PART I

THE HUMAN CONTEXT FOR AN ECOSYSTEM APPROACH TO FISHERIES

1. Introduction and background

INTRODUCTION

In 2000, the United Nations Convention on Biological Diversity[1] (CBD) defined the ecosystem approach[2] (EA) as "a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way" and chose the EA as the primary framework for the CBD implementation; stressing a multidisciplinary collaboration to achieve the CBD objectives.[3]

In the fishery sector, the ecosystem approach has been similarly accepted as one of the key "vehicles" for developing and improving fisheries management. There have been, however, a multitude of variations on the definition of an EA; some have focused more on the natural science ecosystem components, while others stressed a more holistic and integrated (interdisciplinary) interpretation. In response to an international call for assistance to clarify what is meant by an EA in the fisheries context, the FAO published guidelines on the ecosystem approach to fisheries[4] in 2003.

Recognizing the wide range of interpretations of the approach, the FAO proposed the following definition, which is aligned with the more general EA but seeks a pragmatic balance by focusing the EAF on aspects within the ability of fisheries management bodies to implement, even while recognizing the fisheries sector's responsibility in collaborating in a broader multisectoral application of the EA:

> *an ecosystem approach to fisheries (EAF) strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties of biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries*

It is important to note that the concepts and principles of an EAF are not new – they are already either explicitly contained in a number of international and national instruments and agreements (e.g. as in the case of the CBD above) or implicitly manifested through local, regional, and international actions[5] – whether or not these explicitly used the term "EAF".[6]

In particular, other sector-specific applications of the EA include those to urban management, to drylands, to forestry, and to human health. Each of these is naturally interpreted from the perspective of the particular sector – albeit generally incorporating the trio of ecological, social and economic considerations. For example, the ecosystem approach to human health incorporates "human health considerations into the dynamic interrelations of ecosystem analyses" and "places humans in the centre of a series of

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1 http://www.cbd.int and CBC (2000). Report of the fifth meeting of the Conference of the Parties to the Convention on Biological Diversity. UNEP/CBD/COP/5/23.

2 For an historical description of the EA, see FAO (2003b).

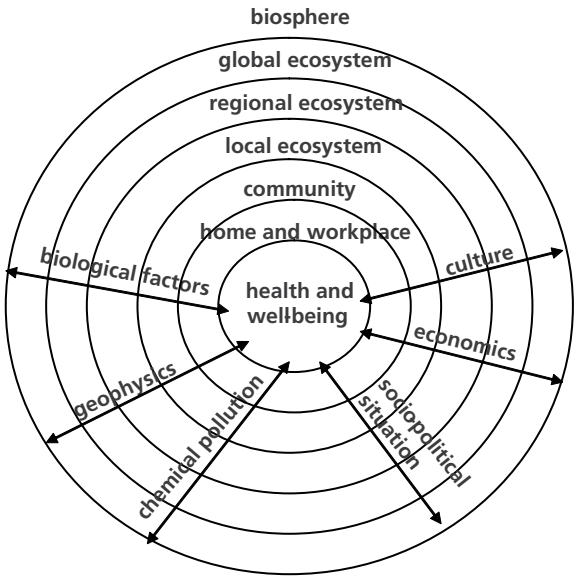
3 Which are "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding."

4 FAO (2003); hereafter referred to as the EAF Guidelines.

5 For brief presentations on national and international efforts at implementing the EAF, see the report from the Seventh meeting of the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (12-16 June 2006) available at http://www.un.org/depts/los/consultative_process/consultative_process.htm.

6 Similar or related concepts include the ecosystem-based fisheries management (EBFM), environmental management, ecosystem management, sustainable management and biodiversity management.

FIGURE 1
Framework for an ecosystem approach to human health



nested spheres, which can negatively and positively influence health and well being" as shown below.[7]

From the above discussion of EA and EAF concepts, the next step lies in understanding what the approach means in practice. This report is grounded in the belief that the **application** of the EAF must be holistic, integrated, participatory, and adaptive, and builds on the EAF Guidelines by providing here a focus on the human dimensions (i.e. political, legal, cultural, social, economic and institutional aspects) of such an application.

Specifically, this report acknowledges the following "entry points" of human considerations – social, economic and institutional – into the implementation of an EAF:

1. Social, economic and institutional objectives and factors may be **driving forces** behind the need for EAF management;
2. The **costs and benefits** of applying the EAF, whether to individuals or to society, have social, economic and institutional impacts and implications;
3. Social, economic and institutional **instruments** are all crucial for successful implementation of the EAF; and
4. Social, economic and institutional factors present in fishery systems can play either **supporting or constraining roles** in EAF implementation.

In other words, social, economic and institutional elements can be simultaneously drivers, constraints, and/or supports for EAF implementation, and in addition, there can be social, economic and institutional outcomes of that implementation. All of these "entry points" need to be taken into account in EAF discussions.

Basically, the EAF takes place in the context of societal and/or community objectives, which inherently reflect human aspirations and values. As implementation of the EAF is a human pursuit, the social and economic forces at play need to be understood, the incentives and disincentives driving human behaviour need to be investigated, and actions need to be undertaken in terms of fishery governance and corresponding institutional arrangements – all so that management can induce outcomes in the fishery compatible with societal objectives.

In addition, although focusing on the fisheries sector, EAF will have inter and intra-sectoral process components that must be taken into account, even if beyond the scope of the fisheries managers' direct responsibility. However, the more integrated or cross-sectoral the approach taken is, the more likely the attainment of sustainable development goals.

Certainly, the need to incorporate human components of the fishery system into an ecosystem approach is clear as humans are part of, depend on, and affect the ecosystem in which they live, work, and play. The challenge lies in implementation. This report seeks to provide support in meeting that challenge, by consolidating a range of available knowledge and experience relevant to EAF implementation, from social, economic and

[7] The Ecosystem Approach to Human Health and Neurotoxics Working Group – http://www.unites.uqam.ca/neuro/.

institutional viewpoints, and examining the manner by which these aspects can be practically incorporated, as well as highlighting the remaining gaps in both knowledge and implementation.

UNDERSTANDING THE COMPLEXITIES AND CONTEXTS

In any given fishery in which implementation of EAF management is being planned, it is important to understand the current state of the fishery and its natural and human environment (the starting point) – the context in which EAF is being developed. This must be the first step in interpreting the EAF for the given situation.

For example, knowing the context will help clarify if the particular EAF will be: incremental or wholesale, intersector or intra-sectoral, local or international, involving intensive scientific research or relying on the best available information, etc. Establishing this EAF context will involve not only understanding the fishery/ecosystem from both the natural science and human perspectives, but also society's goals and values with respect to ecosystem goods and services; the socio-economic context (at the micro and macro levels) in which the fishery operates; the policy and institutional frameworks in place; as well as the political realities and power dynamics affecting the governance of resources. A good understanding of these issues and other realities surrounding the use of aquatic resources is essential to guide EAF policies, objectives and plans – in their absence, policies and plans may very likely fail to assist in the move towards sustainable fisheries.

The human aspects that play a role in determining an EAF include the power and governance structures in place, the economic "push" and "pull" mechanisms driving the fishing activities, the socio-cultural values and norms associated with fishing, and the external contexts (e.g. global markets, natural phenomena, emergencies, and political changes) that impact on our ability to manage our fisheries. Chapters 2 through 4 describe many of the human dimensions and the techniques available assisting their evaluation, surrounding the EAF context.

The context also includes the *motivation* for the EAF. The list of potential factors driving fisheries managers, a community, or a society to adopt the EAF is as extensive and varied as the list of potential reactions to these drivers. These drivers may include human as well as biological factors, at any scale (from local to international), and may be reactionary or forward looking. For example, countries may be reacting to international treaties or conventions, to crises and conflicts within and around the fisheries, or to lobbying from special interest groups. Alternatively, countries may be adopting the EAF as part of a future framework for achieving sustainable development.

KEY CONCEPTS AND ISSUES

This part of the report discusses (i) the idea of an EAF management, highlighting the role of human aspects, (ii) key underlying issues in implementing the EAF (i.e., boundaries, scale and scope), and (iii) the relationship of the EAF to complementary approaches that also include broader looks at the components and interactions in the fishery (the livelihoods approach and integrated management).

EAF management

The word "management" has been purposely left out of the term "EAF" as the approach is not limited to management but applies to policy, legal frameworks, development, planning, etc. However, some of the early motivation for the EAF lay in the recognition that single-species stock assessment and management (what is referred to in the EAF Guidelines as "Target Resource Oriented Management" or TROM) could be insufficient and that there was a need to look more broadly at the surrounding ecosystem – prey and predator species, oceanographic effects, environmental impacts of other human activities, etc.

This broadening of attention from individual species to multiple fish species and ecosystems includes the management of a range of human interactions with the fishery ecosystem, whether technical, economic, social or institutional. Furthermore, the EAF must deal to some extent with interactions with other uses of the aquatic environment, and with linkages throughout the fishery system (e.g. to the post-harvest sector and the socioeconomic environment of the fishery).

Overall, then, the EAF must incorporate whatever ecosystem and human considerations are of direct relevance to fisheries management, i.e. which will typically need to be taken into account for effective fisheries management. This is not really any different from the situation in conventional fishery management, which also needs to take human considerations into account to be successful (even if this has not always been achieved – see, e.g. Charles, 1998a; Cochrane, 2000). However, as pointed out in the EAF Guidelines, the challenge is that much greater in EAF, given the consequent broadening of attention that is needed, to include aspects of ecosystems and of corresponding human elements.

There has been some progress in meeting this challenge, both in terms of moving towards an improved understanding of social, economic and institutional aspects relating to fishery management (and EAF in particular), and in terms of developing tools and instruments to improve management by taking this understanding into account. On the other hand, even with conventional management and certainly with EAF, there remains a gap between words and deeds when it comes to incorporating such aspects into fishery management. One indication of this gap is the recurring pleas from social scientists, over the past several decades, for increased progress in this direction.

The efforts of countries to address aspects of EAF have arisen in three main categories:

1. Issue-based technically-oriented actions, such as:
   - reducing the impacts on bycatch species;
   - increasing the selectivity and decreasing the harmful impacts of fishing gear;
   - protecting and restoring critical habitats and species interactions;
2. Implementation of institutional changes as part of national EAF measures, such as:
   - changing fisheries policies to include EAF and precautionary principles;
   - increasing stakeholder involvement in fisheries management;
   - creating multidisciplinary and/or intersectoral advisory groups/committees;
   - taking part in multicountry projects aiming at harmonizing management at the large marine ecosystem level;
   - using community-based management tools; and
3. Broadening the nation's information systems to include:
   - multispecies or ecosystem models (looking at changes across the food web);
   - bio-economic models (looking at changes across the fish and the fishing industry);
   - incorporated qualitative and quantitative models, such as people's perceptions;
   - multidisciplinary information in risk assessments and cost-benefit analyses;
   - local and/or traditional knowledge;
   - integrated indicator systems;
   - participatory information systems.

While there seem to be few examples to date of a comprehensive adoption of the EAF in all aspects of the fishery system (i.e. from the policy realm to implementing adaptive management operationally, and also adjusting institutional and other supporting frameworks), there have been many incremental moves, and the momentum is building towards broader use of the EAF in many fisheries.

Social, economic and institutional considerations in EAF

A wide range of social, economic and institutional considerations may be relevant to the implementation of an EAF:

1. First, EAF must take place in the context of societal and/or community objectives, which inherently reflect human aspirations and values.
2. Second, as EAF takes into account interactions between fisheries and ecosystems, this includes a wide range of complexities relating to human behaviour, human decision making, human use of resources, and so on.
3. Third, *implementing* the EAF is a human pursuit, with implications in terms of the institutional arrangements that are needed, the social and economic forces at play, and the carrots (incentives) and sticks (e.g. penalties) that can induce actions compatible with societal objectives.

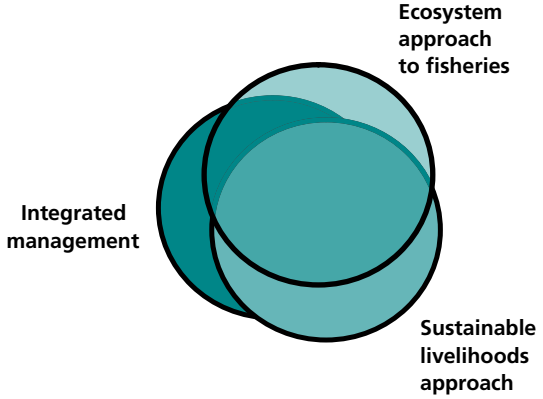
Indeed, the latter aspect – that of institutional arrangements – highlights the need in EAF for structured decision making processes, grounded in the accepted set of societal objectives, and governed by a suitable set of operating principles – what has been referred to as a "fishery management science" approach (Lane and Stephenson, 1995). The fishery objectives being pursued underlie the criteria for judging success, which are in turn needed in order to decide on the best management approach. Parallel to the objectives are principles governing fishery management, which influence the choices made of policy and management measures to best meet the stated objectives – these are drawn from a range of sources such as national legislation, international conventions, and "approaches" including the precautionary approach and the ecosystem approach.

Such processes must take place in a world of complexity, and the hope is that EAF provides an effective vehicle to better recognize and address the wide range of complexities in fisheries, complexities that can bear directly on the success of fisheries management. Social, economic and institutional aspects contribute as much to the set of complexities faced within fishery management as do those relating to fish species and the aquatic environment itself. For example, a fishery typically faces the complexities of: (a) multiple and conflicting objectives; (b) multiple groups of fishers and fishing fleets and conflicts among them; (c) multiple post-harvest stages; (d) complex social structures, and socio-cultural influences on the fishery; (e) institutional structures, and interactions between fishers and regulators; and (f) interactions with the socioeconomic environment and the larger economy (Charles, 2001).

