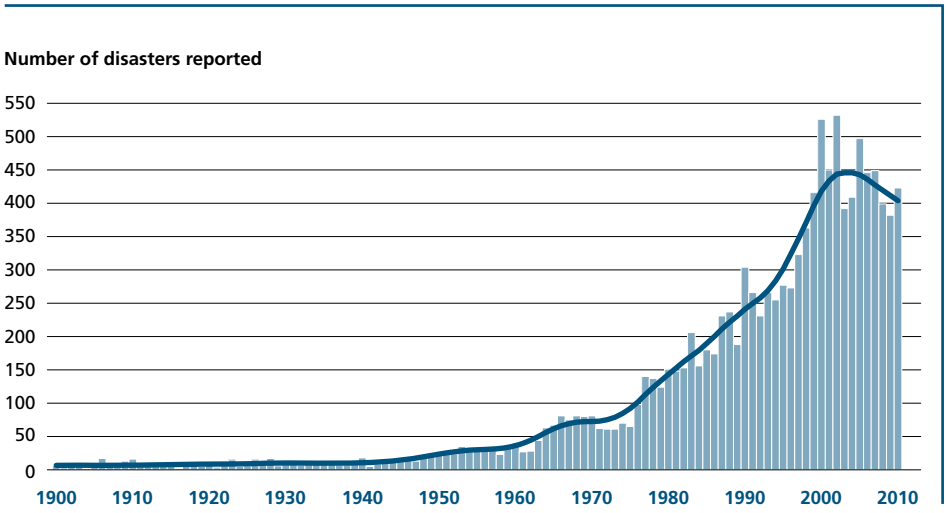
The types of disasters that affect the fisheries and aquaculture sector include natural disasters such as storms, cyclones/hurricanes with associated flooding and tidal surges, tsunamis, earthquakes, droughts, floods and landslides. Disasters of human origin affecting the sector have included oil and chemical spills and nuclear/radiological material. Food and nutrition security, post-conflict and protracted crises, HIV/AIDS and sector-specific hazards (e.g. transboundary aquatic animal diseases and pest outbreaks) can also have significant impacts on aquaculture production and fisheries. In addition to the tragic loss of life, the effects of disasters on the sector can include the loss of livelihood assets such as boats, gear, cages, aquaculture ponds and broodstock, post-harvest and processing facilities, and landing sites. In the longer term, the impact of the effects of disasters can be considerably mitigated by the effectiveness of response activities. However, damage caused by disasters can have social and economic impacts throughout and well beyond the sector (such as in terms of reduced employment and food availability). Other longer-term disasters such as fish disease outbreaks can build up over time and significantly affect production.

The vulnerability of countries and communities to these hazards is determined, on the one hand, by their exposure to such hazards and, on the other, by their ability to withstand (sensitivity), respond to and recover from (adaptive capacity) the effects of such hazards. Thus, susceptibility is directly affected by underlying issues such as food and nutrition insecurity, weak institutions, conflict and poor access to markets. However, the way each of these issues affects people varies considerably. Men and women, the old and the young, the rich and the poor, and small-scale and large-scale undertakings are all affected differently and have different ways of responding to hazards that affect them. Different people can also have quite distinctly different needs in the face of an emergency, face different threats and have different skills and aspirations.[23]

For coastal fishers, fish farmers and their communities, the relationship between them and the ecosystems that they depend on is complex.[24] This complexity is changing as the interface between fishers and fish farmers and the ecosystem is being affected by both slow- and rapid-onset hazards. The exposed nature of the livelihoods of fishers

Figure 36

Natural disasters reported worldwide, 1900–2010



Source: EM-DAT. 2012. *EM-DAT: The OFDA/CRED International Disaster Database* [online]. Université Catholique de Louvain, Brussels. [Cited 22 March 2012]. www.emdat.be

and fish farmers, and the location of their communities, means that hazards often become disasters.

The extent of the impact of such disasters is also affected by people's social and economic conditions, which often include poverty and marginalization, especially in developing countries. Given the important role of the fisheries and aquaculture sector in food and nutrition security at both the local and national levels, disasters that affect these communities will also have multiplier effects on the wider economy. Fishers, fish farmers and their communities have been particularly affected by recent major events such as the Asian tsunami of 2004, Cyclone Nargis (which affected Myanmar in 2008), the recent floods in Bangladesh, Pakistan and Viet Nam, and the 2011 tsunami in Japan.

The effect of these hazards on fishing communities is increasing for a number of reasons. Extreme weather events are becoming more frequent, often associated with increasing climate variability and change. The impacts of disasters on coastal communities are particularly pronounced in the case of subsea events resulting in tsunamis (geological), storm surges and coastal flooding (hydrological), and coastal and lakeshore storms (meteorological). Droughts and floods can also affect river flows, wetland areas, and lacustrine and riparian communities. More indirectly, droughts and other catastrophic events can cause mass migration of people into areas normally occupied by fishing and fish-farming communities, so increasing competition for resources such as water.

Fishers, fish farmers and their communities are also often exposed to more prolonged hazards such as the spread of fish disease, the increase in invasive undesirable alien species, pollution from land and aquatic sources, and aquatic ecosystem degradation from farming, mining, industry and urbanization. Moreover, fishers, fish farmers and their communities often live in locations where tenure over land and other resources is contested, leading to disputes and more complex emergencies.

The land–water interface is being particularly affected by inward migration and the unsustainable use of resources. The result can be a depletion of the ecosystem services that these resources provide, particularly protection from coastal hazards such as storms and cyclones, and a reduction in support for productive livelihoods. Deforestation is leading to increased sedimentation and land erosion in coastal, lakeshore and delta regions, and this can adversely affect marine habitats (especially reefs). In addition, the effects of population increases in fishing and fish-farming communities are compounded by the lack of alternative livelihood options and weak market linkages.

The susceptibility of fishers, fish farmers and their communities to rapid-onset disasters is also being affected by climate change.[25] Seasonal weather patterns are likely to change, with some areas experiencing greater periods of drought and others more floods. Extreme weather events, such as storms, are likely to increase in frequency and affect fishing operations, and coastal and wetland flooding is likely to become more frequent. Increased precipitation in some areas will lead to the erosion of riparian lands and to greater sedimentation in coastal areas, affecting seagrass and reef production. Sea-level rise is likely to increase coastal flooding, and the incursion of saltwater into coastal areas will affect agricultural production and fish farming. Species distributions are also being changed, and increased temperatures are likely to affect coral reefs adversely, with higher incidences of coral bleaching occurring. Temperature changes will also affect fish physiology, with implications for both capture fisheries and fish farming. Increased ambient air temperatures could have very significant effects on the types of fish that can be cultured.

Changes in weather patterns will affect traditional fish processing methods, especially where fish is sun-dried. In some locations, this may be of benefit for processors. However, in other locations, poor weather in glut fish landing seasons will affect drying rates, with the potential for substantial losses. There are also likely to be changes in terms of road access to markets where unusual flooding or heavy rains occur.

Badly managed fisheries and aquaculture farms may cause increased stress in fish, reduce water quality, and make fisheries and aquaculture more exposed to climate change threats such as changes in water temperature and salinity.

Changing weather patterns will also affect non-fisheries livelihood strategies and will increase pressure on people to join a fishery where other opportunities have decreased. Efforts to redirect fishing to alternative livelihoods are also being affected by climate change effects on livelihood options and opportunities in the wider economy.

POSSIBLE SOLUTIONS

Reducing the effects of disasters on the fisheries and aquaculture sectors can be achieved through measures for prevention, mitigation,[26] and preparedness (disaster risk reduction [DRR]; Box 11). In the fisheries and aquaculture sector, this includes preparedness to respond rapidly and effectively if disasters occur, and early warning to provide information before potentially disastrous events occur. Managing the effects of hazards and disasters (disaster risk management [DRM]) goes beyond DRR to incorporate emergency response, recovery and rehabilitation within a management framework. Thus, as shown in Figure 37, DRM involves three distinct phases: (i) reducing vulnerability; (ii) responding to emergencies when they arise; and (iii) rehabilitating communities after the emergency has passed.

Box 11

Disaster management and climate change adaptation: key definitions

Disaster risk reduction (DRR) is the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.[1]

Disaster risk management (DRM) goes beyond preparedness, prevention and mitigation, which form the core of DRR, to incorporate emergency response, recovery and rehabilitation within a management framework.[2]

Climate change adaptation (CCA) refers to adjustments in ecological, social or economic systems in response to actual or expected climate stimuli and their effects or impacts. This term refers to changes in processes, practices and structures to moderate or offset potential damages or to take advantage of opportunities associated with changes in climate. It involves adjustments to reduce the vulnerability of communities, regions and activities to climate change and variability. Adaptation is important in the climate change issue in two ways: one relating to the assessment of impacts and vulnerabilities; and the other to the development and evaluation of response options.[3]

[1] United Nations International Strategy for Disaster Reduction. 2009. Terminology. In: *UNISDR* [online]. [Cited 20 April 2012].

[2] Baas, S., Ramasamy, S., Dey DePryck, J. and Battista, F. 2008. *Disaster risk management systems analysis: a guide book* [online]. Rome, FAO. [Cited 19 March 2012]. ftp://ftp.fao.org/docrep/fao/010/ai504e/ai504e00.pdf

[3] Intergovernmental Panel on Climate Change. 2001. *Climate Change 2001: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK, Cambridge University Press. 1042 pp.

Key actions in the DRM cycle may include:

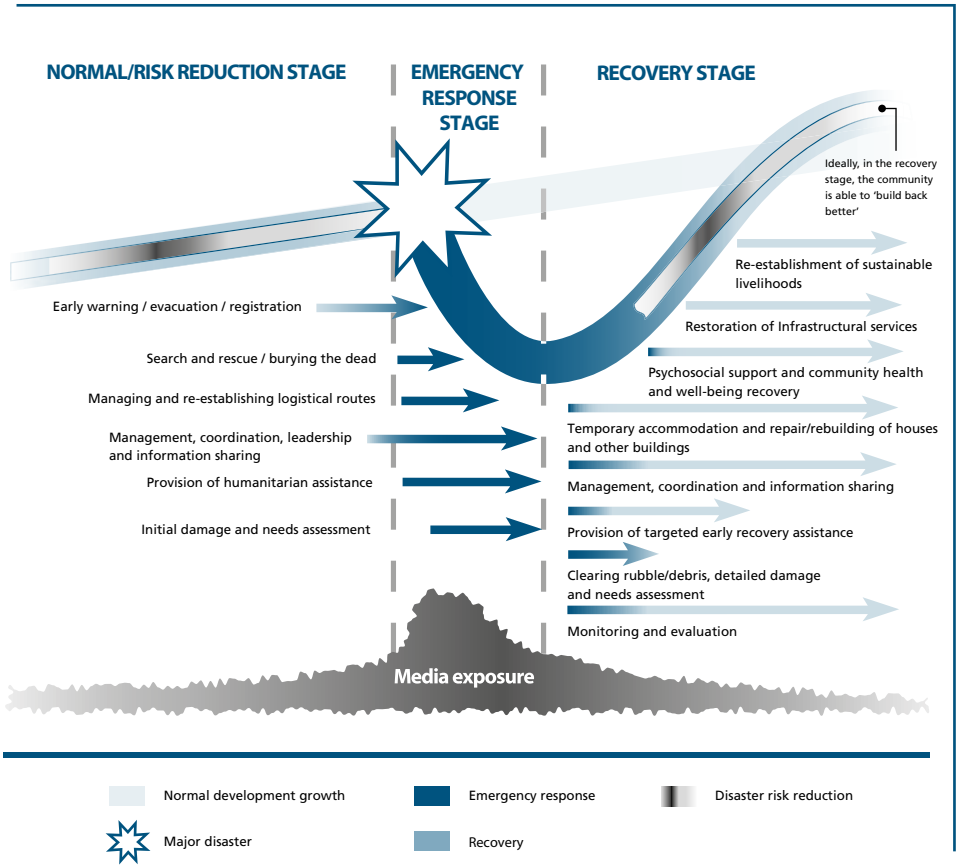
- assessment of damage and need (with respect to fisheries and aquaculture);
- rehabilitation of livelihoods (to reduce dependence on food aid);
- longer-term development and planning and preparedness;
- relief or emergency response to address immediate humanitarian needs and to protect livelihoods following a disaster;
- rehabilitation to initialize the restoration and rebuilding of livelihoods;
- reconstruction for replacing destroyed infrastructure;
- sustainable recovery for longer-term re-establishment and enhancement of livelihoods and livelihood support structures.

