

Toward Sustainable and Resilient Fisheries: A Fishery-System Approach to Overcoming the Factors of Unsustainability

Anthony Charles

Management Science / Environmental Studies
Saint Mary's University
Halifax, Nova Scotia B3H3C3 Canada
Email: t.charles@smu.ca

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Abstract

This paper describes a Fishery-System Approach to broadening the scope of fishery management, to better incorporate crucial aspects from across the fishery system and beyond. The approach builds on and incorporates an Eco-System Approach, while adding a parallel on the human side of the fishery, the Livelihoods Approach. The Eco-System Approach looks at target fish species and fishing activity within the context of the ecosystem, while analogously, the Livelihoods Approach examines human involvement in the fishery within a larger context of households, communities and the socioeconomic environment. A Fishery-System Approach therefore helps to address a fundamental concern: *We will never achieve fishery sustainability if we restrict attention solely to what goes on within the fishery.* The paper (a) outlines how livelihood issues – relating to societal objectives, the post-harvest sector, fishery diversification, women in fisheries, and household decision making – interact with fishery management, (b) draws lessons from integrated coastal management, particularly in terms of fishery interactions with other sectors, and (c) explores the potential for a Fishery-System Approach to deal with such factors of unsustainability as poor governance, lack of secure rights, poverty and lack of alternatives, and an unbalanced treatment of sustainability components.

1. Introduction

Conventional fishery management practices, at least in industrialized fisheries, have focused on assessing individual fish stocks, on setting total allowable catches for each stock, on limiting effort of individual fleets, and so on. Such practices tended to neglect the state of the broader aquatic ecosystem, and are thus widely seen to have been too narrow in scope. Less noted is the reality that this narrowness was also reflected in treatment of the human side of the fishery. A focus on one species or stock at a time usually translated into a preoccupation with those catching that one species/stock, neglecting interactions with other fisheries as well as with the post-harvest sector, the fishing communities, and society at large.

Some moves toward the necessary broadening of perspective in fisheries can be observed, notably as nongovernmental organizations become more involved in examining the broader impacts of fishery decisions, and as governments enlarge their ocean interests beyond a preoccupation with fisheries, seeking to frame fishery challenges within an oceans and coastal context. Greater attention is being paid to the aquatic ecosystem, through an 'ecosystem approach', with the potential to produce important changes in fishery management, if the structure and dynamics of the ecosystem are now to be taken into account in fishery decision making.

The ecosystem approach also serves as a starting point for a more comprehensive Fishery-System Approach that encourages a broader look not just at ecosystems but at other components and interactions within the fishery system as well. This broader perspective on fisheries forms the basis of this paper. Of course, merely advocating a comprehensive approach to understanding and managing fisheries is of limited usefulness, so the paper also provides some concrete ideas for changes to fishery management and policy, to better incorporate a Fishery-System Approach.

The discussion begins in the next section with an examination of fishery systems and their boundaries, scale and scope. This is followed in section 3 by a discussion of the two key components of a Fishery-System Approach – the ecosystem approach (illustrated through its application to marine protected areas) and the ‘livelihoods approach’ (with its links to fishery management) – along with related lessons from integrated coastal management. Section 4 applies a Fishery-System Approach in examining three identified factors of unsustainability: (1) poor governance, (2) a lack of secure fishery rights, and (3) unbalanced treatment of the components of fishery sustainability. Finally, the paper concludes in section 5 with some discussion on implementation realities. It should be noted that since this paper synthesizes a wide range of topics in a relatively short space, readers are referred to related analyses (e.g., Charles 2001, 2004) for further details.

2. Defining the ‘Bigger Picture’: Fishery Systems

A narrow view of a fishery system is that of a specific fish stock and the ‘fleet’ (or set of fishers) exploiting it. Fishery management in such a scenario basically involves two steps: assess the stock, and manage the fleet. Such a perspective may be suited at times to a fishery on a single fish stock in the open ocean, and its accompanying industrial-scale fleet – but coastal, small-scale and/or tropical fisheries are typically multi-species, focused more on a community of people trying to make a living than on an ‘atomistic’ set of fishers exploiting a specific stock. In such cases, it is certainly as important to understand the human aspects of the system as the biological one. Thus, figuring out the fishery system can make or break the success of fishery management.