EAF, the livelihoods approach and integrated management

The move towards a broader approach to fisheries management reflects the fundamental goal of sustainable development, in keeping with WSSD objectives. To this end, it is useful to look at the ecosystem approach to fisheries in comparison with two major multisectoral thrusts in global discussions relating to natural resource and spatial area management: the livelihoods approach and the integrated management approach. These complementary and overlapping approaches, and interactions with the EAF (Figure 2), are discussed in this section.

FIGURE 2
Relationships among the EAF, the LA and IM



The livelihoods approach

Just as the ecosystem approach has developed from an understanding of the need to manage target fish stocks and fishing in the broader context of the ecosystem, similarly the livelihoods approach (Ellis,

2000; Allison and Ellis, 2001) grew from a recognition of the need to place fisheries in a larger context of households, communities and socio-economic environments. Adopting a livelihoods thinking into EAF implies that fisheries management must look at fishers and fishing fleets in the context of where fishers live, in households, communities and fishery-based economies – just as it deals with the fish in the context of where the fish live, the ecosystem. Fisheries management thus deals with the fishery as one of a portfolio of livelihood sources (if such alternatives exist) and as potentially linked, through livelihoods, to other economic sectors.

A livelihoods approach can inform fisheries management in a number of ways, which may, if desired, be incorporated as well into EAF management:

- demographic: population and population trends, migration, age and gender structure;
- sociocultural: community objectives, gender roles, stratification, social cohesion;
- economic: income and its distribution, degree of fishery dependence, markets;
- institutional: community organization and infrastructure, involvement of women;
- marine Infrastructure: wharves, markets;
- community infrastructure: cultural facilities, schools, religious institutions;
- non-fishing activities: boatbuilding, agriculture, tourism, industry; and
- policy: linking fishery objectives to broader regional and national policy goals.

Integrated management

Integrated management (whether of oceans, coasts, watersheds, etc.) is an approach, or mechanism, to manage multiple (competing) uses of a certain designated area – uses such as fisheries, aquaculture, forestry, oil and gas, mining, agriculture, shipping and tourism. This involves managing multiple stakeholders[8] (e.g. local communities, industries) as well as interactions among people and ecosystems, and among multiple levels of government. The integrated management approach is typically characterized by attention paid to a multiplicity of resources (e.g. soil, water, fish stocks, etc.) and of habitats (e.g. open ocean, estuaries, wetlands, beaches, lakes, rivers, etc.), as well as a range of environmental factors (e.g. changes in water temperature, turbidity and acidity, chemical pollutants and water flows).

Typically, integrated management – like the EAF and the sustainable livelihoods approach – involves processes for participatory decision making and conflict resolution, and requires a range of information on characteristics of the designated area, from the local climate and the state of the ecosystem, to the relevant natural resources, and the human community (cultural, economic, social).

A key aspect of integrated management is the implementation of an institutional framework in which to manage the mix of components and interactions within the relevant system, incorporating these aspects within a wider context of human-environment interactions, institutional linkages, multiuse conflict, multistakeholder governance systems and the like. This aspect of integrated management, involving institutional frameworks and managing multiple uses, is similar to that of EAF, but operating in a multisectoral context (i.e. fisheries together with other marine, coastal and/or watershed uses, such as shipping, mining, etc.), rather than solely within the fishery sector. Thus, EAF and integrated management are very much complementary, needing to operate in synchrony even while their scope differs with respect to what is being managed.

[8] The concept of stakeholders comprises all interested parties, whether they are classified as primary, secondary or tertiary stakeholders.

CONCLUSIONS

Adoption of EAF management will, on the one hand, ensure that we take into account impacts of the broader fishery system (the ecosystem and relevant human elements) on fishery management, and at the same time, ensure that the broader consequences of management actions are assessed. The boundaries, the scale of management, and the scope of that management are all crucial factors to consider in implementing EAF management in practice. The EAF deals with the "bigger picture" around fisheries, specifically to allow us to encompass relevant factors affecting and interacting with management from across the fishery system and beyond. EAF management: (1) looks at managing target fish species and fishing activity within the context of the ecosystem; (2) looks at the fishery within a larger context of households, communities and the socioeconomic environment (with support from the livelihoods approach); and (3) considers fishery management in a broader institutional context of managing multiple resource uses (feeding into and interacting with integrated management approaches).

2. Human values of ecosystem services

INTRODUCTION

That ecosystems provide services[9] to human beings (e.g. food, recreation, water, aesthetics) is indisputable. The question of whether and how to formalize the values of these services to society remains a difficult and, at times, controversial subject. This chapter will present briefly: 1) an overview of potential services provided by ecosystems; 2) an overview of the various classifications, from the point of view of economists, of the values that humans may attribute to these services; 3) the methodologies in use to estimate these values, qualitatively or otherwise; and 4) how this information can help in implementing the EAF.

ECOSYSTEM SERVICES

Ecosystem services are a sub-set of the intricate workings of ecosystems in that they are those benefits, both tangible and intangible, provided by ecosystems for which there is an explicit demand by humans (MEA, 2005a)[10]. Trying to make sense of and organize conceptually the myriad of such services provided would be a complicated task for any natural resource manager. Fortunately, in undertaking a global review of ecosystems and their services, the Millennium Assessment (MEA, 2005a) has reviewed various classifications of ecosystem services and suggested a set of four, sometimes overlapping, categories:

- **Provisioning** – the products obtained from ecosystems, including food and fibre, fuel, genetic resources, bio-chemicals, natural medicines, pharmaceuticals, ornamental resources, and fresh water;
- **Regulating** – the regulation of ecosystem processes including those relating to air quality, water, climate, human diseases, erosion, biological controls, and storm protection;
- **Cultural** – the nonmaterial benefits people obtain from ecosystems through, for example: spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences, including cultural diversity, spiritual and religious values, knowledge systems, educational values, inspiration, aesthetic values, social relations, sense of place, cultural heritage values, and recreation and ecotourism; and
- **Supporting** – the benefits "that are necessary for the production of all other ecosystem services. They differ from provisioning, regulating, and cultural services in that their impacts on people are either indirect or occur over a very long time."

Fishery-related ecosystem services would be a further sub-set relating to the ecosystem services of importance to fisheries. The definition of this sub-set would be context specific and could range, depending on the scope of the EAF, from being very

[9] The term "services" includes tangible goods (food, water, etc.) as well as intangible services (cultural, ecological, etc.).

[10] Boyd *et al.* (2004) note that "it is the services created by ecological characteristics that will be explicitly tied to social value" and make the distinction that "ecosystem services are the outcomes of ecosystem functions that yield value to people."

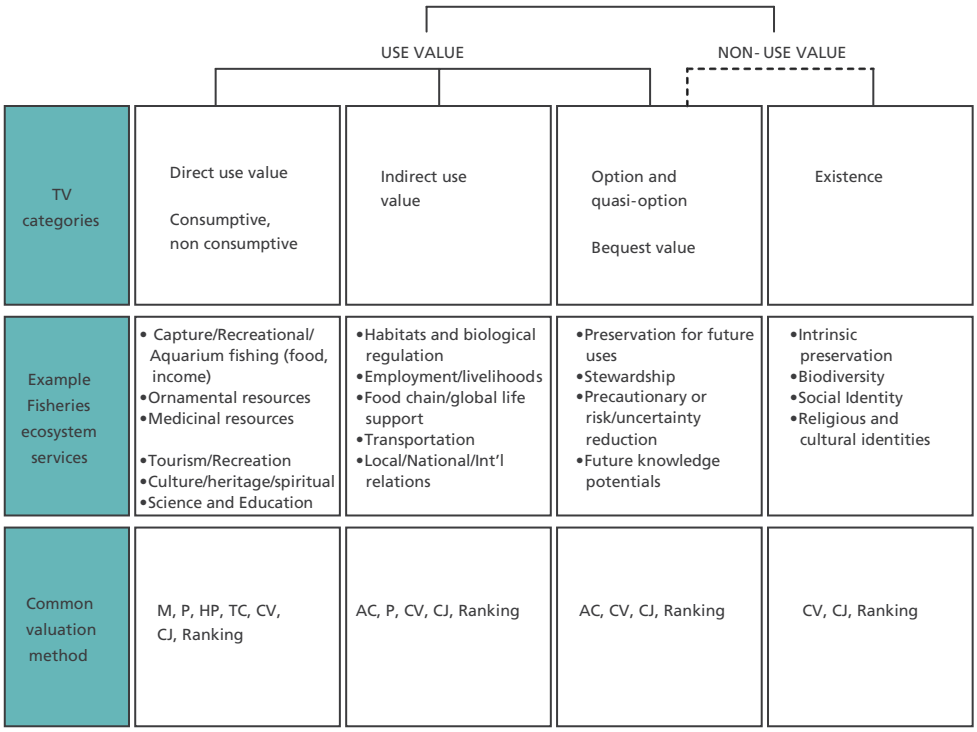
narrow, only including aspects of the target and related species, to a broader inclusion of the entire gamut of ecosystem services, however linked to the fisheries at hand. Ideally, one should move as far towards the latter definition as possible, to incorporate as integrated an EAF implementation as possible. When making decisions about certain fisheries, fisheries managers and other stakeholders would need to know the impacts of their decisions (or lack of decisions) on other sectors and/or benefit holders, in terms of the stream of services provided. Activities meriting management could include, for example, (1) upstream agriculture runoffs impacting the fishery ecosystem's ability to regulate water quality and hence support abundant populations of the targeted species, or (2) destructive fishing practices, such as dynamite fishing harming coral systems, which negatively impact the tourism sector or other members of the community who benefit from the coastal region.

Every time a decision is made, whether it be to start, stop, or change an activity, the decision will impact the stream of services provided by the natural system and, either directly or indirectly, human welfare. Behind any decision, there may be winners and there may be losers in terms of welfare and there will certainly be tradeoffs. Decision-makers in fisheries need to understand what services the aquatic ecosystems provide, to whom (e.g. the fisheries, the communities and economies dependent on them, and others who hold value for these services), and how the distribution of these services will change once the decision is implemented.

THE VALUE OF ECOSYSTEM SERVICES TO HUMAN WELL-BEING

Just as it is useful to categorize ecosystem services to aid in understanding what they are, so too is it useful to categorize the types of values individuals and societies hold for these services. An attempt at such a categorization is presented in Figure 3, providing

FIGURE 3
Total value of a fisheries ecosystem



Sources: adapted from MEA, 2005b; Farber *et al*., 2006
Notes: M = market methods, P = Production approaches, HP = Hedonic Pricing, TC = Travel Cost, CV = Contingent Valuation, CJ = Conjoint analysis, AC = Avoidance Cost

a schematic framework for the various categories of values that humans may hold for ecosystem services.

The framework is divided into use values and non-use values for a particular ecosystem's services. Use values occur when individuals and societies derive benefits and, hence, have value for ecosystems services they use or interact with directly, such as for food, for recreational activities and relaxation, and for other tangible products that come from these ecosystems (direct use). Non-use values, on the other hand, reflect situations in which we value the services indirectly for their supporting and regulating functions, such as maintaining water quality and community traditions (indirect use).

Individuals and societies also value ecosystems for what they represent for the future. Some may value today the knowledge that their grandchildren will benefit from these services and others value having resources available in the case they become necessary for their direct use in the future (referred to as "option value"). In addition, some value the services independently of anyone's current or future uses of these services ("existence values"). This category represents a philosophical value of the inherent right of ecosystems and communities to exist now and in the future. This perhaps vague but very important value can reflect the idea that each part of the ecosystem exists for a reason, whether we are aware of the reason or not, and therefore should be valued as part of the ecosystem.

The above framework may assist in determining the list of ecosystem services potentially affected by management actions. In this regard, two points should be noted. First, it is important to differentiate between the values of a given individual, and those collective values of a community, or of society as a whole. Second, one can expect debates to occur over the balancing of the various values described here – use, non-use, existence and option values. Overall, the key act of bringing together the multisectoral, multidisciplinary stakeholders involved, to identify the various values linked to an ecosystem and to consider which are likely to be affected by management decisions (and how) is one step in understanding the interactions of the fishery and its ecosystem.

The next step in the management process stems from limitations imposed by two realities: 1) that financial and human resources are not unlimited, and 2) that often we cannot improve everything all the time (i.e. there will be tradeoffs attached to each decision). Because of such constraints, decision-makers need some way of prioritizing the changes to the various ecosystem services.

There exist techniques to identify the EAF "issues" and risks in specific fisheries and to determine preliminary priorities for those issues, such as check lists and problem/component trees combined with risk assessments[11,12]. Component trees assist in organizing the scoping and understanding of the services provided by ecosystems. For example, a top level of the tree may branch out into three categories: ecological well-being, economic well-being, and ability to achieve; followed by successive branches organizing ecosystem services further, such as in Figures 4a and 4b. Stakeholders would use these trees to organize their thoughts regarding the ecosystem in question.