During emergency response, advocacy is required in order to ensure that recovery efforts comply with international instruments (including the Code of Conduct for Responsible Fisheries [the Code] and the MDGs) and are guided by international best practice, national policies and agreed recovery plans. This can include the promotion of:

- sustainable rehabilitation of fishing and fish farming;
- fish preservation and processing practices compatible with the state of fishery resources;
- rehabilitation and conservation of the environment and fisheries resources;
- strengthened governance and community-based planning;
- strengthening and diversification of sustainable livelihoods of traditional fishing and fish-farming communities.

Figure 37

The disaster risk management cycle[1]



[1] This mainly applies to a relatively quick-onset disaster (e.g. cyclone, flood, earthquake, tsunami, bushfire), rather than a slow-onset one such as famine (due to drought/war).

Source: Adapted from: Piper, C./TorqAid. 2011. *DRMC version XVI* [online]. [Cited 22 March 2012]. www.torqaid.com/images/stories/latestDRMC.pdf

Resilience to the effects of disasters can be achieved by working with communities and multilevel stakeholders to reduce their sensitivity to disasters (through preventive actions or by reducing levels of dependence) and/or by strengthening coping and adaptive strategies that respond to those hazards. In so doing, the differences between different stakeholder groups within a given community need to be carefully considered.

As the effects of climate change will be to alter the magnitude and frequency of extreme events, it is important to recognize that existing coping and response mechanisms to disasters – based on past vulnerabilities – may no longer be appropriate for what is to come. Indeed, in many countries, existing mechanisms are already insufficient for the current level of vulnerability.[27]

Climate change and more rapid-onset hazards such as cyclones, floods and earthquakes are related in a number of ways:

- They both directly affect the livelihoods of fishers and fish farmers and invariably reduce the quality of those livelihoods.
- They interact to compound the adverse effects of both – most noticeable will be the increased frequency and impact of extreme events as a result of climate change.
- Climate change will interact with extreme events to change their location and, thus, the communities affected.
- Adaptation to both forms of hazard at the community level tends to have many aspects in common.

Effective DRM needs to consider changing climate risk patterns, and, given that an increase in extreme climate events is one of the major threats posed by climate change, DRM is a natural entry point for adaptation.[28] When considering adaptation to climate change risks, it should be recognized that adaptive capacity has developed as a response to existing vulnerability to extreme events. Improving the adaptive capacity of communities, civil society and governments to deal with current hazards is also likely to improve their capacity to adapt to climate change.[29]

The extent of climate change effects on fishing and fish-farming communities has been extensively investigated.[30] The exposure and vulnerability of fishing communities to hazards is increasingly being seen as a convergence of climate change and more acute hazards. This compounds situations where natural resources are already overexploited or under other forms of pressure from human activities. The Intergovernmental Panel on Climate Change has recently drawn attention to the need to integrate expertise in climate science, DRM and adaptation in order to reduce and manage more effectively the risks of extreme events and disasters in a changing climate.[31] However, climate change adaptation (CCA) is not simply an extension of DRM. Adaptation to climate change not only means addressing changes in the intensity and frequency of extreme events, but also more subtle changes in climate conditions as well as emerging risks that have not been experienced in a region before.[32] Some effects of climate change, such as global changes in sea levels, are new within recent human history, and little experience is available to tackle such impacts.[33]

This growing interconnectedness of climate change and more acute events suggests a need for a convergence of DRM and CCA preparedness and response approaches, particularly at the land–water interface where the effects are felt most strongly and particularly by fishers, fish farmers and their communities. This would suggest that DRM and CCA need to be fully incorporated into fisheries and fish-farming policies and plans, and that fisheries and fish farming should be fully considered in CCA and DRM approaches. In addition, the increasing vulnerability of the poor to both climate change and hazards would suggest that CCA and DRM need to link to livelihoods (taking account of the different assets and production, coping and adaptive strategies of different groups, such as the old and the young, men and women, and people from different cultures and religions) in a holistic and integrated way. Moreover, the implications of both extreme events and climate change for wider national and regional food security suggest that these elements also need to be integrated with each other.

RECENT ACTIONS

A World Conference on Disaster Reduction was convened by the United Nations General Assembly (UNGA) in Hyogo, Japan, in 2005 just a few weeks after the Indian Ocean tsunami. The conference, which was attended by representatives of 168 States, agreed on a strategic and systematic approach to reducing vulnerabilities and risks to hazards. The need for building resilience of nations and communities was stressed, and the conference adopted five priorities for action:

- Ensure that DRR is a national and a local priority with a strong institutional basis for implementation.
- Identify, assess and monitor disaster risks and enhance early warning.
- Use knowledge, innovation and education to build a culture of safety and resilience at all levels.
- Reduce the underlying risk factors.
- Strengthen disaster preparedness for effective response at all levels.

The Hyogo Framework for Action (HFA) 2005–2015: Building the Resilience of Nations and Communities to Disasters was endorsed by the UNGA in Resolution 60/195. The ten-year plan of the HFA reflects the intention to take a holistic approach in identifying and putting into action complex multidisciplinary DRR measures. The HFA supports a stronger recognition of climate change concerns in DRR strategies and seeks to establish a multidisciplinary, forward-looking approach. It also calls on the United Nations International Strategy for Disaster Reduction to facilitate the coordination of effective and integrated action among the organizations of the UN System and among other relevant international and regional entities, in accordance with their respective mandates, to support the implementation of the HFA.

In line with the HFA, FAO has developed a Framework Programme on Disaster Risk Reduction/Management. The Framework Programme strives to assist Members in implementing the HFA five priorities for action in the agriculture sector. The direction and content of the Framework Programme respond to recent recommendations by FAO governing bodies, including priority areas as identified by FAO Regional Conferences. These "pillars" are: (i) institutional strengthening and good governance for DRR in the agriculture sector; (ii) information and early warning systems on food and nutrition security and transboundary threats; (iii) preparedness for effective response and recovery in agriculture, livestock, fisheries and forestry; and (iv) good practices, processes and technologies for mitigation and prevention in farming, fisheries and forestry. Interventions under the Framework Programme are tailored to the specific strengths and needs of a country or region and delivered in a demand- and modular-responsive manner.

The fisheries and aquaculture sector must be considered in a different way to other sectors (such as agriculture) in emergencies in view of the many unique challenges related to management and the complex range of activities undertaken by fishers and fish farmers. Specifically, within the fisheries and fish-farming sector, FAO has initiated a programme of consultation with partners at the global level, where the synergies between managing climate change and DRR were explored.[34] At the regional level, in Bangkok, Maputo and San José, consultations with partners addressed regional issues,[35] where the integration of fisheries and aquaculture with DRM–CCA was discussed in detail and options for taking this integration forward were outlined. The need for this integration was further endorsed at the 29th Session of the FAO Committee on Fisheries (COFI) in 2011. The different initiatives at the regional and international level constitute important opportunities for ensuring that concerted efforts are made to tackle the issues relevant to DRM and CCA. However, challenges remain with regard to integrating CCA and DRM sufficiently in fisheries and aquaculture governance and development planning and implementation and, vice versa, integrating fisheries and aquaculture into CCA and DRM, and taking the characteristics and special needs of fishers, fish farmers and their communities into account in DRM and CCA policies and actions. To this extent, FAO is actively involved in identifying climate-related vulnerabilities and adaptation strategies, including DRR/DRM, specific to fisheries and

aquaculture in order to inform more fully fisheries and climate-change decision-makers. The work of the FAO Fisheries and Aquaculture Department is aligned to priorities expressed in international, regional and national policies and agreements, such as national adaptation programmes of action for least-developed countries and regional strategies/agreements for disaster reduction and related programme of action. It is also aligned with the FAO Framework Programme on Climate Change Adaptation (known as FAO-Adapt).

Furthermore, the FAO Fisheries and Aquaculture Department continues to provide support to FAO Members and partners in responding to emergencies affecting the fisheries and aquaculture sector. Since 2005, it has supported emergency responses through 135 projects in 25 countries. The overall objective of this support has been to strengthen food and nutrition security through the sustainable rehabilitation and long-term recovery of the fisheries and aquaculture sector and the livelihoods that depend on it. In particular, efforts have focused on targeting women and other marginalized groups. The technical advice provided aims to ensure that these efforts are aligned to national policies, regional strategies and international best practice and guidance for the sector, in particular the Code.

OUTLOOK

In view of the in-depth and ongoing consultation with partners and stakeholders from the DRM, CCA and fisheries and fish-farming sectors, it seems likely that that the key areas for action in the coming years will include:

- strengthening policy coherence and institutional structures to ensure explicit and adequate consideration of fisheries and aquaculture activities in disaster preparedness and CCA strategies;
- integrating an understanding of the increasing vulnerability of fishers, fish farmers and their communities both to extreme events and to climate change, and developing and incorporating comprehensive preparedness and response strategies into fisheries and fish-farming sector plans and wider development frameworks;
- building an increased understanding of the vulnerability of fishers, fish farmers and their communities into wider social, economic and environmental development plans;
- working with communities, governments and civil society to help build their productive, coping and adaptive capacity and to ensure that the adaptive, coping and livelihood strategies of fishers, fish farmers and their communities are incorporated into wider disaster preparedness and response strategies;
- developing shared tools, guidance and approaches that combine DRM and CCA at a practical level and that link into fisheries and fish-farming development strategies to increase the resilience of communities and that of aquatic systems on which they depend;
- building partnerships at the global, regional, national and subnational levels among international agencies, national agencies, local government, civil society and communities to learn lessons about, prepare for and respond to slow- and rapid-onset hazards in an integrated and informed way.