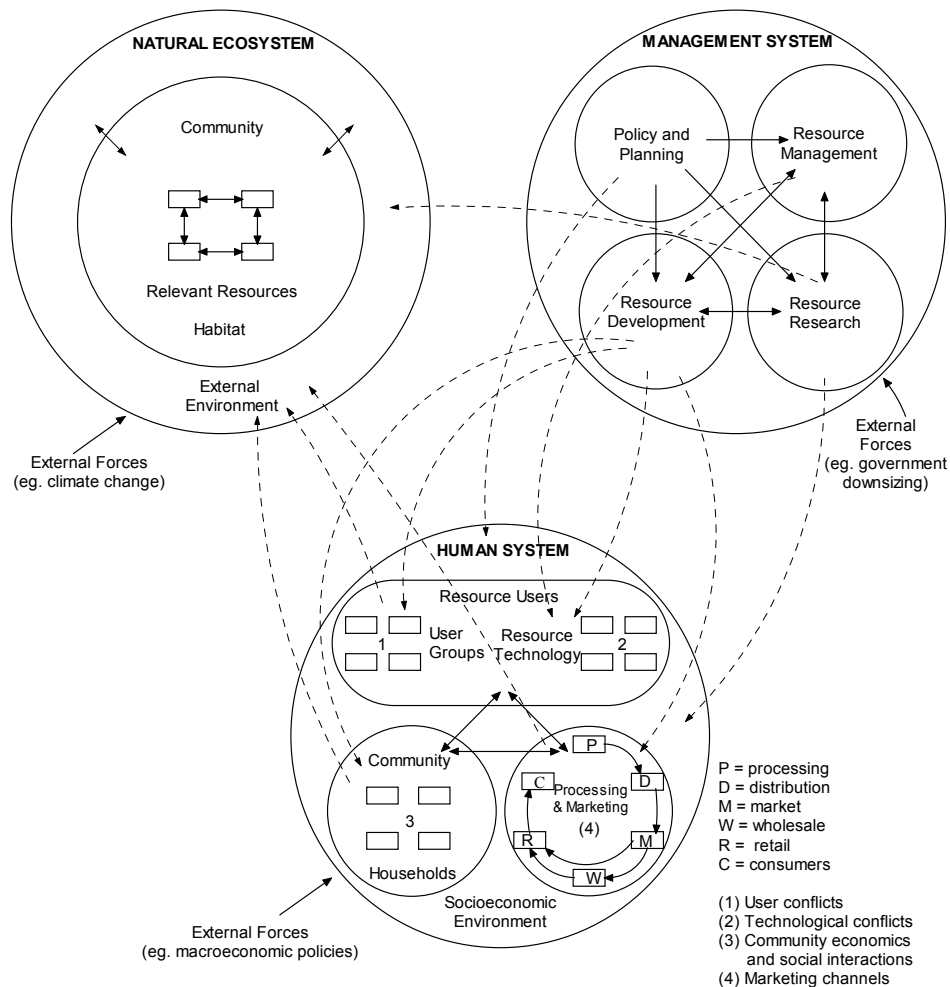
Boundaries. How can the boundaries of the system be set, and can they simultaneously reflect ecological, economic, socio-cultural, institutional and political considerations? If not, which factors are of greatest importance in setting the boundaries? Put another way, what is the balance between defining management units on the basis of human factors (to reflect, for example, the cohesive nature of a fishing community) and defining them to reflect biological stock units? In particular, how do we balance between the ‘natural’ delimitations of watersheds or coastal zones, on the one hand, and the boundaries of the system from the perspective of the local human populations?

Scale. The scale of a fishery system can vary greatly – from a small-scale fishery involving a coastal community and its local fishery resources, to a state or provincial fishery, a national system, or an even larger scale of regional multinational fishery organizations such as the European Union or the FAO’s Regional Fishery Bodies. When is it best to focus on a small scale and when should we look at the fishery as a larger system? Is it possible to be effective in managing at a scale different from that of the resource, or that of the harvesting activity? What happens when there are differences in the scales that are appropriate to deal with each component of a fishery – fish stocks, fishers, science, enforcement, policy, etc.?

In some cases, local solutions may be most effective, in the spirit of the subsidiarity approach (managing at the most local level possible). For example, consider a community-based fishery, harvesting a local, sedentary stock. The relevant *system* would seem naturally to comprise the fish stock and the environment in which they live, together with the fishers and their local community. However, while local management may seem a clear choice in such a case, ‘modern’ fishery management has often failed to embrace local solutions, preferring a broader geographical scale - provincial, state or national. Decisions are then made at this ‘higher’ level and applied uniformly to multiple local fisheries, despite the possibly large differences among them. In such a case, an adjustment to the management arrangements to bring decision making closer to the natural fishery

unit would seem helpful. A similar need can arise from a biodiversity perspective, as we learn more about the genetic structure within fish stocks. For example, if there are found to be genetically distinct sub-stocks within what had been managed as a single fish stock unit, can we adjust the scale of management to allow for spatial heterogeneity, supporting biodiversity and diversity among fishing communities?

Often there are ‘cross-scale linkages’ that are needed – for example, if decentralized and/or local approaches to management are needed to account for local conditions, but the fish stocks range over larger geographical areas. In such a case, coordination across boundaries is needed. Consider a fishery involving a highly migratory stock, such as tuna, crossing national boundaries. While on the human side, the fishers of a specific nation and the national management system may form a cohesive unit, that may not be compatible with the biological reality of the stock. If, accordingly, the system is then defined largely based on natural conditions, the set of fishers and the management sub-system involved may need adjustment. In this case, such an adjustment leads to the type of fishery management in place for ‘internationalized’ large pelagic fisheries world-wide, and is in keeping with the subsidiarity approach of the European Union, in which fish stocks are assessed scientifically in the context of the relevant ecosystem, but catch quotas (TACs) set for the stock are sub-divided among the relevant countries, so each country is able to manage its own fishery.