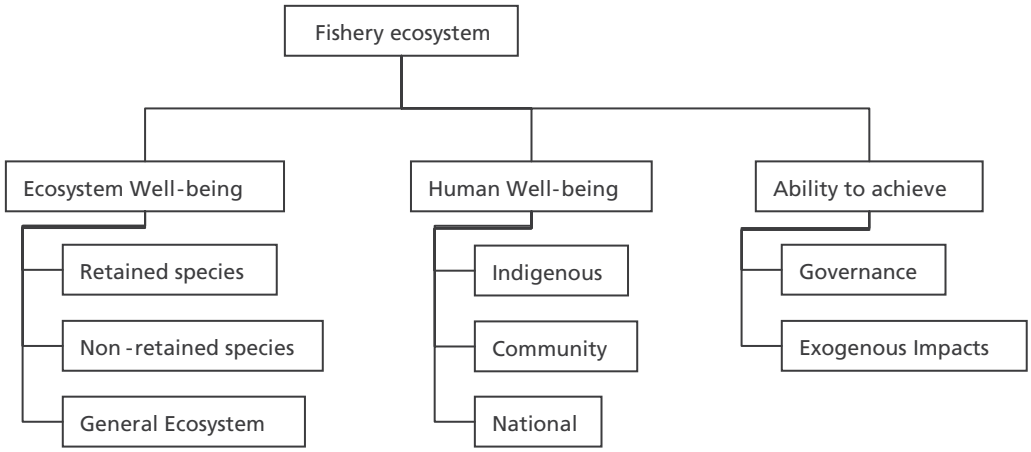
Once the (probably) large number of services has been identified, some sort of prioritization would need to take place before investing in additional analyses. Fletcher *et al.* (2002) propose analysing the magnitudes and probabilities of change in services from implementing a management decision (or not) through risk assessment techniques. This risk assessment would help pull out the relatively highly important services that would require immediate additional consideration.

[11] For example, see the methods used in the ecologically sustainable development (ESD) process for fisheries in Australia; http://www.fisheries-esd.com.

[12] The EAF Guidelines promote this approach and it has been used by FAO in a number of case studies, including the Benguela Current Large Marine Ecosystem programme. In addition, the FAO is developing more globally applicable problem trees based on the Australian ESD trees.

FIGURE 4A

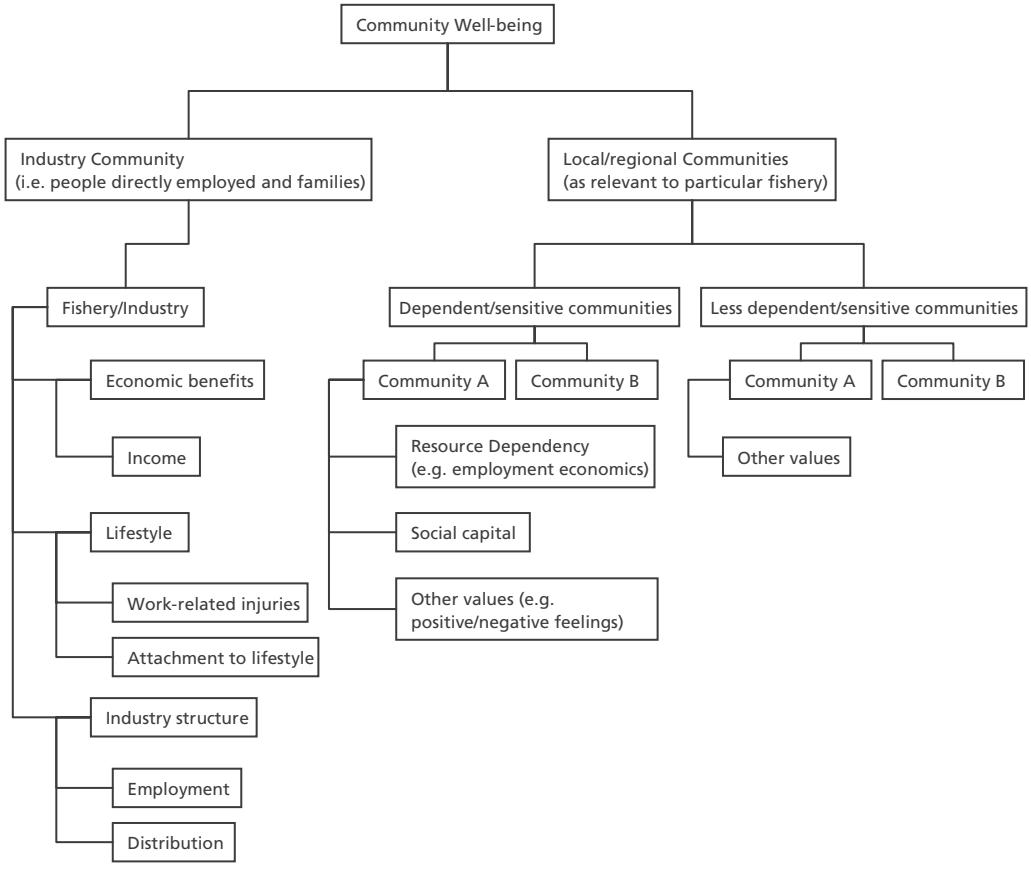
Top level component tree for understanding the contributions of a fishery ecosystem to well-being



Source: Adopted from Fletcher *et al*., 2002

FIGURE 4B

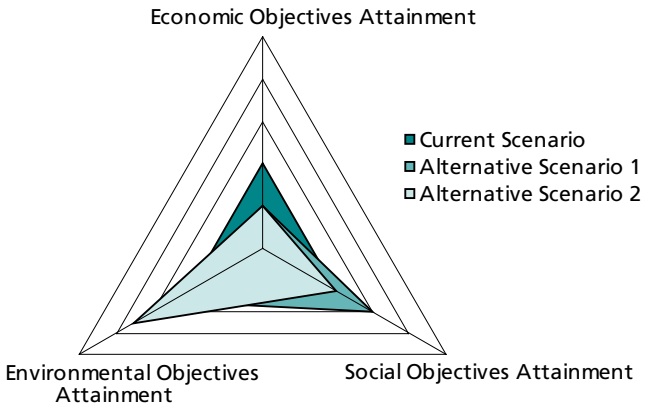
Lower level component tree for understanding the contributions of a fishery-related ecosystem to socio-economic well-being



Source: Fletcher *et al*., 2003

The following section describes some of the methods (quantitative and qualitative) available for further analysis in order to assist decision-makers when contemplating management actions.

FIGURE 5
Example tradeoff representations of alternative management scenarios



METHODOLOGIES FOR ASSESSING THE VALUE OF FISHERIES ECOSYSTEMS

As it is impossible to maximize all societal objectives concurrently, tools are necessary to describe the social, economic, and environmental tradeoffs involved with each management alternative. For example, in Figure 5, three management alternatives are presented in terms of their attainment of environmental, social and economic goals. Each alternative has its own mix of impacts. In order to make comparisons among the possible alternatives, it is useful to have a standardized basis for comparison between two or more states of goods and services provided by an ecosystem. This section presents a few methods commonly used in economics to provide standardized information for decision making.

Given that the cost-benefit framework[13] is currently the most common method for comparing alternatives in decision making, the issue of standardizing the values of services becomes imperative, as important values may be ignored if they are not placed into the cost-benefit language. The rational for this economic valuation[14] approach includes the assumptions that 1) in the absence of such valuations, potential changes in ecosystem services may be otherwise attributed either a zero or an infinite value in a cost-benefit analysis decision-making process; 2) such an approach provides a common unit of measurement (either monetary or ranking) for understanding the contribution of fisheries ecosystems to human well-being and understanding the potential tradeoffs among these contributions linked to management choices; and, 3) human beings make decisions in line with the incentives they face, so understanding such incentives would enable decision makers to understand current fishery ecosystem use choices and potential changes in these choices if such incentive structures evolve.[15]

Figure 3 above, matched the use and non-use categories of ecosystem services with a few of the common methods used to evaluate these services. These methods may be grouped into (1) those that estimate a monetary value for a service and (2) those that do not attempt to place a nominal value but try to provide relative values. The former group estimates how much people are willing to pay for a service or a change in a service and include market-based as well as non-market-based methods. Market-based values are relatively easier to estimate, as quantitative values exist already in one form or another, although they may require some filtering in order to isolate the value of the service at hand. For example, the value of a healthy bay may be nested within the real estate values surrounding the bay. Additionally, the value of a fishery may be theoretically reflected in the value of the use rights to the fishery.

[13] See Chapter 6 for further details on cost and benefits related to the EAF as well as cost-benefit analyses.

[14] Economic valuation differs from other disciplines' values (e.g. ecological value) in that it is focused on human preferences and is measured in terms of how much individuals are willing to forego in other goods and services to obtain a given good or service (Lipton *et al.*, 1995).

[15] See Chapter 7 for a discussion on the use of incentives for obtaining management objectives.

BOX 1

Sample methodologies for assessing value of fisheries ecosystems to human well-being

Conventional economic valuation

Revealed-preference approaches

Travel cost: Valuation of site-based amenities are implied by the costs people incur to enjoy them (e.g. improved sports fishing activities, whale watching);

Market methods: Valuations are directly obtained from what people must be willing to pay for the service or good (e.g. ecolabelling price differentials, increased value of a fishery);

Hedonic methods: The value of a service is implied by what people will be willing to pay for the service through purchases in related markets, such as housing markets (e.g. vessel purchases, housing purchases on coastal areas and waterfronts); and

Production approaches: Service values are assigned from the impacts of those services on economic outputs (e.g. increased efficiency from bycatch reduction methods, improved CPUE in a fishery).

Stated-preference approaches

Contingent valuation: People are directly asked their willingness to pay or accept compensation for some change in ecological service (e.g. coastal reef preservation, endangered species protection); and

Conjoint analysis: People are asked to choose or rank different service scenarios or ecological conditions that differ in the mix of the conditions (e.g. marine protected areas with varying levels of permitted human activities).

Cost-based approaches

Replacement cost: The loss of a natural system service is evaluated in terms of what it would cost to replace that service (e.g. alternative coastal livelihoods); and

Avoidance cost: A service is valued on the basis of costs avoided, or the extent to which it allows the avoidance of costly averting behaviours, including mitigation (e.g. participatory fisheries management reduces conflicts, health benefits of fish products).

Non-monetizing valuation or assessment

Individual index-based methods, including rating or ranking choice models, expert opinion (e.g. expert review of sea turtle stocks, their conservation, status, and major threats).

Group-based methods, including voting mechanisms, focus groups, citizen juries, stakeholder analysis (e.g. fisheries management advisory councils, GIWA LME assessments).

Notes: Examples have been changed to reflect fisheries aspects. For a concise review of these methods including limitations, see Pagiola *et al*. (2004).

Source: Farber *et al.* (2006).

Non-market-based methods are necessary when the ecosystem service in question is not traded in a market. Examples of such services include the cultural identity of coastal communities, the preservation of ecosystems for their intrinsic value, or changes in water quality. Although without established prices, these services may be highly valued. Non-market based methods tend to focus on creating fictional markets for the service in question in that people are asked to contemplate how much of market

goods, which have established prices, they would be willing to forego in exchange for the service. For example, an individual can conceptualize foregoing a meal in order to support the conservation of a marine mammal. If on average, this person spends $30 on a meal, they would be willing to pay $30 for the conservation activity.

Non-monetary methods focus on the relative values of services in that they provide information regarding one ecosystem service relative to another ecosystem service (e.g. it would be more detrimental to well-being to lose service A than service B).

The box below lists some of the methodologies in use for assessing values of fisheries ecosystems to human well-being. Each approach is replete with its own set of limitations, criticisms, and cost implications, and the application of each will depend on the specific issue at hand. Appendix 2.1 provides examples of fisheries-related case studies in which these methodologies have been applied. These examples have been chosen to represent the wide-range of methodologies and their application to multiple fisheries-related issues; however, they do not fully represent the limitations and assumptions associated with each methodology.

HOW ECOSYSTEM VALUATION CAN HELP IN IMPLEMENTING THE EAF

Such valuation methods would provide nominal or relative value estimates, which would then be incorporated into a broader evaluation or into decision-making mechanisms, such as cost-benefit analyses, indicator frameworks, national accounting systems, asset mapping, and bio-economic models. As mentioned previously, such mechanisms would allow the decision-makers to better understand the social, environmental, and economic tradeoffs related to any management alternatives. The use of such broader evaluation mechanisms in EAF management will be discussed in Chapter 6. A complete review of conceptual and practical issues regarding cost-benefit analyses with special regard to the environment may be found in Pearce *et al.* (2006).

There are various caveats to emphasize. First, the valuation of many ecosystem services, especially non-market benefits, is complicated and often costly and will not resolve all decision-making questions. Many, indeed, are ethically opposed to the idea of placing a value on the ecosystem or on cultural values. Furthermore, other ethical issues, such as balancing existence and bequest values against use values, or treating the winners and losers of management measures equally, may remain at the discretion of decision-makers. Second, many of these methods are based on individual preferences and values, which are then aggregated by the number of individuals "affected". This is not necessarily the same value as a societal value of a service.

CONCLUSIONS

The EAF calls for the inclusion of a wide range of ecosystem services in planning, management, and development. Many methods exist for assisting in deepening our knowledge of the value of ecosystem services to individuals, communities, and societies. These values may then be placed into the appropriate decision-making tools in order to understand the possible trade-offs and impacts of the management options under evaluation. Unfortunately, such information comes at a price; therefore, proper thought and planning are necessary before investing in the data collection and analysis process. Included within this planning is the explicit identification by fisheries managers of their objectives and needs with respect to data collection in the search for the most appropriate (and least cost) methods for obtaining these data.

APPENDIX 2.1
Examples of the use of valuation tools in fisheries

Case study – *Contingent valuation*: economic value of non-commercial fish

Situation – Rivers in the Four Corners Region (United States of America) provide 2 465 river miles of critical habitat for nine species of fish that are listed as threatened or endangered. Continued protection of these areas required habitat improvements, such as fish passageways, as well as bypass releases of water from dams to imitate natural water flows needed by fish. A contingent valuation survey was used to estimate the economic value for preserving the critical habitat.