Managing recreational fisheries and their development

THE ISSUE

Recreational fishing is well established in most developed countries and expanding fast elsewhere. It involves a large number of individuals, and there is growing awareness that recreational fishing is a considerable industry in terms of numbers of practitioners, catch and social and economic relevance. However, in many recreational fisheries, this awareness has not been accompanied by enhanced management practices, and

concerns are spreading about the influence of recreational fishing on the livelihood opportunities of full-time fishers, on the environment and on aquatic biodiversity.

Recreational fishing is fishing of aquatic animals that do not constitute the individual's primary resource to meet nutritional needs and are not generally sold or otherwise traded on export, domestic or black markets.[36] While angling is how most people perceive recreational fishing, the activity also includes gathering, trapping, spearing, bow fishing and netting aquatic organisms. Recreational fishing currently constitutes the dominant use of wild fish stocks in freshwater environments of industrialized countries. The increased affordability of high-efficiency fishing equipment (including navigational devices, fish finders and improved boats) and ongoing urbanization in coastal zones have resulted in a continuing expansion of recreational fisheries in coastal and marine environments.

Although estimates are difficult, the total annual catch by recreational fishers was estimated at 47 billion fish in 2004, or at about 12 percent of the total world catch.[37] Tentative estimates indicate that about 10 percent of the population in developed countries practise recreational fishing, and recreational fishers probably number more than 140 million worldwide.[38] One study,[39] summarizing ecosystem-based marine recreation valuation results, estimated the total number of marine recreational fishers for 2003 at 58 million. Several million jobs depend on recreational fisheries as associated spending may add up to billions of dollars annually. In the United States of America and in Europe, where angling is the best-documented form of recreational fishing, it has been estimated in recent years that there are at least 60 million and 25 million recreational anglers, respectively;[40] and it has been estimated that there are 8–10 million recreational saltwater fishers in Europe.[41] Similarly, it was estimated in 2009 that some 10 percent of the population in Central Asia were involved in recreational fisheries in inland waters of that region.[42]

The contribution that recreational fishing can make to local economies is considerable, including in less-developed countries. In some areas, the income and employment generated by the spending of recreational fishers is higher than that generated by commercial fisheries or aquaculture. Improved valuation of natural habitats and clean waters have been additional benefits of recreational fishing.[43]

Recreational fishing has shown itself able to provide value as an educational activity, promoting the concept of responsibility for fish stocks and the environment they inhabit and upon which all people depend. Recreational fishers often have a strong sense of responsibility for the environment in which they fish, as is, for example, recognized by the Bern Convention of the Council for Europe in the European Charter on Recreational Fishing and Biodiversity (2010).[44]

In some cases, aquaculture escapees have come under the control of sports fishers. In southern Chile, recreational fisheries that used to be based only on rainbow trout and brown trout now include escaped Atlantic salmon (*Salmo salar*) and chinook salmon (*Oncorhynchus tshawytscha*). In Chile and Argentina, where chinook salmon have migrated successfully in the ocean, self-sustained populations of chinook salmon have generated much enthusiasm among recreational fishers and concerns among conservationists.[45]

However, at times, recreational fishers also interact negatively with professional small-scale and artisanal fishers in open-access areas and at common fishing grounds. There are records of controversial and anecdotal observations of the detrimental effects of recreational fisheries, such as spear fishing on individual species of groupers along the coasts of the Mediterranean and Australia[46] and in the eastern Red Sea.[47] Moreover, recreational diving for species such as Caribbean spiny lobster[48] in combination with commercial fisheries and other pressures (e.g. pollution) has caused significant declines in certain stocks.

Nevertheless, recreational fishers have the potential to enhance fish conservation and maintain or rehabilitate important habitat.[49] As stakeholders, they can be instrumental in successful fisheries conservation through participation in management and conservation endeavours.

Increasingly, recreational fishers are capable of reaching offshore fishing grounds and use technologies – including fish-locating devices – that can make them equivalent to commercial fishers in term of fishing capacity and capability. Recreational fisheries have developed for species historically only exploited by the commercial fishery, in some cases causing conflict between the sectors.[50] Fishing similar locations and using the same types of fishing gear and facilities, such as moorings, can also put recreational fishers in competition with coastal small-scale commercial fishers. Other specialized recreational fisheries target highly iconic species such as salmon, marlins, sailfish and swordfish, often in particular areas and seasons, contributing significantly to the total catch. However, it should be noted that most game fishing associations actively promote catch-and-release practices and that the fish caught in game fishing tournaments are generally released unless the fish caught is a record fish.

Many recreational fisheries tend to be highly selective. Often, recreational fisheries target larger individuals in the population. However, removal of larger individuals of long-lived species may have important effects on the reproductive potential of the population.[51] Larger females are more fecund, spawn over prolonged periods (thus providing more resilience to changing environmental conditions), and can produce larvae with higher survival rates. Sequential hermaphroditic species may have large individuals of the same sex and their sustained removal can affect spawning success. Age- or size-truncated populations may suffer from changes in density or from behaviourally mediated indirect interactions, and cause significant effects in food webs, also altering the ecosystem structure and productivity.[52] All this would assume even more relevance in the case of those stocks concurrently exploited by both commercial and recreational fisheries.

POSSIBLE SOLUTIONS

Development

Sustainable development of the recreational fisheries sector will depend on the acceptance of its multidisciplinary nature and whether recreational fishery stakeholders will be allowed to facilitate successful conservation and management. There is an urgent need to integrate biological and social sciences in order to provide insights into the dynamics of the entire social and ecological system of the recreational fishing industry.[53]

The sustainability of recreational fisheries – including the conservation of aquatic animal biodiversity in areas fished – in combination with commercial fisheries requires recognition by those responsible for this sector. Policy-makers and managers responsible for recreational fisheries need to obtain information about the sector, as well as knowledge of possible factors that affect the sector negatively (including coastal development, fish habitat modification, pollution and extreme climate events). In addition, recreational fishing has a significant social component, and the benefits of the activity need to be weighed against investment in resource protection.[54]

Appraisal of the performance of recreational fisheries and of their potentialities needs to be a multidimensional and multidisciplinary exercise in order to capture the societal, economic, environmental and educational components of the sector, and importantly, to ensure effective participation of stakeholders.[55] One recent study[56] has made an effort in this respect by recommending "methodologies assessing socio-economic benefits of European inland recreational fisheries", which may be of use not only in Europe but also elsewhere.

Management

Management of recreational fisheries needs to reconcile conflicting demands for access to the wild fish while ensuring both sustained exploitation of the marine fauna and conservation of the marine ecosystem of which the fauna are a part.

To do this, management of recreational fisheries needs to follow a process that is similar to that used by most fisheries managers; it involves: (i) defining the resource to be managed, the state of the system and constraints; (ii) setting goals and objectives; (iii) evaluating management options; (iv) choosing appropriate

actions to achieve management objectives; (v) implementing such actions and monitoring outcomes; and (vi) evaluating the success of management, and adjusting management in the light of learning.[57] The choice of tools is wide in freshwater recreational fisheries. Management tools include: stocking, biomanipulation, prey enhancement, suppression of detrimental fishes, selective removal, renovation, and management of aquatic plants.

However, at the same time, fisheries managers need to recognize that freshwater recreational fisheries differ from commercial fisheries and aquaculture and that, therefore, they need to be dealt with in a way that reflects this difference. The main differences relate to species introduction, stocking of waterbodies, catch-and-release practices, the potential for selective overexploitation, and the role of recreational fishers in habitat and biodiversity conservation.

Managers also need to be aware that for many fisheries there exists a perception that the catch of the individual recreational fisher will have only a minimal and localized impact on resources, and that recreational fishing has had little influence on reported stock declines worldwide. However, this perspective often changes dramatically when the size and activity of the recreational fisher population is considered.

There is an open-access scenario characterizing many recreational fisheries, particularly marine ones, that has consequences for the sustainability of the resources and the fisheries. In contrast, many inland and coastal recreational fishing areas, especially in Europe, North America and Oceania, do not apply open-access regimes and sometimes have extremely restrictive access requirements instead.

However, traditional management objectives such as maximizing yield may not be the most appropriate goal for a recreational fishery – enjoyment of the fishing experience is the primary objective of recreational fishing, and this requires different management strategies and tools.[58]

An integrated monitoring system in support of the management of recreational fisheries should entail all the relevant components of the recreational fishery. It could include, *inter alia*, representatives of: recreational fishers and their associations, equipment suppliers, commercial fishers and their organizations, public authorities, civil society, universities, research institutes, and the tourism industry.

The limited reliable data and scientific information available call for precautionary management. As in any other fishery, management of recreational fisheries requires clear identification of goals and measurable operational objectives. Simple and easy-to-obtain multidisciplinary indicators, and their reference points, should be used to measure the state of recreational fishery systems in terms of pressure exerted on the resources and generation of added value. Such indicators can be used to compare recreational fisheries with commercial fisheries.[59] Adequate funding and support should be available to manage recreational fishing within the wider context of fisheries and environmental management strategies. The recreational fishers may be requested to contribute to the cost of managing recreational fishing; "user-pay, user-benefit" systems could be used in some cases. The need to estimate total harvest, effort and impact has to be addressed in order to be able to manage a resource responsibly. Recreational fisheries registration and licensing can play a major role in this respect; registration being a means to quantify and identify participation, and licensing being a means to do the same and generate income. Issues to consider when establishing licensing schemes are the costs of their establishment and operation, and how to ensure that the licence revenues collected flow back into the sector.

Management that focuses on preserving larger specimens of a population may involve the creation of appropriate conservation areas (refugia, marine protected areas or areas closed to fishing) or guidance and/or regulations on catch and release.

Some recreational fisheries target individuals belonging to stocks of transboundary or migratory fish species that are exploited by recreational and commercial fisheries of more than one country. Moreover, some target species of marine recreational fisheries (e.g. tuna and marlin) migrate between high seas areas and areas under national

jurisdiction. This confers an additional international facet to the national management system. Regional fisheries management organizations (RFMOs) and regional fisheries advisory bodies can provide the regional frameworks required to include recreational fisheries into the regional dialogue and mechanisms for the conservation and management of recreational fisheries of common interest.

RECENT ACTIONS

The Code of Practice (COP) for Recreational Fisheries developed (2007–08) under the auspices of the then European Inland Fishery Advisory Commission (EIFAC, now the European Inland Fisheries and Aquaculture Advisory Commission [EIFAAC]) constituted a major step towards elaborating a suite of tools for the management and conservation of recreational inland fisheries.[60] The COP includes standards for responsible, environmentally friendly recreational fishing in consideration of changing societal values and conservation concerns. Its aim is to foster best practices in recreational fisheries that would promote their long-term viability in the face of expanding threats, such as habitat manipulation and destruction, resource overexploitation, and loss of biodiversity.

The relevance of the development and management of recreational fisheries beyond national jurisdictions is becoming evident in the agenda of regional fishery bodies (RFBs), particularly where recreational fishing occurs in international waterbodies or semi-closed seas.[61] Regional bodies could develop long-term common monitoring frameworks and promote regional cooperation in order to: establish standard guidelines to describe the fishery and determine the impact upon the resources; and characterize the social and economical dimension of recreational fisheries that occur in the region of their competence.