[from Charles, 2001]

Scope. The ‘scope’ of the fishery system is also crucial to determine. If fisheries are merely ‘fish in the sea, people in boats’, and research is just about the study and assessment of commercially-important species, and management efforts are directed solely at the harvesting process, we would be

neglecting the pervasive interactions between the core of the fishery - fish and fishers - and all the other elements of the ecosystem and the human system. The key lies in seeking a reasonable comprehension of the interactions among relevant components of the fishery system, but in a cost-effective way. In other words, there is a need for balance – to achieve a multi-disciplinary and integrated understanding while not spending all available management funds attempting an exhaustive understanding of the fishery. This will be a recurring theme in the present paper.

3. A Fishery-System Approach: Moving to the ‘Bigger Picture’

This section discusses several steps along the path of broadening our perspective of fishery systems. First is an exploration of how adoption of an ecosystem approach, e.g. through marine protected areas, leads logically to a further broadening to deal with the human dimensions of fisheries. Second, we look at the ‘Livelihoods Approach’ as a counterpart to the ecosystem approach on the human side of the fishery system. Third, examples of the interaction between a livelihoods approach and fishery management are explored. Fourth, we discuss how coastal management – with its focus on multiple resources, multiple uses and multiple objectives – provides lessons for the ‘bigger picture’ Fishery-System Approach.

3.1 The Ecosystem Approach and Marine Protected Areas

As noted earlier, the ecosystem approach (also referred to as *ecosystem-based management*) seeks to ensure that the ecosystem is taken into account in managing human involvement in fisheries. Larkin (1996: p.149) suggests that within the marine environment, an ecosystem approach has three essential components: “sustainable yield of products for human consumption and animal foods, maintenance of biodiversity, and protection from the effects of pollution and habitat degradation.” This marks a significant broadening beyond the ‘fish stock and fishing fleet’ sense of the fishery. The ecosystem approach has been the focus of considerable research attention in recent years, generating a range of conceptual, theoretical and practical studies [see, e.g., FAO (2003), Garcia et al. (2003) and references therein] – this work is largely beyond the scope of the present paper, but some fundamental points will be emphasized here.

A key manifestation of an Ecosystem Approach is the development and implementation of Marine Protected Areas (MPAs, or Marine Reserves). However, MPAs also reflect well the inability of a narrow view of fishery management to maximize fishery sustainability. This is because (1) MPAs typically involve more than a single fishery, and indeed more than the fishery sector itself, with implications for a range of ocean users such as tourism, aquaculture, industry and urban development, (2) the various players may well have different perceptions of the choices available, and indeed conflict can arise not only between ocean users but also between the need for acceptability and the need to meet scientific criteria in establishing MPAs. For example, it is possible that an ‘acceptable’ MPA may be small and far away from fishing grounds, while a scientifically ‘desirable’ MPA may be large and centred on the fishing grounds. Therefore it is important to monitor the MPA to measure its success or failure in meeting its specified objectives, and to examine distributional considerations, such as how benefits and costs are distributed spatially, temporally, and across local, regional and national levels. There is also a need for consultation, design, implementation and monitoring of the MPA to occur using participatory processes.

These considerations in establishing MPAs reinforce a point made by Kay and Schneider (1994: p.38) about incorporating the human component of the fishery system into an ecosystem approach: “If we are truly to use an ecosystem approach... it means changing in a fundamental way how we govern ourselves, how we design and operate our decision-making processes and institutions, and how we approach the business of environmental science and management.” While it is helpful to envision such human considerations within an ecosystem approach, the reality is that most efforts to develop and implement ecosystem approaches are focused primarily on ecological aspects. There remains a need to integrate this with similar initiatives on the human side, and this leads into the next topic...

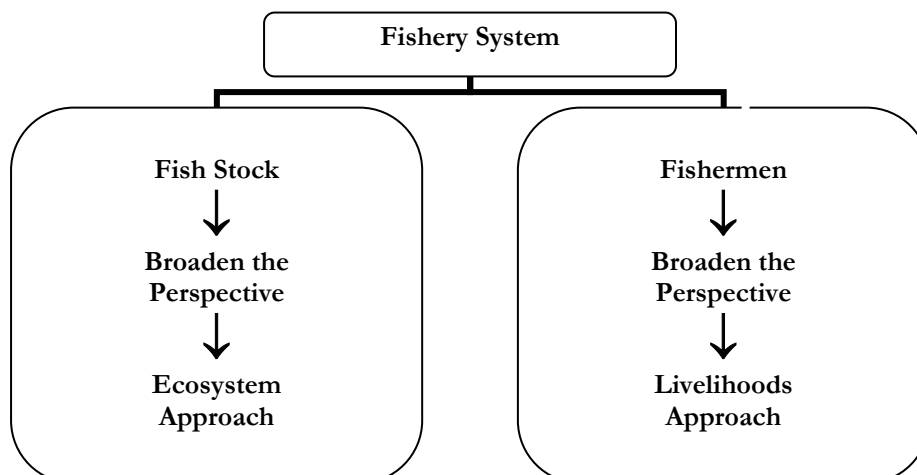
3.2 The ‘Livelihoods Approach’

Just as the ecosystem approach seeks a balance between the traditional emphasis on fish stocks and the broader context of where the fish live (the ecosystem), so too is there a need on the human side for an equivalent balancing – of a conventional emphasis on fishers and fishing fleets with the context of where those doing the fishing live, i.e. in fishing households, communities and the coastal economy. Indeed, effective fishery management requires us to understand when problems can be tackled internally to the fishery and when, as Panayotou (1980: p.146) suggested, “the solutions to the problems of small-scale fishermen are to be found outside the fishing sector”.