Application – Survey respondents were provided detailed maps that highlighted the areas designated as critical habitat units for the fish. They were told that some State and Federal officials thought the combined costs of the habitat improvements and the restrictions on hydropower were too costly and had put forward a proposal to eliminate the critical habitat unit designation. They were asked if they would contribute to the Four Corners Region Threatened and Endangered Fish Trust Fund.

Respondents were also told that efforts to raise funds would involve contributions from all United States taxpayers. If a majority of households voted in favor of the fund, the fish species would be protected from extinction. This would be accomplished through water releases from Federal dams timed to benefit fish, and through the purchase of water rights to maintain instream flows. Also, within the next 15 years, three fish species would increase in population to the point that they would no longer be listed as threatened species.

On the other hand, if a majority of households in the United States voted not to approve the fund, the critical habitats shown on the map would be eliminated. This would mean that water diversion activity and maximum power production would reduce the amount of habitat for these nine fish species. Respondents were told that if this occurred, biologists expected that four of the nine fish species would likely become extinct in 15 years.

The exact wording on the questionnaire was: Suppose a proposal to establish a Four Corners Region Threatened and Endangered Fish Trust Fund was on the ballot in the next nationwide election. How would you vote on this proposal? Remember, by law, the funds could only be used to improve habitat for fish. If the Four Corners Region Threatened and Endangered Fish Trust Fund was the only issue on the next ballot and it would cost your household $_____ every year, would you vote in favor of it? (Please circle one.) YES / NO

The dollar amount, blank in the above illustration, was filled in with one of 14 amounts ranging from $1–$3 to $350, which were randomly assigned to survey respondents.

Results – The questionnaire was sent to a random sample of 800 households in the Four Corners states of Arizona, Colorado, New Mexico, and Utah (with the proportions based on the states' relative populations). An additional 800 households were sampled from the rest of the United States. The average willingness to pay was estimated to be $195 per household. When extrapolated to the general population, the value of preserving the habitat areas was determined to be far in excess of the costs.

Source: King and Mazotta, Undated.

Case study – *Conjoint analysis:* choice management of the Peconic Estuary System, New York

The situation – The environmental and natural resources of the Peconic Estuary System (United States of America)—the bay waters, beaches, wetlands, ecosystems, habitats, and parks and watershed lands—provide many services to the public. The Peconic Estuary Program was established under the National Estuary Program, to create a conservation and management plan for the environment and natural resources of the Estuary.

The challenge – In order to develop a management plan that best serves the public, information was needed about the value that the public holds for the ecosystem services of the Estuary.

The analysis – Several studies were conducted to estimate the uses and economic values associated with the Estuary, including a contingent choice survey to estimate the relative preferences and economic values that residents and second homeowners have for preserving and restoring key natural and environmental resources: open space, farmland, unpolluted shellfish grounds, eelgrass beds, and intertidal salt marsh.

The results – Early discussions revealed that the public has a strong attachment to environmental and amenity resources of the Peconic Estuary, even if they do not use these resources directly. Most respondents to the survey (97 percent) supported at least one hypothetical action to protect resources, and indicated they would financially support such actions. The relative priorities of respondents for protecting natural resources, in order, were for farmland, eelgrass, wetlands, shellfish, and undeveloped land. The estimated per acre dollar values were about $13 000 for undeveloped land, $30 000 for unpolluted shellfish grounds, $54 000 for saltmarsh, $66 000 for eelgrass and $70 000 for farmland. The survey results indicated that the resource priorities, or relative values of resources, are more reliable than are the dollar estimates of values, and thus the researchers recommended that relative values, rather than dollar values, be used in the process of selecting management actions.

Source: King and Mazotta, Undated.

Case study – *Production function*: mangrove-fishery valuation in southern Thailand

"The undervaluation of natural products and ecological services generated by mangrove ecosystems is a major driving force behind the conversion of this system into alternative uses." (Rönnbäck, 1999)

The situation – In recent decades, over 1975–1993 the area of mangroves has virtually halved, from 312 700 hectares (ha) to 168 683 ha. Although the rate of mangrove loss has slowed, in the early 1990s the annual loss was estimated to be around 3 000 ha/year for all of Thailand, and 1 200 ha/year in Surat Thani province. The Gulf of Thailand mangroves are thought to provide breeding grounds and nurseries in support of several species of demersal fish and shellfish, mainly crab and shrimp.

The analysis – To analyse the impact of mangrove deforestation on these fisheries in Surat Thani, harvesting in both demersal and shellfish fisheries was assumed to follow a Cobb–Douglas function of the level of fishing effort and mangrove area. A separate harvesting function was assumed to apply to demersal fish as opposed to shellfish. A panel analysis was conducted to estimate the effort function for all shellfish and all demersal fish in the Gulf of Thailand. The analysis combined harvesting, effort and mangrove data across all five zones of the Gulf of Thailand and over the 1983–93 time period. The cost functions derived for each fishery were used to estimate the likely welfare impacts of a change in mangrove area in Surat Thani, assuming alternatively open access and managed fishery conditions.

The results – For all mangrove-dependent fisheries, the value of a change in mangrove area ranged from US$33-110/ha, depending on whether the fisheries are open access or Managed and the demand elasticity. Given an annual loss of 1200 ha of mangroves in Surat Thani, which was approximately the annual rate of mangrove conversion recorded in the early 1990s in the province, the economic loss in terms of support of the Gulf of Thailand fisheries in Zone three was estimated to be around US$100 000 per year, if these fisheries were optimally managed. Under open access conditions, this economic loss ranges from US$40 000 to US$132 000, depending on demand elasticities.

These partial results should then be placed within a multiple-use, multiple-objective context in which the benefits and costs of alternative land-use choices may be evaluated and compared.

Note: For a discussion of the value for seafood production (aquaculture and capture-based) of mangroves, see Rönnbäck (1999).

Source: Barbier, 2000

Case study – Destruction and loss costs of coral reefs in the Philippines

- Healthy coral reefs can produce, on a sustainable basis, 20 tonnes or more of fish and other edible products per square kilometer per year; once destroyed by use of dynamite or cyanide for fishing, production is reduced to less than 4 tonnes/km²/yr. The sustainable catch from a good reef over ten years is about 200 tonnes while a destroyed but recovering reef catch over the same period is only 72 tonnes – the loss being 128 tonnes of fish with an estimated value of US$192 000 (US$19 200 yearly) at current (year 2000) market prices for reef fish.
- The net present value of benefits per km² from blast fishing to individuals over 25 years (assuming a ten percent discount rate each year) is only US$14 600. This small gain is compared to losses of: US$400 000 from loss of tourism potential, more than US$190 000 from loss of coastal protection and about US$108 000 from foregone sustainable fishery income, all dependent on a healthy coral reef.
- Bacuit Bay, Palawan was the subject of a study that determined that over a ten-year period reef fisheries and tourism would generate US$41 million more than logging the forests in the watershed affecting the bay. Logging in this case caused sedimentation that would have destroyed the coral reefs for both fisheries and tourism in the bay.

Source: compilation of studies by White *et al.*, 2000

Case study – *Travel cost* estimation: oyster reef restoration project in Chesapeake Bay

The situation – For nearly half a century, oyster harvests (and stocks) have been declining in both Maryland and Virginia (United States of America). Three factors have led to the decline of the oyster: over harvest, disease, and sedimentation. Because of the decline in oyster stocks, today's harvests are one percent of levels forty years ago. Closely associated with the decline of the oyster population is the destruction of three dimensional oyster reefs due to commercial harvest of oysters for their meat, the harvest of oyster shell as road substrate, and the clearing of navigational obstructions. In response, the states of Maryland and Virginia in cooperation with the United States Federal Government have been investigating several options to restore the oyster populations; one of which is the creation of artificial reef substrate combined with an aggressive seeding program. The high costs related to reef creation are relatively easy to estimate (almost US$15 000/acre for a total of approximately US$30 million) but the benefits (e.g. oyster resource, finfish habitat improvements, overall ecosystem productivity) are more difficult to evaluate. Therefore, estimates of the benefits of reef restoration are necessary to determine a positive benefit-cost ratio of such projects.

The analysis – A subset of the beneficiaries of an improved oyster reef project included angler reef fishers through potentially improved catch or water quality. The study first linked the policy variable (creation of oyster reefs) to anglers' preferences for fishing, then use a travel cost model to estimate the willingness to pay per trip for an oyster restoration project under two scenarios: the first in which historical catch rates do not change and the second in which stock level increase. In both cases, it is assumed that the number of trips/angle would remain constant.

The results – Total annual willingness to pay by recreational fishers in the Chesapeake Bay was estimated for the two scenarios at approximately US$638 000 and $5 000 000, respectively. Under the first scenario, the anglers' willingness to pay would cover 50 percent of the total restoration costs within thirty years. Under the second scenario (albeit highly speculative) the full restoration costs would be covered within less than five years.

Source: Hicks *et al.*, 2004

Case study – Group-based evaluation of ecosystem services: Plum Island, Massachusetts (United States of America)

The situation – Natural and human-based changes have affected the capacity of an estuarine drainage basin to provide ecosystem services, such as gas, disturbance, and water regulation, water supply, food production, recreation, aesthetics, and spiritual and holistic services. Several management alternatives could be used to address various objectives each with related tradeoffs, such as increasing water supply while maintaining adequate river flow, preserving open space, and maintaining a productive estuarine clam fishery. Two such alternatives are analysed through a services-based approach: business as usual and replumbing sewer and stormwater systems.

The analysis – The effects on ten ecosystem services are scored from -3 to 3 for both the business as usual and the replumbing alternatives. Weights, from 0 to 3, are used to rank each service in terms of its importance. A "value" of each service change is then estimated as the weighted sum of the changes in services.

The results – While the total score for each scenario was negative (-94 for business as usual and -67 for replumbing), the results suggested that replumbing, which would allow continued suburbanization but with adequate river flow, avoids more losses in services than the business as usual scenario. Specific valuation of each service would need to be undertaken; however, such a matrix allows for a relatively inexpensive ranking of scenarios, importance weighting of ecosystem services, and the inclusion of both quantifiable and non-quantifiable values.

Source: Farber *et al*., 2006

3. Policy, legal and institutional frameworks

POLICY FRAMEWORKS AFFECTING EAF

The ecosystem approach to fisheries is not an end in itself, but rather a mechanism intended to help better achieve societal objectives through producing more responsible fisheries, and in particular through broadening conventional fisheries management into an integrated, participatory framework that takes better account of the interaction of fisheries with aquatic ecosystems, as well as with interacting human uses.

As such, EAF interacts with other approaches that have been implemented, or are emerging, in the world's fisheries – such as the precautionary approach and co-management approaches – as well as interacting with international conventions (such as the Convention on Biological Diversity), regional initiatives (such as Regional Fisheries Management Bodies) and particular national legal and regulatory frameworks. This section reviews some of these interactions, from the perspective of policy considerations, while the following section of this chapter focuses on institutional aspects of the relevant linkages.

The specific policy frameworks and approaches discussed here are:

- Millennium Development Goals
- Precautionary approach
- Management and co-management approaches
- International policy frameworks
- "Pro-poor" policies

Millennium Development Goals

The Millennium Development Goals impact significantly on policy priorities globally, in particular renewing the focus on seeking an appropriate balance of human development and environmental conservation – a balance that developed from the Brundtland Commission and on through the Rio Declaration and Agenda 21, now being reflected in the Goals themselves:

- Eradicate extreme poverty and hunger
- Achieve universal primary education
- Promote gender equality and empower women
- Reduce child mortality
- Improve maternal health
- Combat HIV/AIDS, malaria, and other diseases
- Ensure environmental sustainability
- Develop a global partnership for development

Implementation of EAF fits closely within the balance noted above, in that it seeks (1) to ensure the sustainability of fishery use, i.e. of the benefits to people accruing through fishery activities, in particular by ensuring that fishing practices do not compromise ecosystem health and by limiting negative impacts on fishery ecosystems arising from outside the fishery sector, while (2) being implemented in keeping with societal objectives, however defined (and often reflecting many of the above Millennium Development Goals, such as poverty reduction and food security).

While EAF is certainly broadly compatible with these goals, it is nevertheless important to assess the benefits and costs of EAF implementation with respect to

these goals. In other words, any given policy or operational management mechanism to implement EAF may have positive impacts on one or more of the goals, but may also have costs involved. A wide range of possibilities may arise. It is possible, for example, that an initiative to protect a depleted population of a certain species, through EAF measures, would produce positive results in terms of goal #7 (Environmental sustainability), but may restrict harvesting activities so that (at least in the short term) the catch of other species is reduced, which could have a negative impact on goals #1 and #4 (Eradicate extreme poverty and hunger, Reduce child mortality). Alternatively, a "win-win" EAF measure, such as reducing unwanted bycatch in offshore fishing activities, may be positive on all counts – improving environmental sustainability while also improving the food supply in the short term (there being immediately more fish available to small-scale coastal fishers) and in the long term (with less pressure on bycatch species, leading to stock rehabilitation).