At the global scale, the World Recreational Fishing Conference series is a major scientific forum for discussing progress and issues in the development and management of recreational fisheries. The conferences aim to increase dialogue and knowledge about the diversity, dynamics and future prospects of recreational fisheries.

FAO is developing technical guidelines on responsible recreational fisheries. In August 2011, an Expert Consultation met to develop the FAO Technical Guidelines for Responsible Fisheries: Recreational Fisheries. The technical guidelines cover all types of recreational fisheries (harvest-oriented angling, catch-and-release fishing, trapping, spearfishing, etc.) in all environments (marine, coastal and inland). They are global in scope, and will be congruent with the the Code.

OUTLOOK

Recreational fishing is developing and expanding in many countries, as are its impacts on fish stocks through exploitation or related practices such as stocking and introduction of non-native fishes. The social and economic importance to local and regional economies is also being recognized.[62] The dimension of global fisheries is greater than previously assumed when recreational fisheries are considered, and local economies are a major beneficiary of good recreational fisheries management. The economic, educational, health and other social benefits of recreational fishing should be recognized and promoted. Ideally, both commercial and recreational fishing industries should share a common interest in ensuring the maintenance of fish stocks and their habitats.

It seems plausible that, over time, the development and management of recreational fisheries will build increasingly on the application of the precautionary and ecosystem approaches. This will include using a holistic approach to recreational fisheries management based on the concomitant consideration of fish biology, fishing activity, catches, and the economic and social values of recreational fishing.

Given the growing importance of recreational fisheries, national fisheries management will probably recognize and incorporate them in the overall fisheries management discourse, including in fisheries sector reviews, management plans and conservation strategies. Future fisheries management will probably aim for balanced

development of recreational and commercial fishing, including allocation of resource shares in order to optimize local community benefits and ecosystem health.

The potential role of recreational fisheries for livelihoods of rural communities will be assessed and promoted, given that, in many parts of the world, recreational fisheries and associated tourism activities could provide alternative livelihoods for small-scale fishers.

Barriers to achieving low-impact fuel-efficient fishing

THE ISSUE

Most fishing techniques in use today have their origin in an era when fisheries resources were abundant, energy costs were much lower than current levels, and less attention was paid to the negative impacts of fishing on aquatic and atmospheric ecosystems. Current high energy prices and greater awareness of ecosystem impacts are

Box 12

Fishing vessels and fuel consumption

With regard to consumption of fuel, recent overall estimates have shown that about 620 litres of fuel (530 kg) is used per tonne of landed fish.[1] The global fishing fleet is estimated to consume approximately 41 million tonnes of fuel per annum.[2] This amount of fuel generates about 130 million tonnes of CO_2. However, fuel consumption varies widely according to gear type, fishing practice, operational technique and the distance between the fishing ground and port. Moreover, there are substantial differences in fuel consumption between fisheries targeting groundfish or shellfish and those targeting pelagic fish or industrial fisheries.

Notwithstanding the above, studies of fuel consumption patterns by gear type indicate that passive fishing gear (e.g. pots, traps, longlines and gillnets) generally require lower amounts of fuel than active fishing gear (e.g. bottom trawls). Encircling gear types that are dragged a limited distance at slow speed, including gear such as bottom seines, rank between passive and towed gears in fuel consumption.

Active pelagic gear types like midwater trawls and purse seines target fish that form dense schools, and the catch can be hundreds of tonnes of fish in one short tow or haul; therefore, the fuel consumption is generally low in relation to the quantity of catch. In particular, purse seining is one of the most fuel-efficient techniques for catching fish although vessels using this gear often spend significantly more time and fuel searching for schools than actually catching fish. Fishing with the help of powerful artificial lights is common in purse seining, squid jigging and stick-held dip netting, particularly in Asia. While these fishing operations in themselves are fuel efficient, the use of the lights adds to the energy requirement.

[1] Tyedmers, P.H., Watson, R. and Pauly, D. 2005. Fueling global fishing fleets. *Ambio*, 34(8): 635–638.
[2] World Bank and FAO. 2009. *The sunken billions. The economic justification for fisheries reform*. Washington, DC, Agriculture and Rural Development Department, The World Bank. 100 pp.

now realities and present major challenges to the viability of fisheries, particularly in developing countries where access to and promotion of energy-efficient technologies have been limited. However, as illustrated in this article, which is largely based on a paper by Suuronen *et al.*,[63] each type of fishing gear and practice has advantages and disadvantages, and the suitability of each gear type depends considerably on the operational conditions and on the species to be targeted.

The impacts of fishing gear on ecosystems vary widely. Overall, these impacts largely depend on: the physical characteristics of the gear; the mechanics of its operation; where, when and how the gear is used; and the extent of its use. Moreover, gear types that rank high for one kind of impact may rank low for another. Physical damage to the environment may also result from the inappropriate use of an otherwise acceptable gear. Only a small number of fishing methods are recognized as inherently destructive no matter how they are used, prime examples being explosives and toxins. It should also be kept in mind that in spite of the fact that many fisheries are highly selective, fishers are often not capable of catching only the desired target species. When poorly selective fishing occurs, it leads to the incidental catch of fish and invertebrates, part of which may consist of juveniles of ecologically important and/or economically valuable species. In addition, fishing can also result in the incidental mortality of non-target species of seabirds, sea turtles and marine mammals, as well as causing damage to vulnerable ecosystems, such as coldwater corals, which can take many decades to recover.

With regard to greenhouse gas (GHG) emissions, insufficient attention has been paid to the fisheries sector as a whole and to fishing operations in particular. Consequently, it is difficult to rank fishing gear and practices in terms of GHG emissions. However, using the consumption of fuel as a proxy for total GHG emissions can provide a good estimate (Box 12). It is also a fact that, notwithstanding the provisions of existing international conventions, the quality of available fuel is not constant worldwide with regard to sulphur content.

It is noteworthy that life cycle assessments show that significant energy consumption and GHG emissions occur after the catch is taken on board and more so after landing, owing to fish processing, cooling, packaging and transport. Thus, minimizing the impacts and energy consumption throughout the whole product chain would be important to reducing the overall environmental costs of fishing.

POSSIBLE SOLUTIONS

The fishing sector should strive to further lower its fuel consumption and decrease ecosystem impacts. Despite a growing number of initiatives and experimentation with energy-reducing technologies, there is currently no viable alternative to fossil fuels for mechanically powered fishing vessels. However, it is well demonstrated that, through technological improvements, gear modifications and behavioural change, the fishing sector can substantially decrease the damage to aquatic ecosystems, reduce GHG emissions (which is a legal obligation for governments under existing international conventions) and lower operational costs for fuel without excessive negative impacts on fishing efficiency.

Solutions by fishing operation

Demersal trawling

Trawls are flexible gear and can be used on many types of areas and grounds, in shallow and deep waters, and by small and large vessels for a wide range of target species. These characteristics have made trawling the preferred method for many fishers, and it may be the only short-term economic solution for capturing, for example, certain shrimp species. However, bottom trawling has been identified as one of the most difficult to manage in terms of bycatch and habitat impacts.

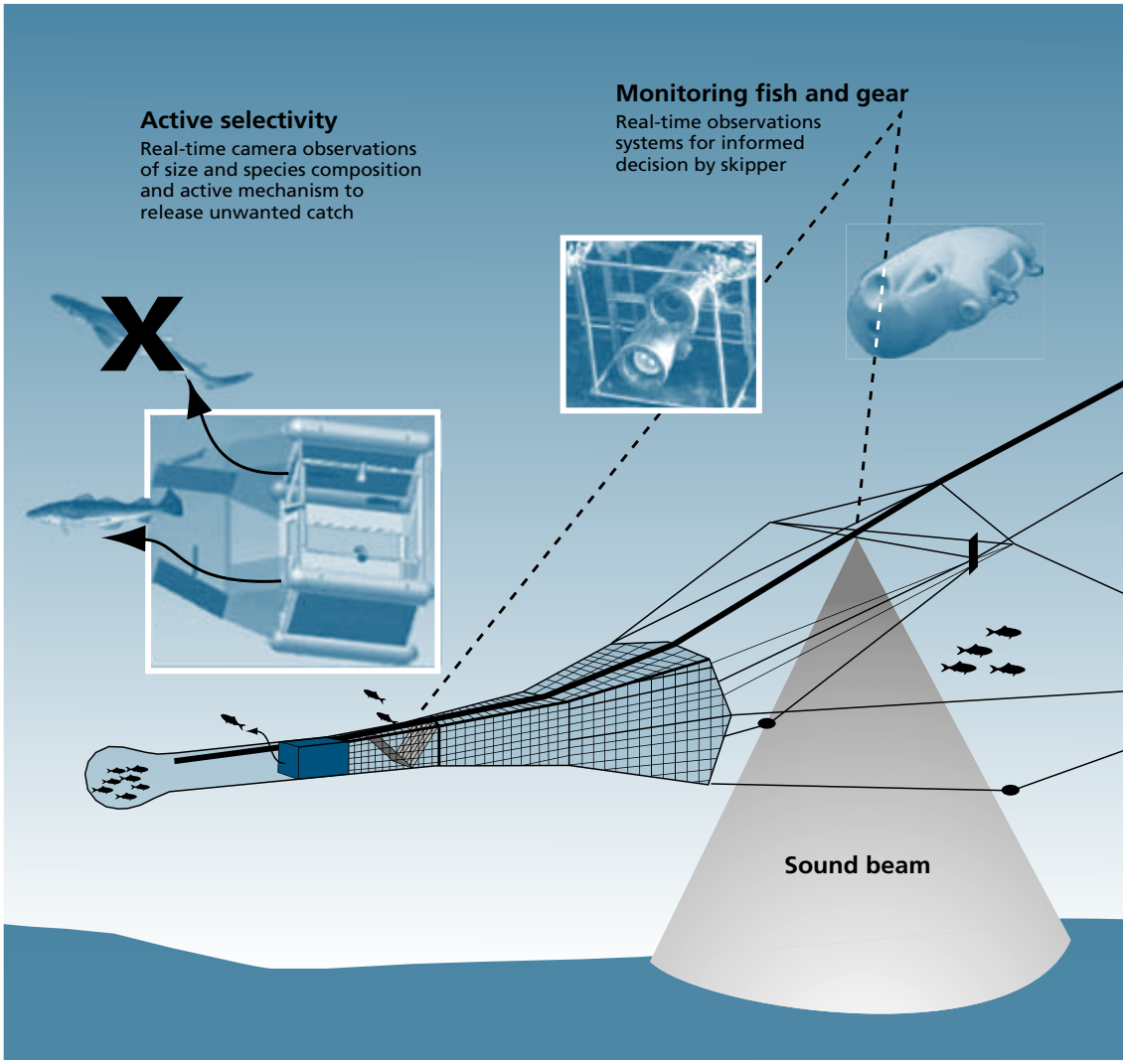
There are many techniques and operational adaptations available to reduce the drag and weight of the bottom trawl gear and, thereby, to reduce significantly fuel consumption and sea-bed impacts without marked decrease in the catch of the target

species.[64] Fuel savings of 25–45 percent and gear-drag reductions of 20–35 percent have been reported.