A ‘bigger picture’ is needed to deal with inherent linkages between fisheries and human activities beyond the fishery system, especially in other coastal and marine sectors such as aquaculture and tourism, and in coastal communities. Furthermore, as needs for more protein, income and livelihoods from fisheries come up against limits on sustainable fish harvests globally, it becomes crucial to seek to maximize the benefits to society produced from each fish caught, which in turn requires attention to all elements of the fishery system. All of this points to the need to incorporate linkages between the fishery itself, and the corresponding fishing households and communities, the post-harvest sector and the broader socioeconomic environment surrounding the fishery.

This provides a motivation for what may represent an equivalent of the ecosystem approach on the human side, namely a Livelihoods Approach. This perspective, also referred to as a ‘sustainable livelihoods approach’, has its own extensive theory largely beyond the scope of this paper – see, e.g., Ellis (2000), Allison and Ellis (2001) and references therein. The key of a Livelihoods Approach is to broaden fishery discussions beyond fishing and ‘fishery jobs’ *per se* to emphasize the entirety of individual, household or community sources of well-being and livelihood (income), and in particular how individuals, households and communities develop ‘portfolios’ of livelihood sources.

This is a crucial matter, since *livelihood diversity* (or economic diversity at the scale of a community or region) is often fundamental to achieving sustainability in fisheries. When fishers and communities have few if any economic alternatives, it will be very difficult to institute effective fishery management. For example, noted fishery economist Ian Smith (1981: p.22) pointed out that policies to deal with over-exploitation and over-capacity by attempting to reduce the number of fishers are likely to aggravate problems posed by a lack of employment alternatives since “Management programmes fail to deal adequately with fishermen who are displaced”. Smith noted that in the absence of non-fishery economic alternatives, such rationalization may fail either because (a) it is *politically* infeasible, due to adverse impacts on those dependent on the fishery, or (b) it is *practically* infeasible, since fishers removed from the fishery and without other options will do whatever necessary, including illegal fishing, to maintain their livelihood. It must be noted as well that such policies may also lead to declines in sustainability through inequitable resource allocation and social dislocation.



For such reasons, a lack of economic alternatives beyond the fishery must be considered as important a problem as over-exploited stocks and over-capacity in the fleets, despite receiving by far the least attention of these three problems. Indeed, it might be argued that this lack of attention is among the most glaring examples of an overly-narrow approach and how it can lead to fishery unsustainability.

A Livelihoods Approach fits – along with an Ecosystem Approach – within the context of an overall Fishery-System Approach, incorporating a range of factors revolving around the fishery, and the various interactions of these with the fish harvesting sector. These factors include:

- Demographic: population and population trends, migration, age and gender structure, etc.
- Socio-cultural: community objectives, gender roles, social stratification, social cohesion, etc.
- Economic: income and its distribution, degree of fishery dependence, types of markets, etc.
- Institutional: community organization, community infrastructure, involvement of women, etc.
- Marine Infrastructure: wharves, marketplaces, etc.
- Community Infrastructure: schools, churches, meeting places, cultural facilities, etc.
- Relevant Non-fishing Activities: boat building and repair, agriculture, tourism, industry, etc.

Within this broadened perspective, it is useful to examine interactions between the fishery and its socioeconomic environment... How do local fishery objectives relate to broader regional and national policy goals? How does the local institutional structure interact with institutions, legal arrangements, legislation and policy frameworks at national and/or sub-national levels? How do demographic aspects of the fishery interact with external influences, such as national population and migration trends? How do aspects of society, culture, history and tradition impact on fishery decision making? How does the fishery economy interact with the economic structure at regional, national levels?

3.3 The Livelihoods Approach and Fishery Management

The following are some examples of how a Livelihoods Approach, and the ‘bigger picture’ inherent within a Fishery-System Approach, interact directly with fishery management.

- *Diversifying for Resilience.* A livelihoods approach recognizes that each fishery participant needs to generate their livelihood one way or another, and resilience is enhanced if those livelihoods can be achieved from a diversity of sources, rather than having each individual relying on just one fish stock or set of stocks. Within the fishery, it is therefore useful to encourage multi-species fishing, in which fishers utilize a range of fish resources, and avoid policies that lead to specialization of fishers in single-species fisheries. Diversifying across sources of fish lets the individual fisher reduce risks, and at the same time, gives management greater flexibility to reduce harvesting of particularly vulnerable stocks. Still focusing on fishers but looking beyond the fishery *per se*, the existence of ‘occupational pluralism’ – fishers holding other jobs during non-fishing times – is to be encouraged so that fishers avoid total reliance on fishing for their income. This reduces the pressure they would otherwise face to obtain a livelihood entirely from the fishery, and thus also reduces pressure on the fish stocks. Encouraging such multiple sources of livelihood for fishers, and by implication, discouraging excessive specialization in the fishery, may boost the system’s overall resilience.
- *Post-Harvest.* From a livelihoods perspective, at the household or community scale, fishing and the post-harvest sector are often complementary. Attention to the processing sector within the context of fishery management can thus help improve livelihoods of fishing households without increasing catches. For example, better fish processing can transform fish into more manageable and marketable forms, making distribution easier and reducing spoilage, thus contributing *value added* to the fish landed by fishers, and potentially increasing prices paid to those fishers. Processing can also produce significant benefits to the fishery by creating employment in fishery-based regions, providing more diversified household income sources, and generally increasing the value of the fishery to coastal communities and to society. Finally, processing can produce conservation benefits,