Precautionary approach

The precautionary approach (Garcia, 1994; FAO, 1995a) provides a policy and management framework for dealing with the various forms of uncertainty faced in fisheries management (Francis and Shotton, 1997; Charles, 1998b and 2001). Aspects of this range from appropriate risk assessments to robust and adaptive fishery management methods, to appropriate institutions capable of implementing such a management approach. As FAO (1995a, p.6) notes:

> *Management according to the precautionary approach exercises prudent foresight to avoid unacceptable or undesirable situations, taking into account that changes in fisheries systems are only slowly reversible, difficult to control, not well understood, and subject to change in the environment and human values.*
>
> *Precautionary management involves explicit consideration of undesirable and potentially unacceptable outcomes and provides contingency and other plans to avoid or mitigate such outcomes. Undesirable or unacceptable outcomes include overexploitation of resources, overdevelopment of harvesting capacity, loss of biodiversity, major physical disturbances of sensitive biotopes, or social or economic dislocations. Undesirable conditions can also arise when a fishery is negatively influenced by other fisheries or other activities and when management fails to take action in the face of shifts in the external conditions affecting, for example, the productivity of the fish stocks.*

Some aspects of implementing the precautionary approach are analytical in nature. For example, a major focus of attention in fisheries has been on efforts to operationalize the precautionary approach in terms of determining and setting suitable limits on catch, fishing mortality or fishing effort. This involves a combination of *risk analysis* and *risk management*, with methods such as management procedures providing analytical frameworks to support the implementation of a precautionary approach.

Equally important is the implementation of the precautionary approach at a policy level. This deals not with analytical matters but rather with the various assumptions and approaches underlying fishery decision making – and how to determine suitable "rules" *governing* decision making (as opposed to decision rules *per se*). This involves questions of the *burden of proof* and the *standard of proof*, the latter relating to "the responsibility for providing the relevant evidence and the criteria to be used to judge that evidence" (FAO 1995, p.6). Specifically, "the standard of proof to be used in decisions regarding authorisation of fishing activities should be commensurate with the potential risk to the resource, while also taking into account the expected benefits of the activities".

Properly putting the precautionary approach into practice requires new information and research. For example, the FAO (1999a) has described a number of implications on the work of Regional Fishery Bodies, e.g. that "uncertainty should be systematically investigated", "outputs should be identified corresponding to objectives", "target and limit reference points should be established", "robustness of management regime to (a)

overfishing and (b) environmental change should be assessed" and "contingency plans should be developed".

The link between the precautionary approach and the ecosystem approach is a logical one: the first calls for suitable use of precaution in decision making, while the second calls for suitable breadth in what is considered within the decision-making. Together, the two approaches imply a significant challenge – to assess and manage a set of uncertainties and risks, but at a broader scale and with a broader scope, covering a range of possibilities larger than what would have been considered in conventional fishery management.

A key benefit of this combination lies in the inherent desirability of integrating approaches for addressing two major realities of fisheries – uncertainty (the precautionary approach) and complexity (the ecosystem approach). On the other hand, there can be costs as well. One such cost arises as a result of combining the greater information needs implied in implementing EAF management (relative to conventional fishery management) and the reality that such a level of information is often unavailable. In this case, the manner by which one applies the precautionary approach becomes a key issue. For example, in the extreme, being highly precautionary within a situation of great ignorance (e.g. a lack of information on all aspects of the ecosystem) could be accompanied by the risk of high costs arising from foregone economic activity and livelihoods, and lowered food security.

From the perspective of social, economic and institutional considerations involved in EAF implementation, the precautionary approach implies a need to take into account a broad set of risks, including (a) those that might arise in fishery use, in terms of environmental impacts, (b) those posed by aspects outside the fishery, such as other economic sectors, but which might impact negatively on the fishery, and (c) those that arise in EAF implementation itself, such as the risk of possible negative social or economic impacts from changes initiated to meet EAF goals.

Management and co-management approaches

The nature of fishery management systems evolves over time, drawing on lessons from history and on trends in management and governance in the broader society. Four aspects of management and governance, and their interaction with EAF implementation, are noted here: the particular jurisdiction that is responsible for management, the degree of centralization or decentralization of management, the degree of integration within the management approach, and the breadth of participation of stakeholders in fishery management.

1. There are many variations around the world in how fisheries management fits within a governmental system. In many locations, fisheries management is a national responsibility, and is found within a ministry of fisheries, or as a component of a ministry of agriculture. In other locations, fisheries management may be a responsibility at a provincial/state level, or (as for coastal fisheries in the Philippines) at a local, municipal level. Whether or not fishery management – or at least some management functions – has been partly or largely devolved to industry or community entities (see below), government will be involved in a coordinating or policy-level role, and in particular, within EAF management, there is an important role in interdepartmental and/or intergovernmental linkages with respect to the impact of fisheries on the aquatic environment and the impacts of other aquatic (and land-based) activities – from aquaculture and shipping to tourism and agriculture – on fish stocks and on fisheries. There are implied benefits from such policy and operational coordination, although it is important to assess the costs involved in this as well.
2. The ecosystem approach to fisheries management must be able to be implemented both in fisheries that are managed by a central agency and

ones in which management is decentralized, as well as combinations in-between. However, whether the fishery management system is centralized or decentralized, it still must deal with ecosystems of varying sizes and scales – it is not the case that central management need only deal with larger-scale ecosystems, or conversely, that a decentralized management arrangement must only deal with smaller-scale ecosystems (e.g. on a more local basis). The fact is that any management system will need to approach EAF implementation based on the scale needed to address each problem arising. This certainly has implications for the linkage between decisions about boundaries (for ecosystems versus for jurisdictions) and about scale (how large should be the area considered in an EAF process, to be compatible with both the ecosystem realities and the management regime in place?). This in turn implies a need – whatever the degree of management centralization – for mechanisms to scale-up or scale-down management decision making. There will also be questions of the efficiency of the management arrangement – which may interact in rather complex ways with the level of centralization and the level of EAF implementation. In any case, EAF is applicable to all fisheries systems, and its implementation must be compatible with a recognition of the variety of different fishery systems that exists.

3. The structure of the fisheries management agency, and the fisheries science infrastructure, must be taken into account in considering EAF implementation. The FAO approach to EAF implementation has been to build on existing management structures and processes. The nature of these existing structures and processes will affect the benefits and costs, and the time frame, of EAF implementation. For example, if management and/or scientific aspects are carried out on a species-by-species basis, a mechanism is needed either to transform this into an ecosystem approach, or to "scale down" EAF implementation to provide some elements of an EAF even within a single-species approach to management and science. A shift from a single-species to a multiple-species approach is to be encouraged, but there may be constraints to this that cannot necessarily be overcome in the short term.
4. Also relevant to EAF implementation is the degree of stakeholder involvement in the fishery management system. The FAO Guidelines on EAF call for the use of participatory approaches within EAF management, but the degree to which this exists varies from fishery to fishery – according to the extent to which ***co-management*** and participatory research have been introduced. The idea of co-management is the creation and implementation of management arrangements through which a set of agreed-upon stakeholders – fishers, fisher organizations, communities, corporations, nongovernmental organizations or other entities – share decision making and management functions with government, and work jointly to develop and enforce fishery regulations and management measures (Charles, 2001). There are many nuances to the co-management concept, some displayed in the following mutually-compatible descriptions of co-management:

   > *…an arrangement where responsibility for resource management is shared between the government and user groups.* (Sen and Nielsen, 1996, p. 406)
   >
   > *…the collaborative and participatory process of regulatory decision-making among representatives of user-groups, government agencies and research institutions.* (Jentoft *et al*., 1998, p. 423-4)
   >
   > *…various degrees of delegation of management responsibility and authority between the local level (resource user/community) and the state level (national, provincial/state, municipal).* (Pomeroy, 1995, p. 150)

> *…a partnership arrangement using the capacities and interests of the local fishers and community, complemented by the ability of the government to provide enabling legislation, enforcement and conflict resolution, and other assistance.* (Pomeroy and Berkes, 1997, p. 465)

Those involved in co-management have both rights and responsibilities, with the rights in this case being management rights – the right to be involved in design and implementation of management measures. The motivation for co-management initiatives includes their potential (1) to reduce conflict between stakeholders and government, as well as between stakeholders themselves, by clearly defining rights and responsibilities, by providing an institutional forum for discussion among decision makers, and by encouraging support for the management process, and (2) to build a conservation ethic, by bringing fishers and others into the decision making process, so they share responsibility for sustainability in the fishery.

The co-management approach can be applied at any scale, from that of a single component (fleet sector, gear type, geographical area) of a single fishery, through to multistakeholder multiresource multiuse situations, as arise within the context of integrated management. Implementation of EAF – typically involving interactions of a fishery with its environment, interactions among a range of fisheries, and/or interactions with sectors impacting on (and affected by) the fisheries – thus can utilize a co-management approach, albeit with potentially greater challenges than might be faced in a simpler within-fishery context.

These challenges may arise through the need to develop suitable policy for cooperative management within an enlarged forum (e.g. between fisheries rather than only within a single fishery), as well as suitable institutions within which this can occur. Of course, it should be noted that even in a management system operating completely at the governmental level (i.e. without co-management) similar issues of coordination arise with respect to implementation of EAF, since – as noted earlier – multiple ministries of government will need to interact together (even if EAF is led by a fisheries agency).

International policy frameworks

Some policy initiatives discussed above – notably the Millennium Development Goals and the precautionary approach – arise from or are closely related to international conventions or policy discussions. Certainly, a number of international conventions, such as the Convention on Biological Diversity, influence the fishery policy environment. However, as noted in FAO (2005a):

> *At the international level, EAF is reflected mainly in voluntary instruments such as the Rio Declaration, Agenda 21, the FAO Code of Conduct for Responsible Fisheries, the Reykjavik Declaration and the 2002 Plan of Implementation of the World Summit on Sustainable Development.*

Also relevant to EAF implementation are UNCLOS and the UN Fish Stock Agreement, as well as the World Trade Organization and a range of trade agreements.

At the regional level, the various regional fishery bodies (RFBs)/regional fishery management organizations (RFMOs) play a key role in EAF implementation on scales above the national. In recent years, RFBs have begun incorporating references to the EAF in their Conventions or Agreements[16], creating subcommittees and working groups on the EAF, implementing regional EAF projects, and co-operatively developing and adopting EAF objectives; however, progress has been slow towards incorporating EAF considerations into RFB decision-making (FAO, 2007a).

[16] Note that the 1980 Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) Convention comprised many of the EAF principles.

Since EAF management requires changes to conventional fishery management approaches, whether those changes are incremental or not, it is clear that at regional and global levels, in addition to those at the national and sub-national levels, there will be a need to assess a range of benefits and costs in order to determine how, when and to what extent EAF management is implemented. There may also be a need for adjustments to legal instruments at each of these scales, to enable adequate realization of EAF management. At all scales, these changes will imply certain costs being incurred, as well as a need for adequate time for implementation.

"Pro-poor" policies

The FAO (2005b) has produced, as part of its Technical Guidelines for Responsible Fisheries, a document on *Increasing the contribution of small-scale fisheries to poverty alleviation and food security*. This describes considerations relating to small-scale fisheries and their role in poverty alleviation and food security, including a range of supportive "pro-poor" policy directions. The document notes that:

> *Small-scale fishing communities are faced with an array of serious problems, including overexploitation and depletion of resources, lack of alternative sources of employment, rapid population growth, migration of populations, displacement in coastal areas due to industrial development and tourism, pollution and environmental degradation and conflicts with large commercial fishing operations. However, small-scale fisheries are critical for food security and poverty alleviation in many countries.*

Of relevance to the ecosystem approach to fisheries is the emphasis in the Guidelines on a broad view of the fishery; noting, for example "the importance of considering cross sectoral uses of fisheries and related resources, the special role of women in fish marketing, processing and value addition, the significant scope for trade…".

The 2005 Guidelines present many policy directions for "pro-poor policies", noting that "all of these issues may need to be legislated for to ensure that certain *rights* are enshrined in law for small-scale fishers and fishworkers so that they cannot be eroded through social, economic and political marginalization" (p. 27). Of particular relevance to how EAF is developed is the statement: "The increasing importance of decentralization in many regions of the world is worthy of special mention in the legislative context. It is important in bringing decision-making closer to the poor and therefore increasing the likelihood of success of pro-poor policies and programmes" (p. 29).

INSTITUTIONAL AND LEGAL FRAMEWORKS AFFECTING EAF

In moving from conventional fisheries management towards an ecosystem approach to fisheries management, some changes to current institutional and legal frameworks are likely necessary. In this document, the term "institutional framework" refers to both the set of rules governing fisheries resources use and the specific organizational arrangements involved in the formulation and implementation of fisheries resources laws, policies, strategies and programmes. These changes include ways of taking account of, and dealing with, the increased scope of this management approach. Such an increased scope conveys the need for:

- increased coordination, cooperation and communication within and among relevant institutions and resource user groups in the planning process and in implementation;
- more information regarding the ecosystem and the factors affecting it;
- incorporation of uncertainties into the decision-making process due to the increase of factors (predator-prey relationships, nearby activities such as agriculture, and their impact on the ecosystem etc.) causing uncertainties; and
- ways of involving the broadened definition of stakeholders in the decision-making and management.

Good governance

Guiding the prospective adaptation of the institutional and legal frameworks, to an ecosystem approach to fisheries management, should be the idea of "good governance". Governance is a term describing how political, economic, administrative and other forms of power or authority is exercised to manage a country's resources and affairs. Thus governance comprises the mechanisms, processes and institutions through which citizens and groups voice their interests, mediate differences, exercise their legal rights and meet their obligations (AusAID, 2000). This broad term is used to explain, amongst other things, to what extent governments are accountable to, and allow participation by, the public (Coffey, undated).