However, in general, further work is needed to improve the construction of different components of trawl gear in order to minimize friction on the bottom and to reduce overall gear drag. In this regard, there is further potential to develop technologies in which the force of trawl doors and ground gear on the sea bed is automatically measured and adjusted by instrumentation (Figures 38 and 39). In the case of beam trawls, progress has been made in recent years by developing alternative

Figure 38

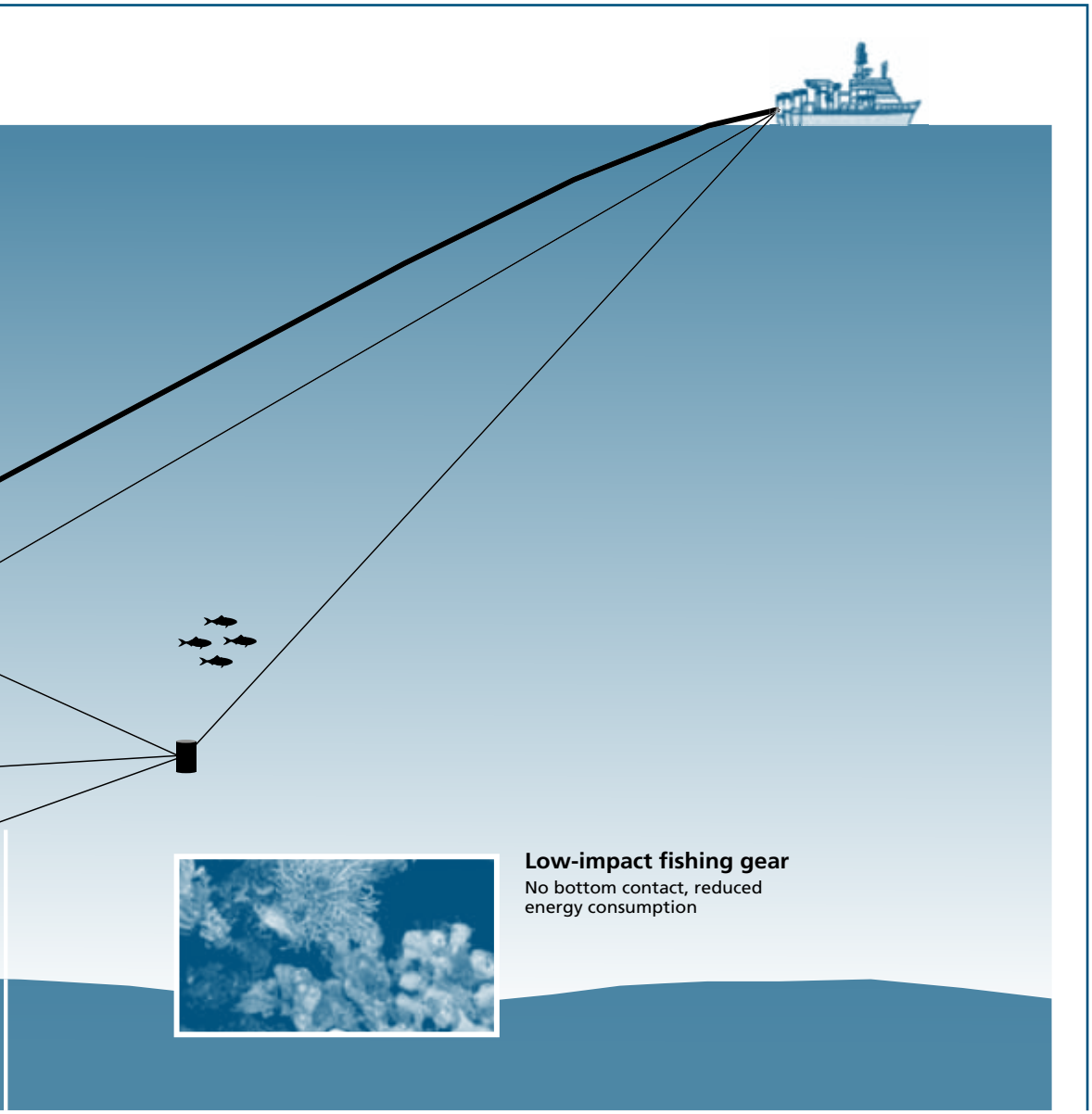
A new semi-pelagic low-impact and selective trawl gear (CRIPS-trawl) that is under development in Norway



Notes: The new trawl design (CRIPS-trawl) has a reduced bottom contact and less drag compared with a conventional bottom trawl. The trawl doors and the footrope of the trawl are lifted off the bottom. The front panels of the trawl are replaced by herding ropes, and the aft parts are made of square-mesh netting. This will reduce the drag of the trawl while still maintaining the stimulation for herding the fish into the codend. The extension piece and the codend are made of four panels and include a net camera and various selection devices to release unwanted fish from the trawl. The four-panel design improves the stability of the trawl and the selection devices. The net camera gives real-time information of the fish species and sizes entering the codend, and allows the skipper to make informed decisions regarding how to continue the fishing process. The trawl may also be fitted with an active mechanism to release unwanted catch (based on image analysis). The trawl concept also includes a cable connection from the vessel to the trawl headline. The cable will carry the video signal from the net camera and acoustic sensors, and it will also increase the vertical opening of the trawl. The concept will later also include an independent system to adjust the distance of the doors from the sea bed.

gear designs. In essence, the objectives are to reduce the amount of tickler chains, avoid excess weight in the beams, and use other stimuli (e.g. electric pulses) as an alternative to chains to scare the target fish off the bottom and into the net. The use of acoustics, light or any other additional stimuli to enhance encounters by target species within the catching zone of trawl nets is worth exploring.

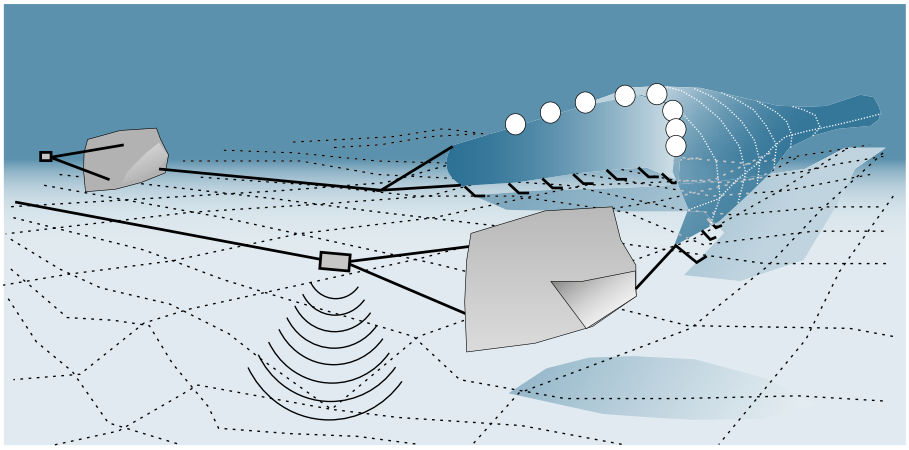
The use of improved location and targeting of fish with the help of electronic seabed mapping tools and integrated global navigation satellite systems has resulted in avoidance of sensitive bottom habitats and helped to minimize fishing effort and fuel



Source: Valdemarsen, J.W., Øvredal, J.T. and Åsen, A., 2011. *Ny semipelagisk trålkonstruksjon (CRIPS-trålen). Innledende forsøk i august-september 2011 om bord i M/S "Fangst"*. Rapport fra Havforskningen nr. 18. Bergen, Norway, Institute of Marine Research. 17 pp.

Figure 39

Smart trawling: reduced seabed damage of bottom trawling



Note: In "smart trawling technology", the distance of trawl doors and ground gear from the sea bed is constantly and automatically measured and adjusted by special instrumentation. The use of ballast elements or dropper chains suspended from the footrope to hold the trawl near to, but not in contact with, the bottom offers potential in some fisheries to reduce sea bed contact while maintaining catching efficiency.

Source: Modified from Valdermarsen, J.W. and Suuronen, P. 2003. Modifying fishing gear to achieve ecosystem objectives. *In* M. Sinclair and G. Valdimarsson, eds. *Responsible fisheries in the marine ecosystem,* pp. 321–341. Rome, Italy, and Wallingford, UK, FAO and CABI International Publishing.

consumption. Multibeam acoustic technology, widely used in sea-bed exploration, has been successfully applied, for example, to mapping scallop beds off the east coast of Canada, thereby substantially reducing the time required to locate the grounds and the actual fishing time.

Bottom seining

Bottom seining (Danish, Scottish and pair seining) is generally considered to be a more environmentally friendly and fuel-efficient fishing method than bottom otter trawling. The gear is lighter in construction and the area swept is smaller than in bottom trawling. Moreover, because there are no trawl doors or heavy ground gear, there is less force on the sea bed. The light gear and low hauling speed mean that fuel usage can be significantly lower than for a comparable trawling operation. Bottom seine nets are generally also regarded as having low impact on benthic invertebrates. However, the high bycatch of both undersized individuals of the target species and individuals of non-target species can be a problem in some seine fisheries.

Trap-net

Trap-nets are passive fishing gear that are usually set on traditional sites in the path of migrating fish in relatively shallow coastal waters. Leader-netting herds and guides fish into a holding chamber or pound where they are entrapped. The pontoon trap is a more recent innovation and offers various advantages compared with traditional trap-nets such as being easy to transport, handle and haul, adjustable in terms of size, target species and capture depth, as well as being predator-safe. Future developments may include large-scale, ocean-based fish traps together with the technology to attract fish. Modern trap-net fisheries can be energy efficient, flexible, selective and habitat-friendly, providing catches of high quality as the catch is usually alive when brought aboard the vessel. Live capture provides the operator with a greater number of options to add value to the catch. However, designs and practices need to be developed to prevent the entangling of non-fish species in netting and mooring ropes of the trap.

Pots

A pot is a small transportable cage or basket with one or more entrances designed to allow the entry of fish, crustaceans or cephalopods, and prevent or retard their escape. Pots are usually set on the bottom, with or without bait. While pot fishing vessels in general have low fuel use, some pot fisheries have high fuel use owing to the need to tend fleets of many pots and lifting them more than once a day, necessitating travelling at high speed over long distances.