such as reduced waste through better utilization of by-catch, which in turn can relieve pressure on the resource base. Post-harvest marketing and distribution channels can also have impacts on fisheries and livelihoods – for example, if fish caught in developing nations are diverted from local markets to those in Northern countries, and/or from use as food fish to use as fish meal in salmon and shrimp farms, this could result in lower availability for local nutritional needs.

- *Societal Objectives.* Broadening the perspective on fishery systems through a livelihoods approach provides a better framework to account for costs and benefits of management, relative to society's objectives. For example, consider a fishery involving isolated communities with few alternative employment options, where the fishery is the 'engine' of the coastal economy. In such a situation, if fishers have no job alternatives, then the *social opportunity cost of labour* – the true cost to society of having a fisher working in the fishery, measured by what that person could otherwise have been doing in the economy – is essentially zero. There is no social cost to keeping the fishers in the fishery. Indeed, the social cost of labour may even be negative, so rather than being a cost to be minimized, the employment of fishers is a positive 'good'. This could happen if (a) the loss of fishers from the fishery leads, through a multiplier effect, to an economic *loss* to the regional economy, or (b) if social costs rise as unemployment rises, due for example to increased crime and/or decreased health and welfare levels. Both of these possibilities can be analysed through a Livelihoods Approach. In any case, a Livelihoods Approach facilitates a more complete analysis. In particular, it highlights where private decisions may not fit with society's objectives. For example, from the private perspective of a fishing vessel owner, there is an incentive to minimize the use of labour since employing a crew member implies a positive labour cost, given by the wage level (i.e., the *private cost of labour*). In the scenario described above, even though such a private incentive may be individually 'rational', its consequences may be undesirable from society's perspective.
- *Household Decision-making.* Choices made at the level of fishing households can have major conservation impacts. Consider for example the extent to which a fishing household involves family members in the fishing enterprise. Doing so could lead to *greater* fishing intensity by a *profit-maximizer* (since costs of fishing are lower by using family members) or *lower* fishing intensity in the case of a *satisficer* (since a sufficient household income will have been more rapidly obtained). Furthermore, in many cases, household members not involved in harvesting may be highly involved on the post-harvest side, perhaps working in processing plants (in an industrial setting) or marketing and distributing the catch within the community and beyond (for those in an artisanal context). Depending on the motivations of the household, this may reduce pressure on the resource. Finally, if those in the household hold jobs entirely outside the fishery system, this could have the effect of stabilizing family income and reducing the risk of major loss if a disaster in the fishery were to occur (such as an unexpected stock collapse). All these considerations can be usefully examined within a livelihoods approach.
- *Women in Fisheries.* The case has been made often that fishery management can be more effective if it pays more attention to the role of women in fisheries. Studies indicate that women are active participants in many fishery systems, certainly in fishing households but also in fishing itself, in post-harvest components (such as processing in industrial contexts, and marketing in artisanal settings), and in the community's fishery planning (e.g., Nadel-Klein and Davis 1988). In particular, Ruddle (1994) highlights the role of women in the building up and holding of fishery and marine environmental knowledge within the community. FAO (1984) long ago concluded that "Fisheries development programs should recognize that women often play an important role in fishing communities..." The role women play in fishing households, fishing communities and fishing enterprises – essentially, in generating livelihoods – is important to understand if fishery management is to avoid missing a key element of the system.

3.4 Learning from Coastal Management

Combining into fishery management both an ecosystem approach and a livelihoods approach requires us to deal with all the various components and interactions within the fishery system, and for this, it is helpful to draw on ideas and approaches found in Integrated Coastal Management (and the related integrated watershed management). Such integrated approaches are characterized by a multiplicity of resources (e.g., soil, water, vegetation, fish stocks, etc.) and of habitats (e.g., open ocean, estuaries, fresh vs. salt water, wetlands, beaches, etc.), as well as a range of environmental variables (such as changes in the water temperature, turbidity and acidity, chemical pollutants and flows of fresh and sea water).

On the people side, integrated coastal management deals with interactions among multiple coastal uses (such as forestry, oil and gas, offshore mining, coastal agriculture, shipping, and tourism, as well as fisheries) and among multiple stakeholders (including coastal communities, industries, and so on), interactions among people and ecosystems, and among multiple levels of government. Typically, this utilizes processes for participatory decision making and conflict resolution, and calls for a wide range of information on characteristics of the shoreline, the immediate hinterland, the inshore and offshore waters, the local climate and currents, the ecosystem in question (estuaries, reefs, etc.), the natural resource in question, and the human community (cultural, economic, social).