While the concept of "governance" is descriptive, the idea of "good governance" is *standard-setting*, i.e. normative in nature. The exact meaning of "good governance" varies according to the policy area in question but the general principles of good governance are seen to involve (UNESCAP, 2007; OECD, 2007): accountability; transparency; responsiveness; effectiveness and efficiency; rule of law. The OECD (2007) expands on these five aspects as follows:

- Accountability: the governing body should be able and willing to show the extent to which its actions and decisions are consistent with clearly-defined and agreed-upon objectives.
- Transparency: the governing body's actions, decisions and decision-making processes should be open to an appropriate level of scrutiny by other parts of government, civil society and, in some instances, outside institutions and governments.
- Responsiveness: the governing body should have the capacity and flexibility to respond rapidly to societal changes, and take into account the expectations of civil society in identifying the public interest, and should be willing to critically re-examine the role of the governing body.
- Efficiency and effectiveness: the governing body should strive to produce quality public outputs, including services delivered to citizens, at the best cost, and ensure that outputs meet the original intentions of policymakers.
- Rule of law: the governing body should enforce equally transparent laws, regulations and codes.

Further principal elements of "good governance" are: consensus-orientation, participation, equality and inclusiveness, decentralisation (UNESCAP, 2007; Coffey Undated), and forward vision, the latter implying the governing body's ability to anticipate future problems and issues based on current data and trends and develop policies that take into account future costs and anticipated changes (e.g. demographic, economic, environmental, etc.) (OECD, 2007).

Good governance is an element needed in implementation of EAF management. In fisheries, where management and exploitation occur largely out of public view and scrutiny (even given that the fishery is often managed by the public sector), accountability is of great importance. As a means of ensuring accountability, access to information and transparency in policy are critical. This access is also a precondition for meaningful public participation in decision-making. Policy effectiveness can be improved by decentralised management, as measures can be tailored to local needs and increased opportunities be given local stakeholder participation in decision-making (Coffey, Undated). In terms of the legal framework for good governance within fisheries management, the FAO Code of Conduct on Responsible Fisheries, although non-binding, refers to the need for increased transparency within the decision-making processes and to ensure that timely solutions to urgent matters are achieved. In addition, states are called upon to facilitate consultation and effective participation in decision-making (Article 6 of the Code) (Coffey, Undated).

Nested institutions

If governance describes how a resource sector, fisheries in this case, is governed, and the principles of good governance suggest the ways in which a resource *ought* to be governed, then an understanding of how institutions interrelate is vital in moving forward. Such an understanding will assist in highlighting *negative* interrelationships as well as the interrelations that contribute positively to governance.

It is suggested that institutions operate at multiple levels of jurisdiction (Scott, 1995, in Hersoug, 2004) and that they work at different levels of society. Because they are linked to each other, and thus form networks, they should be analysed as open systems, which receive impulses from the outside, i.e. from other institutions, in the form of impacts, resources and ideas (Scott 1992, in Hersoug, 2004). As they do not "exist in a cultural, social and institutional vacuum", institutions are never fully self-controlled (Hersoug, 2004: p. 212). This conclusion is of importance when considering institutional adaptation to EAF management, as any successful change requires understanding of how the institutional system really works and which factors need to be considered.

An institutional system can be divided into two levels – a practical level and a higher, political level. Institutional change may originate at both levels. If, for example, technological change has undermined *established* institutions at the practical level, corrective actions may be needed at the political level. More general institutional reform may originate at the political level, which could convey changes to institutions at the practical level which were, in their original form, considered legitimate by their main users. Sometimes a required reform at the practical level needs to await a shift at the political level in order to take place. Institutional change may also occur at the practical level, without it being noticed *or sanctioned* at the political level. Importantly, however, there will be rules structuring the relationship between the levels, deciding for example which issues at the practical level will be considered at the political level, the procedures for this, who is allowed to participate in decision-making, etc. (Holm, 1995).

A high degree of interconnectedness between institutions can produce dynamic change patterns – changes in one part of the system may have effects on other parts of the system and a new balance may be established. Likewise, a small change in one part of the system may lead to cumulative effects on the system as a whole. For example, by allowing an increased scope of stakeholders to participate in the decision-making procedures, greater changes to the system of management institutions may be felt to be required in order for it to be viewed as legitimate. On this matter, it is also relevant to highlight the point made by Easter and McCann (2007) that "Informal institutions such as norms and culture affect which laws and policies can be implemented. …changes in formal institutions that contradict norms are unlikely to be successful." (p. 10-11).

Within organizations

As a way of identifying problem areas in the institutional framework in relation to the attainment of good governance, the field of organization theory can give some insight into what it is about organizational behaviour that gives rise to unsustainable natural-resource policies and practices (Ascher, 2000). In terms of lessons that may be useful for EAF management, organization theory suggests the need (Ascher, 2000) to:

1. establish simpler, non-competing mandates for agencies;
2. provide information to many governmental and non-governmental actors;
3. Restructure intra-governmental arrangements to reduce the opportunities for interagency jurisdictional conflicts;
4. restructure organizational incentives to create longer time horizons for agency leaders and personnel;
5. liberalize to reduce rent-seeking alliances that promote corruption.

Chapter 7 will specifically address adjustments to current institutional frameworks in the move towards EAF management. Two key questions to be addressed are:

1. What kind of new institutional mechanisms are warranted, or how would existing institutions need to change, in order to facilitate an implementation of the EAF?
2. What examples are there of the practical use of EAF-friendly institutional mechanisms or frameworks?

CONCLUSIONS

As mentioned in the beginning of this chapter, EAF management is not an end in itself but simply a mechanism in moving towards sustainably managed fisheries. The discussion above on the policy, institutional, and legal frameworks of the ecosystem approach to fisheries management, has set out the context within which this broader management approach is to take place. In the discussion, general ways forward have been suggested, and problem areas highlighted. Whether a desirable result is achieved or not, will however depend on the success of implementation. However, success will be more likely given an ability to work within broadly accepted policy frameworks, and to develop or reinforce institutional and legal arrangements that allow for good governance, for effective nested institutions (outside and between institutions), and for appropriate organizational structures (inside institutions and/or agencies). In addition, there will always be a need to deal with problems arising through gaps between policy and management (e.g. lack of capacity), legal failure and a lack of compliance (e.g. due to lack of capacity), and the possibility of institutions being affected by power and politics. All these aspects form the reality within which EAF implementation must take place.

4. Social and economic considerations

INTRODUCTION

The ecosystem approach to fisheries (EAF) management has been advocated widely, on the basis of its potential to meet a range of broad objectives relating to ecosystem health, biodiversity conservation, and sustainable natural resource use, among others. These general benefits can in turn be broken down into more specific benefits, including those relating particularly to human considerations, such as greater employment and income generation as a result of rehabilitated ecosystems, reduction in the risk of fishery collapses, aesthetic benefits, etc. At the same time, there are potential costs involved in implementing EAF, ranging from direct costs of implementation (e.g. increased management costs) to possible indirect or induced costs, resulting from how the EAF is implemented (e.g. reduced employment and/or revenues in the short term, as well as ethics and equity-related considerations).

Accordingly, this chapter discusses some of the social and economic considerations that can influence the form and extent of EAF implementation. The particular aspects discussed here include: (a) employment, livelihood and regional effects; (b) impacts on poverty levels, e.g. resulting from changes in income or employment; (c) impacts on food security, e.g. resulting from short-term decreases in catch levels, if they occur in shifting to an ecosystem approach to fisheries management; (d) cultural factors that may affect EAF implementation; (e) use of traditional knowledge and management practices; and (f) impacts on the distribution of benefits and costs related to EAF implementation.

Of course, the overfishing and ecosystem degradation that typically underlie the need for EAF result in immediate economic losses for the fisheries, and a disruption of livelihoods, community well-being and traditional ways of life. Likewise, applying the ecosystem approach, while aiming to contribute to sustainable development in the longer term, will also undoubtedly result in costs, at least in the short term – particularly since one implication may be a reduction of fishing effort and output. However, there are also possible long term social benefits such as an improved quality and diversity of fish stocks (e.g. increased size of individuals and greater abundance of higher value species). Improved quality may, for example, lead to increased income for fishers. Actual impacts on effort and catch will depend on many factors, including the nature of the ecosystem and the state of exploitation at the time of implementation of EAF.

This chapter attempts to raise some social and economic issues that may need to be addressed in the application of EAF, such as the social impacts of any decreases in fishing effort that may prove necessary. In examining these issues, one should keep in mind that the implicit assumptions in moving to EAF management are: 1) that in the long term, EAF will promote the attainment of the ultimate objectives, such as reducing poverty and hunger; and 2) that failing to implement EAF will eventually have serious negative impacts on those whose livelihoods depend on aquatic resources. Furthermore, it is useful to note that the FAO Code of Conduct for Responsible Fisheries (FAO, 1995b), in highlighting the relationship between fisheries and food security, and the need for transparency in decision-making processes and for effective participation of interested parties, provides helpful guidance on the social aspects of applying the EAF.

THE PARTICULAR SITUATION OF ARTISANAL AND SMALL-SCALE FISHERIES

In the developed as well as in the developing world, artisanal and small-scale fisheries serve important roles in terms of providing employment, income and food security, as well as maintaining cultural/traditional practices (Berkes *et al.*, 2001). Their key role has been acknowledged in the above-noted FAO Code of Conduct:

> *6.18 Recognizing the important contributions of artisanal and small-scale fisheries to employment, income and food security, States should appropriately protect the rights of fishers and fishworkers, particularly those engaged in subsistence, small-scale and artisanal fisheries, to a secure and just livelihood, as well as preferential access, where appropriate, to traditional fishing grounds and resources in the waters under their national jurisdiction.*

Five key points that have been raised pertaining to implementation of EAF in the context of small-scale fisheries in developing countries are as follows:

- For developing countries, there is a particularly great need for fisheries management to focus on and take into account the human dimension in the fisheries sector. As fisheries in coastal areas in developing countries contribute to poverty alleviation and food security, it is difficult to reduce the fishing fleet, especially as the State might have scarce resources for creating alternative employment. Coastal fisheries may also constitute a better opportunity for people in other areas, with occupations that cannot provide a basic livelihood, thus leading to migration into fishery areas, as experienced, for example, in countries such as China, India, Madagascar, Peru and Senegal (Mathew, 2003).
- Small-scale fisheries, even those that financially generate only marginal profit levels, may have significant comparative advantages over industrial fisheries in the form of greater economic efficiency; fewer negative impacts on the environment; a wider distribution of economic and social benefits (being geographically more spread out and decentralized); and their contribution to cultural heritage, including ecological knowledge (FAO, 2005b).
- Although small-scale fisheries most often are focused on supplying fish and fishery products to local and domestic markets, and for subsistence consumption, export-oriented production has increased in many of these fisheries during the last one to two decades as a result of greater market integration and globalization. For example, fisheries products, especially from the small-scale subsector, are one of the few areas where African, Caribbean and Pacific countries have seen their share of world trade increase (Mathew, 2003; FAO, 2005b).
- It has been noted that from an ethical point of view, applying the ecosystem approach globally will require that industrialised countries take some responsibility – for example, by not selling their excess fishing capacity to developing countries at low prices, or giving it away as an article of aid. On the contrary, establishing an "international fisheries management assistance fund" has been proposed to support developing countries in the management of overexploited fisheries in a consultative manner, using the ecosystem approach as a framework (Mathew, 2003). For example, financing from development banks and development-oriented financial institutions could be a way of easing many small-scale fisheries' transition towards a more sustainable use of living resources (FAO, 2005b). At the same time, where feasible, it will be helpful for governments in developing countries to invest more in fisheries management from existing revenue resources, particularly in cases where net earnings from fisheries exports are high. Accompanying this is a need for dissemination of information regarding the value of the resources, and a need for education in order to explain how an ecosystem approach can improve the state of the resources (Mathew, 2003).
- A key challenge for small-scale fisheries in applying the EAF is dealing with impacts caused by factors beyond their control, or outside their territories, such as pollution and habitat destruction from land-based activities, destructive

practices of non-fishery activities within aquatic environments (e.g. impacts of oil exploration and extraction and offshore mining activities), and destructive fishing practices by large-scale fisheries. An example of the latter is when industrial fishing vessels encroach on inshore areas previously only used by traditional fishers, in order to make up for a shortage of resources in their original territory. Possible implications of this include a reduction of resources, destruction of fishing gear, damage of habitats, etc. Such implications could result in an added economic burden to the small-scale fishers, ranging from needing to replace gear, through to a loss of livelihood (FAO, 2005c).

EMPLOYMENT, LIVELIHOOD AND REGIONAL ASPECTS

Shifting fisheries to EAF management, with its broadened attention to ecosystem effects and interactions with other economic sectors, may well have impacts on employment, livelihoods and regional economies. While in some countries, the fisheries sector contributes relatively low proportions of national employment and economic activity, the regional implications within a given nation of a transition towards responsible fisheries may be more severe, as employment tends to be concentrated where few livelihood alternatives exist (OECD, 1997). This is a major issue when an EAF leads to reduced levels of employment, and indeed labour stickiness, few employment alternatives and low education levels are some of the obstacles for a smooth transition in these regions (OECD, 1997).

Impacts on employment stem from the need to reduce fishing effort, which might be carried out through direct controls on effort (input controls) or indirectly through output controls, or with technical measures, including closed areas, etc. Below are some examples of employment impacts of input and output controls:

1. Direct effort controls may result in immediate reductions in employment, if the limits on effort are applied in terms of labour inputs, or applied to all inputs. On the other hand, if effort is reduced by decreasing capital inputs rather than labour inputs (e.g. by shifting to less capital-intensive vessels), employment may not be much affected.
2. An output control in the form of a Total Allowable Catch (TAC) that is set below current harvest levels will initially lead to a decline in harvesting employment, to the extent that such a quota induces less fishing activity (as opposed to merely inducing highgrading of the catch). However, as the stock recovers, effort will likely increase along with employment, perhaps to above the previous level. If a TAC limit applies at the same time as a "race-to-fish" occurs, there could be a shortening of the fishing season, leading to a situation with higher employment in numbers but of shorter duration. With individual quotas, there will also be initially reduced employment as the TAC decreases. This will be exacerbated, if quotas are transferable in the marketplace; a concentration of control in the fishery can lead to extensive employment losses (although such losses may be reduced somewhat in the long run by a possible lengthening of the fishing season). Another form of output control is that of individual, or vessel, catch limits restricting landings per day, week or month. While the effect of catch limits of this sort on fleet size and harvest employment are not definitive, such an approach may have the stabilizing benefit of providing a mechanism for equitable access to fishery resources, one that may favour small producers over large, thereby protecting owner-operated fishing vessels (OECD, 1997).