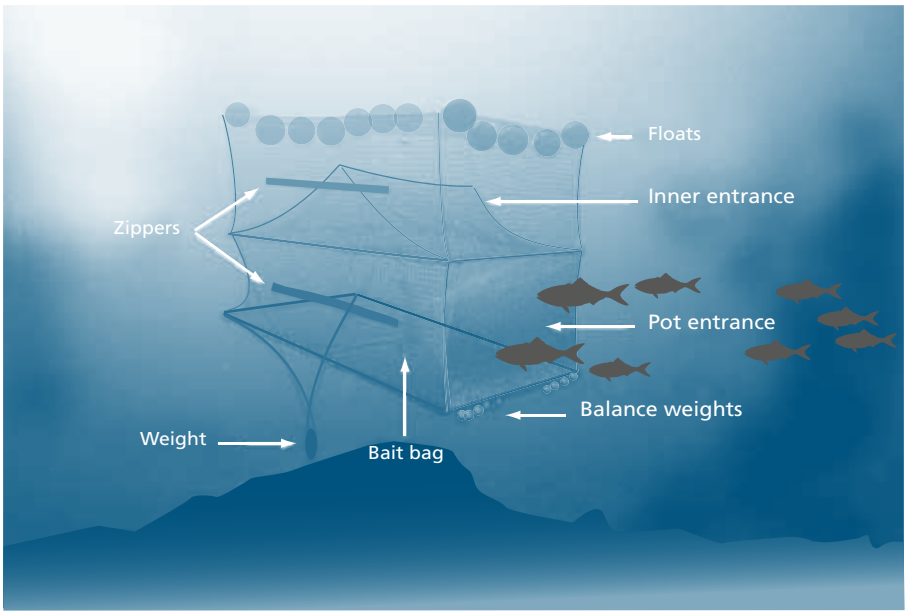
Pots are extensively used in the capture of crustaceans such as lobster and crab. Although the use of pots for capturing finfish has a long tradition in many parts of the world, it has progressively declined. Nevertheless, pots are still an efficient and economically viable fishing method for finfish. They are also successfully used in fisheries targeting coral-reef species inhabiting areas where the use of active gear is banned or not practical.

Recent tests with collapsible pots have shown promising results for Atlantic cod in Canada and for pink cusk-eel (*Genypterus blacodes*) in Argentina. A floating pot developed in Scandinavia provides another example of an innovative pot design that has shown significant potential (Figure 40).[65] Floating the pot off the bottom allows the pot to turn with the current so the entrance always faces down current, resulting in a higher catch rate of cod. It also avoids non-target catch of crabs and may also reduce the seabed impacts compared with a pot sitting on the bottom. The same type of floating pot has successfully been tested in the Baltic Sea as an alternative to the gillnet fishery for cod, where there are serious problems with depredation by seals.

Compared with many other types of fishing gear, pots, like trap-nets, possess several appealing characteristics such as low energy use, minimal habitat impact, high quality and live delivery. On the negative side, lost or abandoned pots may continue catching target and non-target species (ghost fishing) and contribute to marine debris with associated effects. Design features such as biodegradable materials may reduce ghost fishing, while delayed surface marker buoys and location aids may promote the recovery of lost gear. Understanding fish behaviour in relation to pots is essential in

Figure 40

A floating pot



Source: Adapted from Königson, S. 2011. *Seals and fisheries: a study of the conflict and some possible solutions.* Department of Marine Ecology, University of Gothenburg. (PhD thesis)

order to increase efficiency for those species that are currently not captured by pots in commercially viable quantities.[66]

Hook and line

Hook and line refers to gear to which fish, squid or other species are attracted by natural or artificial bait or lures placed on a hook, on which they are caught. Wide variations in hook and line configuration and their mode of operation have made them an effective gear type for a wide variety of species. It is a versatile fishing method, employed by a wide range of vessels from artisanal boats to large mechanized longliners. Hook and line fishing is generally considered an environmentally friendly but labour-intensive fishing method that catches fish of high quality. Fuel consumption in these fisheries is comparatively low although it can increase significantly depending on the distances vessels have to travel to and from the fishing ground (e.g. coastal hook and line fisheries versus high seas tuna longlining). Longline fishing may cause the incidental mortality of seabirds, sea turtles and sharks, many of which are either protected or endangered. The lines can be set with a streamer[67] in order to deter seabirds from seizing the baited hooks – this system is reported to have led not only to a reduced mortality level of sea birds but also to higher catch rates of the target species. There are several other mitigation measures capable of reducing the likelihood of incidental bycatch of seabirds[68] and sea turtles,[69] such as the new "circle hook" and "weak hook". While bottom-set longlines may snag and damage benthic epifauna and irregular objects on the bottom, longline fisheries do offer the potential to conduct fishing without severe habitat damage and to do so in a relatively energy-conscious manner.

Gillnetting

Bottom-set gillnets, entangling nets and trammelnets are widely used, and improved materials and techniques have allowed the expansion of such gear to rougher grounds (including wrecks and reefs) and deeper waters. Gillnetting is a very versatile and flexible fishing method but can also be labour-intensive. Except with trammelnets, the size selectivity for finfish is generally good, but species selectivity can be poor. In addition, fish are often injured and die during capture; accordingly, catch quality is typically not as good as with pots, traps and longlines, although gillnets may also give catch of good quality when the time the net is left in the water to fish is short.

Gillnet fishing operations in general can damage benthic epifauna during retrieval of the gear, at which time the nets and leadlines are more likely to snag bottom structures. Although the capture of seabirds, sea turtles and marine mammals by gillnets has received increased attention in recent years, more development work is required to develop mitigation measures further.

The impacts of ghost fishing by abandoned, lost or otherwise discarded gillnets are of concern as such nets may continue to fish for long periods depending on their construction, the depth, and prevailing environmental conditions. This problem can be addressed by increasing efforts to avoid losing gillnets and by facilitating the quick recovery of lost nets. Abandoned gillnets have been identified as a particular problem in deeper waters and where long lengths of gear are deployed.[70]

Barriers to change

There are many barriers to the transition to low-impact and less fuel-intensive practices and gear.[71] In summary, the most important seem to be:

- lack of familiarity with cost-effective and practical alternatives;
- limited availability of suitable technologies, especially in developing countries;
- incompatibility of vessels with alternative gear;
- risk of losing marketable catch;
- additional work at sea;
- concerns with safety at sea related to using unfamiliar gear or strategies;
- high investment costs;

- lack of capital or restricted access to capital;
- ineffective technology infrastructure support;
- inflexible fisheries management systems that include too rigid regulatory regimes.

With regard to inflexible management systems, regulatory regimes that are too rigid can create a new set of problems to be solved and deny fishers the flexibility required to innovate and adopt new technologies. In this regard, stakeholders should be an integral part of the management process, particularly as and when amendments to legislation are under consideration. Changes from high-energy high-impact fishing methods or practices to ones with lower energy consumption and lower ecosystem impacts offer opportunities for conserving fuel, preserving ecosystems and improving food security. However, the transition from one gear type to another is seldom easy or practical. First, the size and design of existing fishing vessels and their machinery and equipment often limit the possibilities of changing the fishing method. Second, fishing gear, fishing vessels, operations and practices have evolved around specific fishing grounds and the behaviour of target fish species over a considerable period. Accordingly, the evolved fishing gear and practices are "tailor-made" to catch specific target species or species groups in a manner that is often perceived to be optimized to the best technical and economic scenarios that will be encountered during fishing. Moreover, where fishing practices are rooted in tradition there is a strong resistance to change.

Nevertheless, fuel consumption and ecosystem impacts can often be reduced through simple modifications in operational techniques and gear design without drastic changes in the gear and operational practices. This approach has shown promising results in many cases and is often preferred by the fishing industry over transitioning to a completely new gear type and fishing practice, which is an alternative that has many more uncertainties and higher economic risks.

RECENT ACTIONS

Environment

International conventions include timetables for compliance regarding emissions of nitrogen oxides from diesel engines of over 130 kW and new fishing vessels are required to comply. Morevoer, as a consequence of research and development (R&D) on energy-saving technologies carried out by designers of machinery and fishing vessels and gear, there are signs that the fishing industry has begun to improve its fuel efficiency. Nevertheless, fuel continues to be the major cost of operation in capture fisheries and further refinements to fuel quality, such as lowering the content of sulphur oxides and particulate matter, could well lead to even higher fuel and lubricating-oil costs. This may have an even greater impact on the fishing industry in developing countries where mechanization continues to increase, although it will also strengthen the drive for fuel efficiency.

Bycatch and discards

The seriousness of the impacts related to bycatch and discards has been recognized by the international community and in particular through the endorsement of the International Guidelines on Bycatch Management and Reduction of Discards at the Twenty-ninth Session of the FAO Committee on Fisheries in 2011. There is a range of tools to manage bycatch and reduce discards, including technological measures to improve the selectivity of fishing gear. The declines in the bycatches and discards in many fisheries have mainly been the result of introducing effective gear modifications and bycatch reduction devices.[72] However, there remains concern about the impacts of unaccounted fishing mortalities such as ghost fishing by abandoned, lost or otherwise discarded fishing gear and the fact that such gear may also cause environmental damage.

Furthermore, at the sixty-second session of the Marine Environment Protection Committee of the International Maritime Organization (IMO) in July 2011, Annex V

of the International Convention for the Prevention of Pollution from Ships 1973/78 (MARPOL) was amended to provide a regulation for the loss of fishing gear that may be a substantial threat to the environment or the safety of navigation to be reported to the flag State, and, where the loss occurs in waters under the jurisdiction of another coastal State, to that State. This regulation is supported within guidelines for the application of Annex V currently under revision.

OUTLOOK

With continued exposure to rising fuel prices and little or no significant price increases at the point of first sale for catches, capture fisheries will probably continue to suffer declining profitability. Moreover, if resource abundance remains static, some bottom trawl and dredge fisheries may become uneconomic (although passive gear and seine net fisheries may be less affected). As demersal trawl fishing accounts for a significant part of the total catch destined for direct human use, there could be an adverse affect on global fish supply and food security, at least in the short term.

With medium-term forecasts indicating a high likelihood of further and steady increases in fuel prices, as indicated by the International Energy Agency, the future of the fishing industry is challenging. An increase in sulphur-oxide-emission control areas (the most recent being adopted by the IMO in 2011) would add to the cost of fuel for vessels operating in such zones.

The fishing sector will no doubt strive to lower its fuel consumption, reduce its carbon footprint, and decrease ecosystem impacts. Although the continuation or expansion of fuel subsidies would reduce immediate costs, this is less acceptable. To help the fisheries sector achieve significant and permanent reductions, governments will most probably strengthen their fisheries sector energy policy and create an enabling environment in which fishing industries can rapidly and comprehensively adopt low-impact fuel-efficient (LIFE) fishing technologies and practices. The development and adoption of such fishing techniques offer scope for maintaining the long-term profitability and sustainability of capture fisheries worldwide.

With fossil fuels remaining the dominant energy source, pursuing energy efficiency in capture fisheries may generate benefits by reducing operating costs, controlling GHG emissions and minimizing environmental impacts within the aquatic environment. However, the success of this transition will depend heavily on the response of governments to the implementation of international conventions together with a positive reaction from the engine manufacturing sector, fuel-oil and lubricating-oil producers and the fishing industry (including the manufacturers of fishing gear). This could lead to the development and application of suitable and acceptable measures to conventional fisheries and create an appropriate catalyst for change in the behaviour of fishers. Of equal importance are initiatives such as pursuing the modification of existing gear types and the development of low-resistance towed fishing gear with minimal impact within the aquatic environment. In some cases, it may be necessary to switch to completely new gear types or practices in order to enable LIFE fishing.