Coastal management typically provides a balance in the attention paid to *natural* and *human* systems and dynamics. This contrasts with the conventional approach to fishery management alluded to above, in which a focus on a single species or stock at a time usually translates into attention only to those catching that one species/stock, to the neglect of interactions with other fisheries and those in the post-harvest sector, the fishing communities, and society at large, who rely on the fishery one way or another. An effort to incorporate into fishery management this perspective of coastal management would, then, address the point made many years ago by Orbach (1980: p.150):

“The human component of a fishery involves more than fishermen themselves, that is, others besides those who harvest the resource from its habitat. These harvesters are only a small part of the total set of people involved in fisheries. For every commercial fisherman, for example, there are three sets of people who are equally a part of the human dimension of his activity: his family and ‘community’ in the social or political sense; the people in the boatyards, supply stores, and service facilities who are both integral to and dependent upon the harvesting activity; and the distributors, marketers, and consumers who create the demand for his product.”

Integrated coastal management thus illustrates a broader-based approach, incorporating components of the fishery within a wider context. It is also a useful framework within which to look at economic diversification in fishery-dependent coastal areas. This may well be the single most important ingredient in the pursuit of sustainable, resilient fisheries, relieving pressure on the resource base by creating sustainable economic activity outside the fishery sector. From the perspective of the individual, this enhances the range of available livelihood choices, tending to make it more attractive for those so-inclined to leave the fishery, and reducing economic incentives for others to enter. A key route to this end lies in supporting indigenously-created employment alternatives within the local region or community, utilizing local comparative advantages in ocean-related activity. Economic diversification can help increase fishery resilience, as well as community and socioeconomic sustainability (Charles and Herrera 1994) – it is not a simple task, but can draw on both a livelihoods approach and integrated coastal management mechanisms.

4. Dealing with the Factors of Unsustainability through a Fishery-System Approach

This section examines how a Fishery-System Approach, and the corresponding livelihoods approach and ecosystem approach, can help counter three key Factors of Unsustainability.

4.1 “Poor Governance”

The need for effective ‘governance’ in fisheries is clear, and in particular, the need for effective management institutions is crucial given that, in the past, poor institutional arrangements in many fisheries led to disastrous conservation failures. An ineffective management institution will be unable to overcome the many economic incentives that run counter to societal objectives in the fishery. A Fishery-System Approach, and its component livelihoods approach, provide a wider framework to explore governance options. In particular, once fishing households and communities are included in discussions of fishery management, attention is naturally drawn to the potential for community-based management.

In fisheries, community-based management is rooted in the idea that fishers and other residents of coastal communities, living closest geographically to the resources of the sea, should have a large degree of responsibility for and control over managing those resources. It implies participation in decision-making on a range of aspects of marine stewardship and fishery management (see, e.g., Charles 2001; Pinkerton 1999; Wiber et al. 2004). Community-based management is particularly compatible with a livelihoods approach, in that the geographically-based emphasis allows for inclusion of multiple sources of livelihood, within and beyond the fishery. Essentially a form of co-management, community-based management is most appropriate when the fishery interacts broadly with a community in a particular location, and deals with a multiplicity of societal objectives. The idea, then, is to devolve management authority in part to the local level, held within a suitable management body of resource users, organizations and community representatives.

While on the one hand, such an arrangement is conducive to incorporating livelihood considerations into fishery management, on the other hand, community-based management would itself be aided by adoption of a Fishery-System Approach, since the latter (1) has widespread participation in the local management process, and (2) looks beyond the fishery, to provide knowledge of and connections with non-fishery marine resource users and institutions in the communities involved.

4.2 “Absence of Secure Rights”

Whenever a fishery is managed by restricting who can have access to the fishery, how much fishing activity (fishing effort) individual participants are allowed, or how much catch each can take, those with such entitlements are said to hold use rights – ‘the rights to use’, as recognized or assigned by the relevant management authority. There is a considerable literature emphasizing the problems that arise in the absence of secure use rights in fisheries. I have written elsewhere (Charles 2001, 2002a) on the importance of both use rights and management rights – the rights to be involved in decision making about fishery management. Crucial as well is the recognition that the need for clear rights must be accompanied by an equal emphasis on responsibilities, as reflected in the FAO Code of Conduct for Responsible Fishing.

A Fishery-System Approach does not resolve the absence of clearly-defined and secure rights, but it does provide a suitably broad framework within which to assess fishery rights. This is important because there are no simple ‘cook-book’ formulas for determining suitable rights, and great harm can come from an inappropriate rights system. It is crucial to assess whether suitable use rights already exist in a given fishery, and if not (or if current rights are ineffective), to exercise great care in developing an appropriate rights system. Perhaps the key requirement, prior to implementing a rights system, is to know what fishery objectives are being pursued. For example, rights are often advocated as a means to reduce fishery over-capacity, but the introduction of rights linked to capacity reduction is rarely if ever carried out systematically, with the aim of moving toward a specified desired fishery

configuration. Such an overly-narrow approach, one that ignores the full extent of the fishery system, can be harmful to one or more components of sustainability and resilience (Charles 2001).