Employment impacts, particularly in fishery-dependent regions, are driven by characteristics of the labour force:

- In some regions, there are few employment alternatives for fishers, and where alternatives do exist, these may require employees with higher levels of education than that held by the fishers. While only a few countries have published sector-

specific data on the level of education among fishery workers, this data does suggest that the assumption of low-level education amongst fishers is correct (OECD, 1997). Of course, in addition to their level of formal educational attainment, the fishers may have informal learning and experience that equips them with skills of use in other sectors.

- The average age of fishery owner-operators is often greater than that found in the working population at large (although the average age of hired workers is not significantly different from elsewhere) and re-employment in another occupation becomes more difficult the older a person is (OECD, 1997).
- The level of labour-stickiness is high in such areas due to strong roots in community or (family) tradition, reducing the willingness to move in order to find similar or alternative employment elsewhere, and thus also making it more difficult to reduce fishing effort (OECD, 1997).
- While adjustment to reduced fishing effort levels may be feasible if there is a functioning social security system or some kind of adjustment programme, poorer countries and regions may not have the same possibility of providing such aid to their fishers. [In OECD member countries, for example, adjustment problems have been approached through such means as extended-term unemployment benefits for younger workers; programmes for retraining; early retirement packages for older fishermen whose vessels have been withdrawn; and investment in infrastructure, tourism and other regional and rural development (OECD, 1997).]

Changes to fisheries in the course of implementing the EAF may have more widespread effects than just in the fishers' livelihoods (FAO, 2005b). This is because changes in demand and production have impacts not only on producers themselves, but also indirect impacts through the commodity supply chain. This includes the supply of inputs to the fishing operation through "upstream" activities such as (a) investments in vessels, engines and gear, (b) operational costs (fuel, ice, food, bait; labour costs), and (c) maintenance costs, as well as through "downstream" activities following the harvesting.

There can also be major interactions of gender and employment that influence the nature of EAF-related impacts. In terms of "downstream" activities, such as post-harvest processing of fish and fishery products, as well as marketing, women often play a predominant role (TABFM, 2006; FAO, 2007b). Impacts of implementing EAF management on the "downstream" activities, e.g. by a reduction in employment opportunities caused by a change in the fishery management regime, may thus affect food security *indirectly*, as women tend to spend more of their income on feeding their families than men (see case studies in Argentina, Brazil and Uruguay: Josupeit, 2004). Women also tend to be less educated, and less able to migrate for work due to social/cultural/traditional/religious reasons, thus further reducing their mobility in terms of labour.

Boxes 2 and 3 provide an example of the livelihood consequences of conservation measures and a brief outline of the sustainable livelihoods approach to fisheries, as an example of an approach that can be used when attempting to understand the nature of people's livelihood opportunities.

In summary, attention to alternative livelihoods is of crucial importance in moving to an EAF, and more generally to changing towards more sustainable fishery practices, by reducing the number of people dependent on fishing as their sole income and thus reducing barriers to change. However, there is no easy answer to the challenge of introducing alternative livelihoods in situations of fishery dependency – barriers such as labour stickiness and low levels of education among the fishing population have to be acknowledged, as does the reality that no single "solution" will work in all circumstances. Undoubtedly, a customized approach must be adopted.

BOX 2

Example of livelihood consequences of conservation measures in India

An example of a dire consequence of not taking into account the social aspects when deciding to protect endangered species is the case when some fishermen in Orissa, a state in India, committed suicide over a fishing ban. This ban was imposed by the state government to protect the Olive Ridley turtles in the Gahirmata Marine Sanctuary, by prohibiting fishing for six months of the year within a five km radius of the Bay of Bengal, in the coastal districts of Kendrapa and Jagatsingphur.

The fishing communities accuse the government of being indifferent to their need for alternative livelihoods, yet the government officials claim they are aware of the implications and that efforts are being made to provide for such alternatives, however, they also have a duty to protect these turtles. As a result of reduced fishing possibilities, and through that reduced income, ten fishermen have been reported to have committed suicide. Now whole families are left behind without a bread earner. There is also a risk that the problem will increase as another ban will be imposed in July as this is the time for the breeding season. In desperation people have made attempts of fishing within the prohibited area, however, a number have been arrested and their boats seized.

This case shows the importance of making some kind of social impact assessment before introducing a conservative measure. An ecosystem approach would suggest that the human needs also need to be considered and thus, if a measure reduces certain livelihood possibilities, alternative livelihoods ought to be created. However, the possibility for such efforts are seldom great, and even less so in developing countries.

Source: NewKerala, 2006

POVERTY AND SOCIAL SECURITY/SERVICES

Poverty can be viewed both as impacted by inadequate fisheries management (a result of depleted fish stocks, etc.) and as a constraint in improving fisheries management. The constraint stems from the fact that it is not typically considered to be reasonable to exclude poor people from fishing without creating alternative sources of food and livelihoods. Neither can the reality of poverty in fishery-dependent communities be necessarily resolved through fisheries management, since it is not always directly related to the resource or catch levels. For example, poverty can also be observed in remote fishing villages where fishers catch and trade reasonable volumes of fish, but where access to health and other public services is lacking and the community is politically un-represented (FAO, 2005b).

It has been noted that while fishing may not necessarily generate high economic returns, for a majority of households, fishing activities have simply provided them with a way to sustain their livelihoods, preventing them from becoming poorer. From an economic perspective, there may be no resource rent generated by such activities, but from a social point of view this way of providing livelihoods is vital. In areas where alternative employment is scarce, and where social security is less than common, fisheries constitute a kind of welfare system by way of reducing dependency and vulnerability (greater exposure and sensitivity to risk). The vulnerability of households – for example, a family head's loss of job may lead to sudden reduced income – implies that fisheries, as additional or alternative sources of income and food, are extremely important (FAO, 2005b).

This implies a major dilemma arises in implementing EAF management. On the one hand, it is the open-access state of the fishery which is the main mechanism providing the above safety net, as it allows people the opportunity and flexibility to engage in

BOX 3

Sustainable livelihoods approach to fisheries

As mentioned in Chapter 1, a sustainable livelihoods perspective may be useful in the application of the EAF as it highlights people's livelihood situations, the factors affecting these, how these can be improved or maintained, and linkages to ecosystem health. The use of such an approach may clarify impacts from a change in fisheries management on poor people's livelihoods, and their ability to deal with such a change. For example, if applying the ecosystem approach means more conservative levels of fishing, what alternative income sources exist, and how plausible are these options?

In this approach, "a livelihood comprises the capabilities, assets and activities required for a means of living" (FAO/DFID, 2000, p. 2). In brief, the sustainable livelihood framework consists of five elements:

- People's livelihoods depend upon assets. These can be natural (e.g. fisheries resources), financial (e.g. cash or credit), physical (e.g. fishing gear), human (knowledge of where to find fish and how to catch it), and social capital assets (e.g. traditional management mechanisms, co-operative arrangements).
- The transforming structures and processes influencing the access people have to the different assets. Examples of these are the institutions, policies and regulations which influence the livelihood approaches people adopt and how they make use of their livelihood opportunities.
- The livelihood strategies are the options and the combination of options people have and adopt in order to make a living. For example, a community may rely on combining fishing for parts of the year with agriculture for the rest of the year in order to have an income throughout the whole year.
- Livelihood outcomes are the result of the strategies people adopted.
- The vulnerability context is made up of the factors (e.g. floods and droughts in inland fisheries) in the external environment which may affect the success of people's livelihood strategies.

People seek desired livelihood outcomes, such as an increased income, by exploiting available assets through various livelihood strategies. However, poor people are generally vulnerable to external impacts (e.g. natural disasters), trends (e.g. resource depletion, population change), and seasonal change (e.g. food availability and prices) hence their desired livelihood outcomes may not always be attainable, and these may also fluctuate. A sustainable livelihood would enable poor people to become more resistant or at least resilient to changes, trends and external shocks, so that they can maintain or enhance their assets and capabilities. The SLA is valuable in assessing the likely impact of potential or actual interventions, and may therefore be useful in moves towards an ecosystem approach.

Sources: Glavovic, 2006; FAO/DFID, 2000

fisheries following their needs. On the other hand, a commonly-advocated element of applying the ecosystem approach is to restrict access to the resource, e.g. through limited rights systems (FAO, 2005b). The latter move can produce significant impacts on the poor, if people are excluded when limited access is introduced. Alternatively, fishermen may migrate to other areas where they can access, and fish from, the same stock, thereby maintaining livelihoods but failing to limit resource exploitation). And furthermore, since small-scale fisheries take place along thousands of kilometres of coasts where enforcement and surveillance costs are high (Berkes *et al*., 2001; Castilla and Defeo, 2001, in Defeo and Castilla, 2005), how feasible is it to move to limited

BOX 4
Poverty mapping

Poverty mapping is a tool used by various organizations such as IUCN, the World Resources Institute, the World Bank and FAO. It can be used to identify areas globally where there might be specific problems in applying the EAF due to high levels of poverty, but at the same time indicating important social and conservation reasons for implementing the EAF. Such areas will therefore be high priorities for external support, unique and practical local solutions, or both.

One example is the IUCN Poverty-Conservation Mapping. Poverty in combination with high population density, in areas of high levels of biodiversity, is of particular concern as these areas are of great value in themselves, but are also exposed to high pressure from the people who may want to exploit the resources as a source of livelihood. As high level of poverty often suggest that employment opportunities are few, and the ones that do exist are thus very important, a measure of reduction in fishing effort may therefore be difficult to implement without some kind of community aid in the shape of alternative employment creation etc. In such cases, models can be developed to help predict causal relationship between socio-economic variables (e.g. poverty) and environmental change (e.g. biodiversity loss, decreasing fish stocks, damaged reefs). For example, the World Resources Institute (WRI) has used a mapping system to make an assessment of the health of many ecosystems' goods and services globally. In combination with poverty data, ecosystems in need of "pro-poor ecosystem management" can be found. Another related use could be that of linking biological resources data with that of poverty and nutrition, thus finding potential biological resources-food security relationships. These maps may in that way constitute an aid in identifying where poor people largely depend on biodiversity assets, and where they will benefit from ecosystem management.

This type of mapping is an analytical tool which can provide inputs in examination of poverty issues, for example in a sustainable livelihood approach. However, it should be remembered that although this tool is useful for exploring spatial relationships (visual correlations) between indicators, the maps do not in themselves show causal relationships. Thus, there is a risk of misinterpretation.

Sources: IUCN, 2004; FAO, 2003c.

access? The dilemma, then, is how to devise an effective, equitable way to implement EAF management in such fisheries.

Below follows an example of a tool for identifying areas in which there may be a high correlation between poverty and resource depletion. Related tools for information acquisition and management are provided in the Annex to this report.

FOOD SECURITY

Since 1973, the consumption of fish as food has doubled globally, and the developing world has been responsible for over 90 percent of this growth, largely from small-scale fisheries. Small-scale fisheries contribute fifty percent of all food-fish, and almost all fish from small-scale fisheries is used for food. Fish form a crucial part of the diet of millions of the world's poor (FAO, 2005b). Indeed, in 2001, more than 400 million people received more than 50 percent of their protein from fisheries (FAO, 2005c).

There are two ways in which fishing can contribute to food security – *directly* through the supply of fish itself (i.e. self-consumption), and *indirectly* through revenues generated from production and related processing and marketing activities, depending on whether individuals are self-employed or paid wages, which can then be used to

purchase food (FAO, 2005b). At a national level, direct domestic consumption of fish can be encouraged (e.g. self-sufficiency of fishing communities) and/or exports of high value fish species can enable imports of low value fish species and other food types.

Various possible impacts of EAF on food security could occur. For example, if EAF leads to decreases in available fish landings (whether only short term or both short- and long-term), the result is less access to food/protein (even if only temporarily) for a certain fraction of those who rely on fish as a key protein and food source. On the other hand, if applying the EAF would lead to greater abundance of higher value species, this could possibly lead to increased export revenues. These revenues could thus lead to increased opportunities of purchasing low value fish species and other food types, hence increasing food security.

CULTURAL AND RELIGIOUS CONSIDERATIONS

Another social consideration when applying the ecosystem approach to fisheries is how the religious practices or cultures of certain fishing communities may be affected, or may bear on EAF implementation. Fishing activities often have a cultural or religious value and these may contribute to, or perhaps hinder, the adoption of an ecosystem approach. At the very least, such aspects must be *understood* in order to facilitate a change in management approach.

Traditional beliefs regarding fisheries have developed through processes of association and interpretation of natural phenomena, and they often play an essential role in deciding how people use fisheries resources, or at least in justifying and explaining resource use. Therefore it is vital to have some understanding of existing beliefs and customs regarding fisheries resources when presenting ideas for management, as these will provide key information on what may be acceptable to the local community (FAO, 1998).

The religious structure of the community may have important implications for the way in which fisheries resources are exploited – both in the fishing activity and the consumption of fish products. For example, religious proscriptions which forbid the consumption of shellfish, molluscs or particular types of fish may mean that fishing effort is concentrated on other species, hence increasing the chances of depletion of those stocks. Local beliefs and customs may also impose other limits on fishing activities or on participation in fisheries (FAO, 1998).