However, to be effective, this would require global R&D priorities to be established and work undertaken in support of the development and uptake of LIFE fishing.[73] These include:

- promoting and funding studies of cost-effective gear designs and fishing operations, including the establishment of technology incubators and other public–private sector initiatives to commercialize economically viable, practical and safe alternatives to conventional fishing methods;
- analysis and review of best practice operations across fisheries;
- improvement of technical ability among fishers;
- establishment of appropriate incentives;
- industry compliance with international conventions;
- execution of robust but flexible fishery policies that support the transition to alternative technologies.

Finally, close cooperation between the fishing industry, scientists, fisheries managers and other stakeholders will be fundamental to the development, introduction and acceptance of LIFE fishing technologies.

Putting into practice the ecosystem approach to fisheries and aquaculture

THE ISSUE

The ecosystem approach to fisheries (EAF) represents a move away from management systems that focus only on the sustainable harvest of target species to a system that also considers the major components in an ecosystem, and the social and economic benefits that can be derived from their utilization.

An ecosystem approach to aquaculture (EAA) follows similar considerations and it has been defined as: "a strategy for the integration of the activity within the wider ecosystem such that it promotes sustainable development, equity and resilience of interlinked social-ecological systems."[74]

While the term "ecosystem approach" often evokes the idea that the approach is mainly a natural-science undertaking, the approach adopted by FAO[75] explicitly states the importance of taking into account all the essential components of sustainability (ecological, social and economic), i.e. taking a genuinely systemic approach by considering fisheries and aquaculture as systems whose sustainability depends on all their parts.

In addition to sector-based approaches, the need for developing adequate institutional frameworks to address multisectoral management is also recognized (e.g. ecosystem-based management), and EAF/EAA will then be nested within these broader frameworks.

Despite general acceptance of the principles of EAF and EAA, a widespread perception has existed of their being too complex and impossible to implement in practice because they require human and financial resources that are usually not available, particularly in developing countries.

POSSIBLE SOLUTIONS

Despite the perceived complexity of implementing an ecosystem approach, there is good evidence that progress is being made at various levels, from formally adoption of the framework by regional and national institutions, to actually starting with implementation.

There are examples of concrete steps being taken towards an ecosystem approach, both in sectoral fisheries management (e.g. EAF and EAA) and at the multisectoral level (such as ecosystem-based management), the latter being necessary where more than one sector affects a given area or region. Management approaches that integrate across sectors become particularly relevant in inland waters (Box 13), where major impacts on fishery resources and ecosystems are often not caused by fishing activities but by water use and habitat modification. Moreover, as the once-separate sectors of "fisheries" and "aquaculture" increasingly overlap and integrate an ecosystem approach may well facilitate sustainable resource management (Box 14).

Practical implementation of EAF/EAA entails examining existing or developing fisheries or aquaculture activities so as to identify key priority issues to be dealt with by management in order to achieve sustainable outcomes within a risk-based management framework. An example of a framework for planning and implementation is presented in Figure 41. The framework facilitates the developing of the EAF/EAA management/development plans, which are the backbone of any ecosystem approach strategy.

The key features of the strategy proposed for implementing an ecosystem approach to fisheries and to aquaculture can be summarized as:

Box 13

The need for an ecosystem approach in inland waters

Inland waters are characterized by strong competition for freshwater resources from sectors outside the fisheries and aquaculture sector. Demands on freshwater are expected to double by 2050 as the world population reaches 9 billion people. Of the available 3 800 km^3 of freshwater in the world, agriculture currently uses 70 percent, industry extracts another 20 percent, and 10 percent is for domestic use.[1] These sectors are extremely important in national economies, but they rarely consider fishery resources, although freshwater fisheries are a non-consumptive user of water. Implementing an ecosystem approach to managing freshwater resources for fisheries and aquaculture will necessitate involving these competing sectors and appreciating the value of multiple uses of freshwater resources.

In 2008, capture fishery production from inland waters was 10.2 million tonnes and was worth about US$5.5 billion, while the corresponding figures for inland aquaculture were 33.8 million tonnes and US$61.1 billion, respectively. However, these figures are much lower than the value derived from other uses of freshwater. On a global scale, the value of industrial and agricultural products produced with freshwater as a necessary factor of production is several magnitudes larger. However, at the regional or local level, there may be little industrial use for freshwater, and fish can be an essential contributor of animal protein and micronutrients in local diets. In such locations, using an ecosystem approach to the development and management of natural resource should ensure a place also for freshwater fisheries.

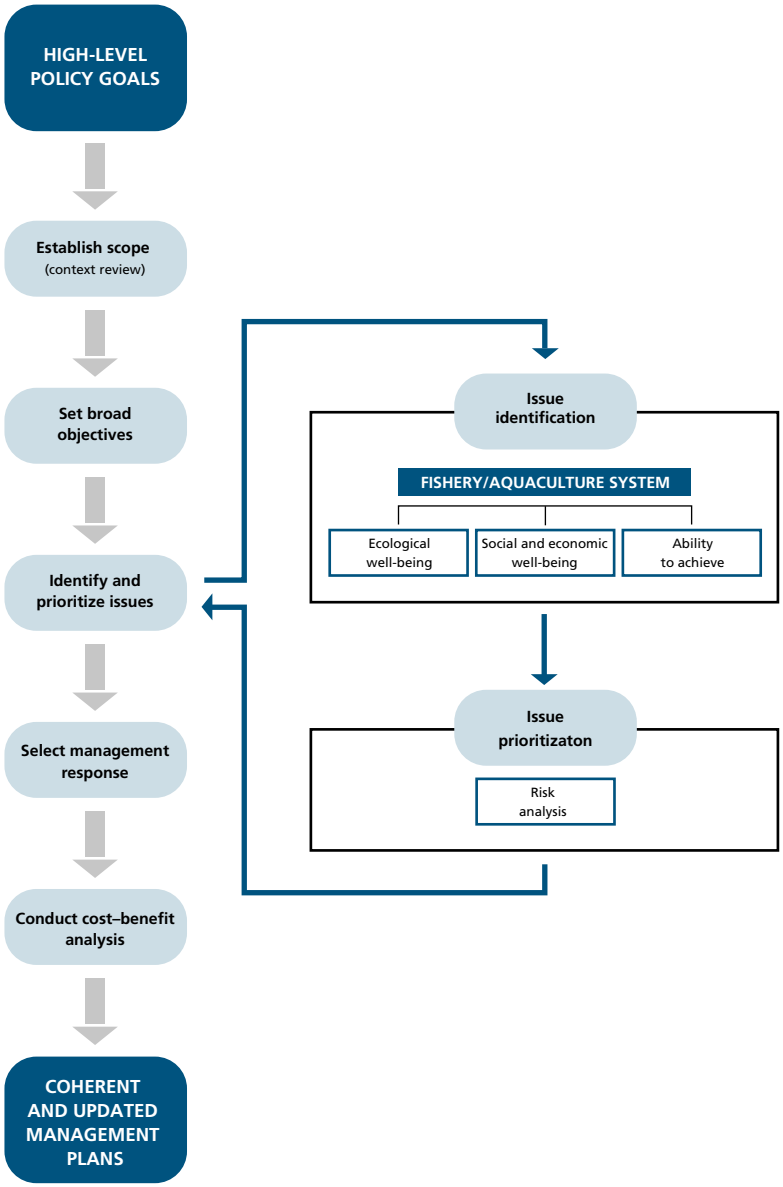
The continued use of freshwater as a locale for fish production, as industries and agriculture grow, can be promoted through technological change. There are encouraging signs of this, such as the development of improved fish passes that allow riverine fish to migrate past hydroelectric facilities and improvements in irrigation systems that increase their efficiency.[2] However, many countries still lack the institutional capacity to deal effectively with multisectoral issues.

[1] Comprehensive Assessment of Water Management in Agriculture. 2007. *Water for food, water for life: a comprehensive assessment of water management in agriculture*. Summary. London, Earthscan, and Colombo, International Water Management Institute. 40 pp.
[2] FAO. 2003. *Unlocking the water potential of agriculture*. Rome. 70 pp. (also available at www.fao.org/DOCREP/006/Y4525E/Y4525E00.HTM).

- adopting participatory approaches at all levels of the planning and implementation steps;
- ensuring that all the key components of the fishery/aquaculture system are considered, including those related to the ecological, social, economic and governance dimensions, while also taking into account external drivers (e.g. changes in the supply of and demand for inputs and outputs; climate change; and environmental disturbances);
- encouraging the use of the "best available knowledge" in decision-making, including both scientific and traditional knowledge, while promoting risk assessment and management and the notion that decision-making should take place also in cases where detailed scientific knowledge is lacking;

Figure 41

The EAF/EAA planning framework



Source: Modified from: FAO. 2003. *Fisheries management 2. The ecosystem approach to fisheries.* FAO Technical Guidelines for Responsible Fisheries No. 4, Suppl. 2. Rome. 112 pp.; and FAO. 2005. *Putting into practice the ecosystem approach to fisheries.* Rome. 76 pp.

- promoting the adoption of adaptive management systems, including monitoring performance and creating feedback mechanisms linked to performance, at different time scales, to permit the adjusting of the tactical and strategic aspects of the management/development plans;
- building on existing institutions and practices.

The methodology proposed has aspects that are common to any other sector utilizing renewable natural resources. The methodology is recommended by the ISO 14000 that deals specifically with the management of renewable resources.[76]

The methodology builds on the accumulated experience of the management of fisheries and aquaculture but also embraces recent insights about what makes socio-ecological systems sustainable. These insights lead to an approach that:

Box 14

Interactions between fisheries and aquaculture

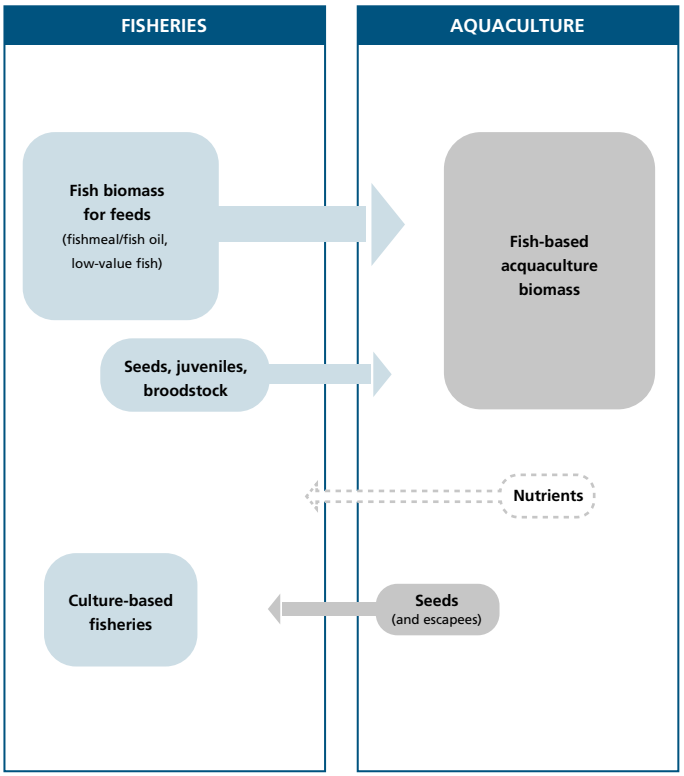
Increasingly – by design or by accident – fisheries and aquaculture occur in the same ecosystem. Aquaculture-based fisheries (stock enhancement programmes) and capture-based aquaculture are becoming more common and resulting in a growing interdependence of fisheries and aquaculture. Fish that escape from fish farms may affect not only local fisheries but have a wider interaction in the marine environment. Fisheries and aquaculture interact with increasing intensity as fishers shift from fishing to aquaculture and by competing in the same markets with similar products. The need to integrate planning and management of the two sectors seems vital to their future development and sustainability.