4.3 “Unbalanced Treatment of the Four Components of Sustainability”

This Factor of Unsustainability is particularly well addressed by a Fishery-System Approach, since this approach is inherently so broad as to make it impossible to pursue a narrow view of sustainability. As stated in reports of previous workshops on Factors of Unsustainability, “the modern concept of sustainability” includes ecological, social, economic and institutional components (see also Charles 1994, 2001). This reflects an evolution from an original preoccupation with ‘sustainable yield’ to a multi-dimensional perspective based on maintaining or enhancing multiple ‘sustainability components’. This is compatible with both the ecosystem approach, which looks broadly at ecological matters and thus at ecological sustainability, and the livelihoods approach, which incorporates individuals, households and communities – and thus addresses socioeconomic and community sustainability. It is important as well to recognize a need for management to work simultaneously toward both sustainability and *resilience* in the fishery system. The concept of resilience (Holling 1973) refers to the capability of ecosystems, human systems (such as fishing communities) and management systems to absorb unexpected shocks and perturbations without collapsing, self-destructing or otherwise entering an intrinsically undesirable state (Berkes and Folke 1998). In a fishery, then, we can envision resilient management institutions, resilient fishing communities, a resilient economic structure in the fishery, and a resilient ecosystem in which the fish live. In other words, resilience relates to the entire fishery system, and beyond the fishery as well, with resilience-enhancing strategies best considered within a Fishery-System Approach.

In exploring fishery policy and management measures that will move us in the right direction, toward a balanced treatment of sustainability and resilience, it seems crucial to overcome two fundamental problems that have become ingrained in many fishery management systems (Charles 2001, 2004):

- *The Illusion of Certainty*. Despite the pervasive and well-documented uncertainties inherent in fisheries, some management systems tend to downplay major elements of uncertainty, so that far from recognizing and working within the bounds of this uncertainty, management approaches may create an ‘illusion of certainty’ (e.g., applying management tools highly sensitive to uncertainty) that leads to the opposite result.
- *The Fallacy of Controllability*. The fishery is a good example of a system that can be only partially, and imperfectly, controlled. This reality is unfortunately far from universally recognized. Instead, we often see in the fishery a fallacy of controllability, reflecting a sense that more can be known, and more controlled, in fisheries than can be realistically expected.

Dealing with these challenges requires a recognition that complexities and uncertainties inherent in fishery systems make it risky to rely on management methods that are sensitive to highly uncertain variables or which depend on high levels of controllability. The change in fishery management and policy this implies is one I have characterized as a shift toward **robust management** (Charles 2001, 2002b, 2004) – management designed to achieve reasonable success in meeting societal objectives, even if (a) we have an imperfect knowledge of the fishery (notably the status of the resources), its environment and the processes of change over time, and/or (b) the actual capability to control fishing activity, notably given unexpected changes in nature’s course, is highly imperfect. As with ‘sustainability’ or ‘resilience’, robust management is not a simple goal to achieve, but rather one to strive for – in other words, we should aim for more sustainability and resilience in fisheries, and simultaneously seek out more robust approaches in fishery management.

5. Conclusions: Implementing a New Approach

How are we to deal with the Factors of Unsustainability in fisheries? There are, of course, important actions that can be taken to address specific concerns internal to the fishery. This paper, however, has argued that in addition, it is crucial to deal with the ‘bigger picture’:

We will never achieve fishery sustainability if we restrict attention solely to what goes on within the fishery.

This is apparent from the fact that three of the six original Factors of Unsustainability identified in Greboval (2002) go beyond the fishery *per se*, i.e. (a) poverty and lack of alternatives, (b) high demand for limited resources, and (c) interactions of the fishery sector with other sectors. Indeed, it can be argued that a failure to take a broad enough perspective on fishery problems – i.e., “*An overly narrow approach to fishery problems*” – is itself a significant Factor of Unsustainability in fisheries.

A Fishery-System Approach has been outlined here as a mechanism to adopt a ‘bigger picture’ in understanding and managing fisheries, one that looks beyond conventional ‘fish and fleet’ thinking. This builds on and incorporates the Eco-System Approach (‘ecosystem-based management’) and adds a parallel on the human side of the fishery, the Livelihoods Approach. The first of these looks at target fish species and fishing activity within the context of the ecosystem, and in an equivalent manner, the Livelihoods Approach looks at human elements in the fishery within a larger context of households, communities and the socioeconomic environment. Overall, then, a Fishery-System Approach allows us to encompass relevant factors affecting and interacting with fishery management from across the fishery system and beyond.

As described earlier, a concrete example of this arises with respect to marine protected areas. MPA development and implementation certainly requires an ecosystem approach, but it also requires an understanding of the ‘big picture’ from the human side – relating to non-fishery marine uses, distributional impacts of MPAs among households and coastal communities, approaches to integrated management, conflict resolution, and more. In other words, a Fishery-System Approach is needed. This paper also explored the potential of a Fishery-System Approach to contribute to ameliorating three of the identified Factors of Unsustainability in fisheries – poor governance, absence of secure rights, and unbalanced treatment of the four components of sustainability.