The practice of a particular fishery may be at the centre of people's beliefs and customs, and the use of a particular gear may be based on traditions and beliefs, resource knowledge or skills which often have been passed from generation to generation. In such cases, people's attachment to the fishery on which they depend often goes beyond the economic benefits derived from it. An example of this is salmon fishing by native Americans and Canadians on the west coast of North America, where the importance of the fishery for indigenous cultural values has been recognized in current efforts to manage the fishery (FAO, 1998).

Attempts to alter patterns of fisheries which form an important part of local cultures may be resisted if they are interpreted as a threat to the social and cultural independence and distinctiveness of a community. Thus, the success or failure of management measures will often ultimately depend on the extent to which those affected by them understand their function. However, scientists' understanding of fisheries resource issues and artisanal fishers' understanding will often differ quite radically. Therefore it is important to seek out common ground and find ways in which "scientific" management measures may translate into a locally appropriate form (FAO, 1998).

For example, in an attempt to establish a way to harvest mussels sustainably for subsistence needs, in an area on the east coast of South Africa, harvesters participated in an experiment which was designed to visually demonstrate appropriate harvest levels. This was done by allowing different levels of harvesting intensities in different

sub-zones, which then clearly showed how intense harvesting could lead to over-exploitation. In order to ensure an understanding of the activity, role-playing was used both before and during the experiment. Results from the experiment were also presented at joint committee workshops by using images, models and clearly intelligible graphs, as well as translating the findings into Zulu. It was noted that although traditional knowledge played a valuable role in the project, it was said to be limited to observable phenomena. It was therefore felt that providing harvesters with scientific information would help them better understand the resource and participate in management decisions (Harris *et al.,* 2003).

Some further factors may provide guidance on the level of adaptability, and underlying attitudes, towards management measures such as the ecosystem approach:

- Skills and knowledge regarding fishing techniques and fisheries resources will often be passed from one generation to the next at the household level. The extent to which this takes place, and the patterns of inheritance of occupational skills, will inform on how an understanding of management issues will be passed from generation to generation.
- Where fisheries resources are in decline, or access to fisheries is threatened, it can be important to provide opportunities for youth to have the education needed to shift to non-fishery activities more easily. This of course also depends on the *availability* of schools and/or the *opportunities* a household has to send its children to school, as well as traditional/cultural/religious *attitudes* towards education, particularly of girls/women.
- As people's attitudes towards authority will play a great role in shaping their responses to efforts to manage their fishing activity, this would mean that if a particular institution is perceived by fishers as being either not trustworthy or dominated by particular sets of interests which are not necessarily sympathetic to the needs of fishers, co-operation is likely to be hindered (FAO, 1998).
- In terms of introducing changes to the customs of a society, it should be remembered that the culture of a society is not an accidental collection of customs and habits, but rather something that has been evolved by the people to help them in their conduct of life. There is a definite purpose and function behind each aspect of the culture of a society. Social structures, in general, need to be understood in order to gain appreciation of who does what in a community, who makes decisions, and who (from within the community or from outside) may influence the community to accept change. Such structures may be based on sex, religious and ceremonial groups, age, kinship/kinship groups, grouping on the basis of common residence, etc. If there is a reluctance to change within the community from the beginning, unforeseen difficulties in attempts to achieve EAF management may cause further reluctance to change.

In Box 5, an example is given of a theoretical framework which can inform the implementation of EAF management, by highlighting cultural and religious factors in a local/traditional community context.

INDIGENOUS PEOPLE AND TRADITIONAL KNOWLEDGE

In addition to the role that cultural or religious practices may play in the application of an ecosystem approach to fisheries, the knowledge held in local communities and by indigenous peoples is also important. Mechanisms to use this appropriately need to be developed.

It is well-known that many indigenous people or local communities have a profound empirical knowledge of the environment in which they live, one central reason being the fact that their survival may depend on their understanding of how different patterns of resource use will affect the sustainability of resources in the future. Their understanding of the environment is often close to the conceptual basis for integrated

BOX 5

The interdependency hypothesis and local communities/indigenous people

The *interdependency hypothesis* suggests that ecosystem viability and community viability are interconnected. Its theoretical framework consists of three dimensions: *ecosystem viability, community viability, and external forces*. It is suggested that ecosystem viability and community survival are two interdependent objectives that should be given equal focus if both are to benefit, and stresses the need to consider the extensive knowledge of local communities about local ecosystems. Although this framework is created for application to conservation projects, the relevance to an EAF can be found in its highlighting of the local/traditional community context and which factors may need special attention when shifting towards more sustainable fishing practices. The proposed theoretical framework consists of a series of factors important for ecosystem conservation and community viability and can provide a general guide during the design, monitoring, and evaluation phases of projects. These general factors should be considered in the light of the specific human culture and natural ecosystem considered.

The three dimensions that form the basis of the theoretical framework are ecosystem viability, community viability and external forces. Given the focus on human dimensions in this report, the latter two of these are discussed below.

Community viability. The community viability dimension consists of four main categories – culture, well-being, participation, and knowledge – each of which consists of a series of factors that are assumed to contribute to the viability of local communities.

a) Culture – consists of *cultural sustainability* and *social and environmental values*. As many projects try to provide local people with alternative sources of income, insufficient attention is often given to the cultural importance of the original source of income. Certain practices, such as tree harvesting and hunting, are not solely performed for the sake of the economic income, but have important social, cultural and religious values too. Because there are cultural and spiritual reasons why local people engage in these practices, providing them with alternative sources of income is often a simplistic and unsuccessful strategy in alleviating problems such as over-harvesting.
b) Well-being – consists of *economic well-being* and *physiological and psychological well-being*. Even if communities are not poor, economic well-being may be essential in ensuring the viability of those communities. For example, reduced employment opportunities, due to more conservative fishing, may lead to migration of young people to urban areas, thus leaving villages populated with older residents and no mechanism for community viability. In addition, when such fundamental needs as health and security are missing, community cohesion and survival are threatened and long-term conservation goals (e.g. sustainable fishing practices) may seem less important.
c) Participation – includes the factors *community participation* and *community capacity*. Through participating in the process that would impact their lives, local people can have the opportunity to choose activities (practices) that do not compromise the integrity of their culture and the viability of their community.
d) Knowledge – consists of the factors *environmental knowledge* and *cultural knowledge*.

Traditional environmental or ecological knowledge is being passed on from one generation to another. This knowledge may be useful in finding the most appropriate way of applying the ecosystem approach in a certain cultural/traditional setting, possibly basing it on such traditional knowledge.

External forces. As local communities and the associated natural ecosystems constitute a part of a larger social, economic, and political context, they are inevitably subject to influences originating from outside of their locality. An external environment may on the one hand support and enable local

communities and natural areas to thrive, and on the other hand it might instead threaten the ecosystem and community viability. This component describes what form external social, economic and political forces may take. Such forces need to be acknowledged, and preferably addressed, in order to enhance ecosystem and community viability.

a) Social forces – can work in two extreme ways: (i) policies promoting the conversion of natural areas to commodity goods may be favoured by a public that seek fast economic growth at the expense of nature conservation, or (ii) people may be willing to sacrifice the sustainability of local communities and their culture for nature conservation. Thus the social values of the public can provide an indicator for predicting whether certain projects will have the support of the society at large.
b) Economic forces – Financial incentives often contribute to the destruction of natural ecosystems.
c) Political forces – It has been suggested that national and international laws and policies are the most powerful external factors that impact ecosystem- and community viability. This type of force can be, for example, national land policies which encourage migration to remote areas and the clearing of forests in exchange for land, but also international policies, such as trade liberalization and structural adjustment.

Source: Michaelidou *et al.,* 2002

or holistic management. A gender aspect of this local knowledge is that women often exploit resources and ecological niches which men may have little or no knowledge of. This special knowledge, and women's skills in exploiting it, may provide important input into fisheries management decision-making (FAO, 1998).

It has also been suggested that conservation measures can support the recognition and guarantee of the rights of indigenous people (IUCN/WWF, 1999). One can find similarities between aspects of the ecosystem approach and the approaches of many indigenous and other traditional peoples' organizations (Berkes, 1999) - for example, with respect to protected areas within their territory. The concept of sustainable use of resources is most often an inherent part of the traditional/indigenous way of thinking as they feel connected to the land/water, as a home to their ancestors but also to their children, suggesting that certain restrictions to the use of the resource may be acceptable as it would benefit future generations (Borrini-Feyerabend *et al*., 2004).

Some of the ingredients considered important in this regard are:

- that their rights to the territory, and their rights to control and co-manage the resources and determine their own development priorities, are recognized;
- participation of traditional institutions in co-management arrangements is allowed;
- prior informed consent; and
- sustainable use of natural resources that have been used traditionally by indigenous people is incorporated in the management plan whilst maintaining the integrity of the ecosystem (IUCN/WWF, 1999).

In applying the ecosystem approach and reducing fishing pressure where needed, traditional knowledge can often provide suitable management options. For example, there may be rights-based fisheries in place, often based on rotational access to fisheries resources – although this system is more easily applied to non-mobile gear and species and often focuses on mitigating conflicts between user groups over access rather than reducing overfishing pressures (Mathew, 2003).

Box 6 describes an example of a local community's effort to adopt the ecosystem approach to fisheries.

BOX 6

Example of an ecosystem approach initiative in Bocas del Toro, Panama.

Bocas del Toro is a marine archipelago off the coast of Panama with diverse mangrove forests, a unique flora and fauna, and coral reefs. A rise in tourism has led to unplanned development in the area, putting great pressure on the ecosystems because of over-fishing of the lagoons and coral reef destruction. The local communities have always sustainably used and depended on the goods and services provided by the ecosystems, hence by their own initiative, indigenous fishermen have now suggested regulation of the access to fishing grounds and area protection to the government, as means towards more sustainable use of the resources. These suggestions are supported by, amongst others, the IUCN Commission on Ecosystem Management, and a community management plan for the whole archipelago has been developed, based on the ecosystem approach, together with local authorities and NGOs. This plan includes a national park, seven community areas with areas for conservation but also for sustainable use, and also a buffer zone with regulated access and use. However, these areas are controlled by the authorities and as the communities have not yet received a response from these, they are not sure how to proceed without legal confirmation of their plans.

Source: Windevoxhel, 2006

DISTRIBUTIONAL ASPECTS

A crucial matter to consider in any management action, and particularly in the implementation of as profound a shift as the introduction of EAF management, is that of the distributional impacts of the changes. Four issues that need to be considered are as follows:

1. **To whom do the various benefits and costs accrue?**
   A major consideration in EAF implementation, as noted in the EAF Guidelines, is the question of who receives the benefits and who incurs the costs of that implementation. This question arises in terms of the cross-section of current participants in the fishery (and beyond) as well as over time (see below).
2. **Intertemporal aspects: When do the various benefits and costs occur?**
   The potential benefits and costs of EAF management, if they occur at all, may do so over a wide range of time scales in the evolution of the fishery. For example, some potential benefits may be realized over a longer time frame (e.g. larger fish stocks), while some costs (e.g. of more elaborate management) are potentially arising in the short term. There may be certain realities (e.g. annual food supply considerations, electoral time frames) that also affect or constrain implementation of EAF.
3. **Scale: At what scale do benefits and costs occur?**
   Similarly, the potential benefits and costs of EAF may occur over a wide range of spatial/geographical or administrative scales (e.g. local, national, international). There may, for example, be a benefit that is international in scale (e.g. increased existence value of conserved biodiversity) and a corresponding cost that is local in scale (such as a negative impact on displaced fishers in a specific fishing community near an MPA), or any other combination could arise. Even within a given fishery ecosystem, the migration of fish and/or larvae may lead to situations in which those incurring the costs of conserving resources or habitats may not be those receiving the benefits (or at least may be sharing the benefits with others who are not incurring costs).

4. **Form of the benefits: What is the distribution of benefits across the various types?**
   The various benefits and costs of EAF implementation reflect the range of human values of fisheries ecosystems, as discussed in Chapter 2. Therefore it is important to recognise that the benefits could arise in any of the following forms:
   Use values:
   - net economic benefits of fishing, including income and employment
   - food provision and food security benefits
   - non-fishing use values that arise from fisheries ecosystems, e.g. tourism, aquaculture
   - the values of fisheries ecosystems as mechanisms for social interaction and as local "commons", as well as providers of livelihoods

   Non-use and existence values:
   - cultural benefits of fisheries ecosystems (e.g. for artistic expression or ceremonies)
   - aesthetic and existence benefits (e.g. the value of watching a sunset by the sea, or of knowing that whales are swimming in the sea)
   - option value (i.e., the value of maintaining fisheries ecosystems in terms of possible future benefits that might be realized as a result)

CONCLUSIONS

This chapter has explored a wide range of social and economic considerations that can influence the form and extent of EAF implementation. Specifically, the following have been discussed: (a) employment, livelihood and regional effects, (b) impacts on poverty levels, (c) impacts on food security, (d) cultural factors that may affect EAF implementation, (e) use of traditional knowledge and management practices, and (f) impacts on the distribution of benefits and costs related to EAF implementation. This list of themes can be viewed as a form of checklist to consider in moving to an EAF management framework. However, it must be noted that (i) since only brief overviews of each topic have been provided here, in practical EAF implementation, more in-depth understanding of each topic will be required, and (ii) no claim is made here to the completeness of this list of topics, as fisheries have within them a very wide range of social, economic and cultural considerations. Nevertheless, the material presented in this chapter represents a starting point in incorporating relevant factors in the move to EAF management.