The implementation of the ecosystem approach to aquaculture and the ecosystem approach to fisheries should help to overcome the sectoral and intergovernmental fragmentation of resource management efforts and to develop institutional mechanisms and private-sector arrangements for effective coordination among the various sectors and subsectors active in ecosystems in which aquaculture and fisheries operate and between the various levels of government. Ecosystem-based management involves a transition from traditional sectoral planning and decision-making to the application of a more holistic approach to integrated natural resource management in an adaptive manner.

In the long run, all significant commercial seafood supplies and non-food fish will come from one of three sources: (i) fish farms/aquaculture; (ii) aquaculture-enhanced fisheries; and (iii) fisheries that adopt efficient management systems. The first two pose a challenge to aquaculture and require an emphasizing of the synergies and complementarities between fisheries and aquaculture including institutional, social, economic, environmental and biotechnological aspects. Acknowledgement of these interactions offers opportunities for sectoral development, for increasing food security, reducing poverty and improving rural livelihoods. The two subsectors need to form partnerships as both are strongly linked (see accompanying figure), both depend on healthy aquatic environments, and both are affected by other development activities. For example, in the coming decades, culture-based fisheries will probably play a much greater role in sustaining and increasing capture fisheries yields for an ultimate public good including conservation objectives. Therefore, it is important to analyse the present status of culture-based fisheries culture-based fisheries and stock enhancement, to assess comprehensively the impacts of the activities, and to identify constraints and ways to improve the ecological, economic and socio-economic benefits by implementing an ecosystem approach to overall fish production. It is also necessary to improve understanding on the potential and actual environmental impacts of stocking and escapees worldwide.

- is context-specific – it describes a process whose result depends on cultural context and needs;
- emphasizes stakeholder participation – the approach advocates participation of stakeholders in the planning and implementation processes, and encourages various forms of comanagement that will in turn be shaped by context and type of fisheries;
- is systemic – by taking a "systemic" approach, it tries to ensure that all "system" components move towards the same and agreed direction;

Biophysical linkages between capture fisheries and aquaculture



Source: Soto, D., White, P., Dempster, T., De Silva, S., Flores, A., Karakassis, Y., Knapp, G., Martinez, J., Miao, W., Sadovy, Y., Thorstad, E. and Wiefels, R. 2012. Addressing aquaculture-fisheries interactions through the implementation of the ecosystem approach to aquaculture (EAA). *In* R.P. Subasinghe, J.R. Arthur, D.M. Bartley, S.S. De Silva, M. Halwart, N. Hishamunda, C.V. Mohan and P. Sorgeloos, eds. *Farming the Waters for People and Food. Proceedings of the Global Conference on Aquaculture 2010, Phuket, Thailand, 22–25 September 2010*, pp. 385–436. Rome, FAO, and, Bangkok, NACA. 896 pp.

- is risk-based – being risk-based, it allows a more proactive approach to addressing information-poor situations, considered one of the main obstacles to the ecosystem approach in fisheries and aquaculture.

In summary, success in implementing the ecosystem approach to fisheries and aquaculture requires that management and development of the sectors are well-functioning components in a public-sector, multisectoral coordination effort supported by adequate governance. Consistent with the commitments reflected in the United Nations Convention on Biological Diversity (CBD), each economic sector (including,

mining, tourism, coastal development, fisheries and aquaculture) relying on the use of natural resources within a given region/ecosystem should adopt an ecosystem approach.

RECENT ACTIONS

The ecosystem approach was first defined by the CBD in 1993 as a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.

Since 1993, countries have taken several steps to promote the use of the ecosystem approach, including specifically in fisheries. The Code of Conduct for Responsible Fisheries (the Code) was adopted in 1995 by FAO Members. The Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem (adopted in 2001) encouraged countries and fishing entities to achieve sustainable fisheries in the marine ecosystem. Guidelines for an EAF were produced by FAO in 2003. Aquaculture has also developed a framework for the adoption of the ecosystem approach.[77] At present, FAO is developing voluntary guidelines on securing small-scale fisheries. These guidelines will recognize the ecosystem approach as an important guiding principle.

Approaches are being developed to coordinate multiple uses of natural resources, such as marine spatial planning[78] and integrated watershed management. These are methodologies that complement the sectoral-based approaches to management that remain the basic pillars of sustainable development and its governance.

In some ways, the ecosystem approach has been practised in traditional management regimes for a long time. An example is the tenure system in marine fisheries as practised in Pacific island States.

More recently, many countries have made important strides towards the application of several of the principles contained in the EAF/EAA. Some are partly implementing the approach without necessarily recognizing this.[79] In some cases, progress has also been made in the development of multisectoral management.

In Australia, following the outcomes of the 1992 United Nations Convention on Environment and Development, a national strategy for ecologically sustainable development was endorsed in the same year.[80] Since then, significant progress has been made in implementing an ecosystem approach within the management of most individual fisheries and, and there has also been more recent progress in adopting more coordinated regional level management for this sector.[81]

In the European Union, substantial efforts are being made to integrate the objectives of its Marine Strategy Framework Directive within the new European Union Common Fisheries Policy, as part of an ecosystem-based management approach. As a result of the project Making the European Fisheries Ecosystem Plan Operational (funded by the European Union), fisheries ecosystem plans have been developed for three major European marine regions (North Sea, North Western Waters and South Western Waters).[82] Efforts are also being made at the national level. For example, in Norway, an integrated management plan for the Barents Sea–Lofoten area has been developed to resolve conflicts between petroleum activities, fisheries activities and to address conservation concerns.[83] Implementation of the plan is ensured through multisectoral coordinating groups headed by a steering group that is in turn coordinated by the Ministry of Environment. Representatives from the Norwegian Petroleum Directorate and the Directorate of Fisheries have worked together to revise laws and regulations covering seismic activities in order to reduce conflicts. A central concept of the plan is that it is based on science and takes a precautionary approach. A similar plan has also been developed for the Norwegian Sea, and the idea is to cover all the Norwegian Exclusive Economic Zone (EEZ).[84]

Ongoing efforts in the adoption of ecosystem-based approaches at both the sectoral and multisectoral level are being pursued in various large marine ecosystems including in the Caribbean,[85] the Canary Current,[86] the Benguela Current[87] and the Bay of Bengal.[88] However, in most of these large marine ecosystems, efforts are concentrated

on planning for an ecosystem-based approach – its full-scale implementation remains to be realized.

In addition, FAO has specifically addressed EAF by developing guidance[89] for its implementation and by providing extrabudgetary funding for regional and/or national case studies, dedicated workshops and training courses.

Collaborations with universities in Africa, i.e. University of Ghana (Ghana), Rhodes University (South Africa) and Ibn Zohr University (Morocco), have allowed a large number of fisheries professionals to be trained in the ecosystem approach, and it is hoped that the approach will be absorbed by universities in developing countries as part of existing curricula in fisheries science and management. These efforts have resulted in increased understanding of the approach and its "demystification".

OUTLOOK

A dramatic shift in attitudes as regards the relevance and applicability of the ecosystem approach has taken place, including an increasing appreciation of how this approach can help in addressing the challenges linked to sustaining socio-ecological systems such as fisheries, both within the sector and across sectors affecting a given ecosystem. Pragmatic ways are being adopted to improve conventional fisheries and aquaculture management by incorporating ecosystem considerations and by dealing with the social dimension more properly.

However, important challenges still exist beyond the technical aspects of practical day-to-day implementation. The challenges are not only those related to controlling the direct drivers of marine ecosystem change such as fisheries and aquaculture. Probably the greatest challenges come from indirect drivers such as changes in human population coupled with a widespread aspiration for improved standards of living. At the national level, economic policies and social and economic conditions are often in conflict with sustainability objectives. Climate change will most probably emerge as a major driver of change in aquatic ecosystems and will in turn affect coastal communities. In this situation, modifying governance towards more holistic approaches (such as the ecosystem approach), both horizontally (across sectors and institutions) and vertically (from local to global), may take on increased urgency.

NOTES

1 Arenas, M.C. and Lentisco, A. 2011. *Mainstreaming gender into project cycle management in the fisheries sector.* Bangkok, FAO. 92 pp. (also available at www.rflp.org/mainstreaming_gender/Mainstreaming_gender_handbook.pdf).

2 United Nations. 1997. *The Report of the Economic and Social Council for 1997* [online]. A/52/3. [Cited 20 March 2012]. www.un.org/documents/ga/docs/52/plenary/a52-3.htm

3 Bennett, E., Valette, H.R., Mäiga, K.Y. and Medard, M., eds. 2004. *Room to manoeuvre: gender and coping strategies in the fisheries sector*. Portsmouth, UK, IDDRA. 154 pp.

4 The FAO Fisheries and Aquaculture Department regularly collects employment statistics in fisheries and aquaculture related to the primary sector only. Therefore, the data exclude post-harvest activities.

5 Williams, M.J., Agbayani, R., Bhujel, R., Bondad-Reantaso, M.G., Brugère, C., Choo, P.S., Dhont, J., Galmiche-Tejeda, A., Ghulam, K., Kusakabe, K., Little, D., Nandeesha, M.C., Sorgeloos, P., Weeratunge, N., Williams, S. and Xu, P. 2012. Sustaining aquaculture by developing human capacity and enhancing opportunities for women. *In* R.P. Subasinghe, J.R. Arthur, D.M. Bartley, S.S. De Silva, M. Halwart, N. Hishamunda, C.V. Mohan and P. Sorgeloos, eds. *Farming the Waters for People and Food. Proceedings of the Global Conference on Aquaculture 2010, Phuket, Thailand, 22–25 September 2010*, pp. 785–822. Rome, FAO, and, Bangkok, NACA. 896 pp.

6 Weeratunge, N. and Snyder, K. 2009. Gleaner, fisher, trader, processor: understanding gendered employment in the fisheries and aquaculture sector. Paper presented at the FAO–IFAD–ILO Workshop on gaps, trends and current research in gender dimensions of agricultural and rural employment: differentiated pathways out of poverty, Rome, 31 March – 2 April 2009. 32 pp.

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More generally, toolkits such as the FAO Agri-Gender Statistics Toolkit (www.fao.org/gender/agrigender/en/) and Web sites such as FAO's Sharing our resources – participation (www.fao.org/Participation/) are also becoming available.

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