The need to look at fisheries as systems has been advocated for years, but how can a ‘big picture’ Fishery-System Approach be implemented in practice? First, it can build on the momentum toward the Eco-system Approach in fishery and ocean management, essentially expanding ‘ecosystem-based’ thinking into ‘fishery system based’ thinking. At the same time, a Fishery-System Approach can draw lessons from Integrated Coastal Management (and watershed management) in terms of understanding human-environment interactions, institutional linkages, multi-use conflicts, multi-stakeholder governance structures and the like. Thus implementation of a Fishery-System Approach might take place by linking ‘back’ to the widely-supported Eco-system Approach and ‘forward’ to the similarly well-accepted approach of Integrated Management.

Comprehensive adoption of a Fishery-System Approach will, on the one hand, ensure that we take into account impacts of the broader fishery and coastal system on fishery management, and at the same time, ensure that the broader consequences of management actions are assessed. While clearly there is no single solution to overcome all the Factors of Unsustainability, a Fishery-System Approach may well be an important mechanism to move in the direction of improved fishery sustainability and resilience.

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References

Allison, E.H., and F. Ellis (2001). The livelihoods approach and management of small-scale fisheries. *Marine Policy* 25:377-388.

Berkes, F., and C. Folke (1998). *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. 459 pp. Cambridge, U.K.: Cambridge University Press.

Charles, A.T. (1994). Towards sustainability: The fishery experience. *Ecological Economics*, **11**, 201-11.

Charles, A.T. (2001). *Sustainable Fishery Systems*, 370 pp. Oxford U.K.: Blackwell Science.

Charles, A.T. (2002a). Use rights and responsible fisheries: Limiting access and harvesting through rights-based management. In: *A Fishery Manager's Guidebook. Management Measures and their Application*. (K. Cochrane, editor) FAO Fisheries Technical Paper, No. 424, Food and Agriculture Organization, Rome Italy, 231p.

Charles, A.T. (2002b). The precautionary approach and 'burden of proof' challenges in fishery management. *Bulletin of Marine Science* 70(2):683-694.

Charles, A.T. (2004). Sustainability and resilience in natural resource systems: Policy directions and management institutions. *Encyclopaedia of Life Support Systems*. UNESCO. Paris, France.

Charles, A.T., and A. Herrera (1994). Development and diversification: Sustainability strategies for a Costa Rican fishing cooperative. In: *Proceedings of the 6th Conference of the International Institute for Fisheries Economics and Trade* (M. Antona, J. Catanzano, & J.G. Sutinen, editors), p.1315-1324. IIFET/ORSTOM, Paris, France.

Ellis, F. *Rural Livelihoods and Diversity in Developing Countries*. Oxford University Press. Oxford, U.K.

FAO (1984). *Report of the FAO World Conference on Fisheries Management and Development*. Food and Agriculture Organization, Rome Italy.

FAO (2003). The ecosystem approach to marine capture fisheries. *FAO Technical Guidelines for Responsible Fisheries* No. 4 (Supplement 2). Food and Agriculture Organization, Rome Italy. 112p.

Garcia, S.M., A. Zerbi, C. Aliaume, T. Do Chi and G. Lasserre (2003). The ecosystem approach to fisheries. Issues, terminology, principles, institutional foundations, implementation and outlook. *FAO Fisheries Technical Paper*. No. 443. Food and Agriculture Organization, Rome Italy. 71p.

Greboval, D. (2002). Report and documentation of the International Workshop on Factors Contributing to Unsustainability and Overexploitation in Fisheries. Bangkok, Thailand, 4-8 February 2002. *FAO Fisheries Report*. No. 672. Food and Agriculture Organization, Rome Italy. 173p.

Holling, C.S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics* 4:1-23.

Kay, J.J., and E. Schneider (1994). Embracing complexity: The challenge of the ecosystem concept. *Alternatives* 20:32-39.

Larkin, P.A. (1996). Concepts and issues in marine ecosystem management. *Reviews in Fish Biology and Fisheries* 6:139-164.

Nadel-Klein, J., and D.L. Davis (1988). *To Work and To Weep: Women in Fishing Economies*. Social and Economic Papers No. 18. Institute of Social and Economic Research, Memorial University of Newfoundland, St. John's, Canada.

Orbach, M.K. (1980). The human dimension. In: *Fisheries Management* (R.T. Lackey and L.A. Nielsen, editors), p.149-63. John Wiley & Sons, New York, U.S.A.

Panayotou, T. (1980). Economic conditions and prospects of small-scale fishermen in Thailand. *Marine Policy* 4:142-146.

Pinkerton, E. (1999). Directions, principles, and practices in the shared governance of Canadian marine fisheries. In: *Fishing Places, Fishing People: Traditions and Issues in Small-Scale Fisheries*. (D. Newell and R. Ommer, editors), p.340-354. University of Toronto Press, Toronto, Canada.

Ruddle, K. (1994). Local knowledge in the folk management of fisheries and coastal marine environments. In: *Folk Management in the World's Fisheries: Lessons for Modern Fisheries Management* (C.L. Dyer and J.R. McGoodwin, editors), p.161-206. University Press of Colorado. Niwot, U.S.A.

Smith, I.R. (1981). Improving fishing incomes when resources are overfished. *Marine Policy* 5:17-22.

Wiber, M., F. Berkes, A. Charles, and J. Kearney (2004). Participatory research supporting community-based fishery management. *Marine Policy* 28:459-468.