The Ecosystem Approach of the CBD and Fisheries Management in Japan

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Abstract

The Ecosystem Approach of the Convention on Biological Diversity (CBD) is a social and holistic decision-making framework for ecosystem management. It links biological, social and economic information and aims to achieve a socially acceptable balance between nature conservation priorities and the use and sharing of benefits of resource. This article introduces this approach's conceptual background as an alternative to conventional environmental policy concepts. Then, it examines institutional characteristics of Japanese fisheries management from the viewpoint of the Ecosystem Approach. The objective of the analysis is to define the advantages and shortcomings of Japanese fisheries management, and to derive logical foundations for policy responses necessary to achieve marine ecosystem management in Japan.

As an environmental management institution, the Japanese fisheries management system has many advantages such as a decentralized management system, adaptive management process, use of local and scientific knowledge, multi-scale and interlinked management and promotion of sustainable resource use in economic context. On the other hand, conservation of ecosystem structures and functions falls basically beyond the scope of this management. Progress in scientific understanding should be promoted in order to achieve marine ecosystem management. Discussions should also be facilitated of appropriate characteristics of rights and licenses, ecosystem perspectives in formulating TAC and TAE, and the role of fisheries in marine ecosystem management. Also required will be wide-ranging stakeholder involvement, a watershed management viewpoint, identification of ecologically necessary data, development of long-term ecosystem indicators, and role-sharing in data collection and monitoring. The 'term Marine Protected Area (MPA)' is not synonymous with 'no-take zone.' An economically and ecologically meaningful MPA system can be devised and should be implemented where necessary.

Key words: Ecosystem Approach, environmental policy, fisheries management, institution, Japan.

1. Introduction: CBD and the Ecosystem Approach

The Convention on Biological Diversity (CBD) is the first global agreement on the conservation and sustainable use of biological diversity. It was adopted in June 1992 at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, along with the United Nations Framework Convention on Climate Change (UNFCC), the Rio Declaration on Environment and Development, the Declaration of Forest Principles, and the Agenda 21.

The CBD set out a commitment for maintaining the world's ecological underpinnings as economic development proceeds, and established three main goals: (1) the conservation of biodiversity, (2) sustainable use of the components of biodiversity, and (3) sharing the benefits arising from the commercial and other utilization of genetic resources in a fair and equitable way (UNEP CBD, 1992). In order to deliver these goals, the Ecosystem Approach was adopted as the primary framework for action (decision II/8), and was defined as 'a strategy for management of land, water and living resources that promotes conservation and sustainable use in an equitable way.' It is based on the application of appropriate scientific methodologies focused on levels of biological organization which encompass the essential processes, functions and interactions among organisms and their environment. It also recognizes that humans, with their cultural diversity, are an integral component of ecosystems. Decision V/6 endorsed the description of twelve principles of the Ecosystem Approach and five operational guidelines for application of the approach (Table 1).

Table 1 Principles and operational guidance of the Ecosystem Approach (from UNEP CBD, 2000; Smith & Maltby, 2003).

Principle 1.	The objectives of management of land, water and living resources are a matter of societal choice.
Principle 2.	Management should be decentralized to the lowest appropriate level.
Principle 3.	Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
Principle 4.	Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should: a) Reduce those market distortions that adversely affect biological diversity; b) Align incentives to promote biodiversity conservation and sustainable use; c) Internalize costs and benefits in the given ecosystem to the extent feasible.
Principle 5.	Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.
Principle 6.	Ecosystems must be managed within the limits of their functioning.
Principle 7.	The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.
Principle 8.	Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.
Principle 9.	Management must recognize that change is inevitable.
Principle 10.	The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.
Principle 11.	The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
Principle 12.	The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

Five Points of Operational Guidance

1. Focus on the functional relationships and processes within ecosystems.
2. Enhance benefit sharing.
3. Use adaptive management practices.
4. Carry out management actions at the scale appropriate for the issue being addressed, with decentralisation to lowest level, as appropriate.
5. Ensure intersectional cooperation.

This article focuses on the Ecosystem Approach of the CBD, and introduces its conceptual background. Then institutional characteristics of Japanese fisheries management are examined from the viewpoint of the Ecosystem Approach. The objective of the analysis is to define the advantages and shortcomings of Japanese fisheries management, and to derive logical foundations for policy responses necessary to achieve marine ecosystem management. There are several previous works, as cited in section 3, which deal with the institutional features of Japanese fisheries management system, but this article is the first study which deals with the ecosystem management of fisheries resources and the relationship between the Ecosystem approach of the CBD.

2. The Ecosystem Approach as an Alternative to Conventional Environmental Policy

This section briefly introduces a shift in the world environmental policy since 1972, and presents the characteristics of the Ecosystem Approach and the process of its international application to marine policy.

Human beings have long been aware of their adverse impacts on ecosystems and have been taking measures to combat these problems. In 1972, as the first global conference on environmental issues, the United Nations Conference on the Human Environment was held in Stockholm. One of the core issues of the conference was environmental destruction and pollution caused by industrialization and urbanization. In the process of the discussions, however, there were sharp divisions elicited between the developed countries, who were emphasizing on environmental degradation caused by developmental activities, and the developing countries who wished to eradicate domestic poverty and starvation through industrialization and development. With regard to this situation, the World Commission on Environment and Development, also known as the Brundtland Commission, published a report of their four-year discussions; 'Our Common Future,' in 1987. They presented the idea of 'sustainable development;' meaning 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs,' in other words, development not antagonistic to environmental conservation, but essential to satisfy human needs and improve the quality of the environment and human life. The point is that development must be based on the efficient and environmentally responsible use of all of society's scarce resources-natural, human, and economic.

During these decades, concurrently, there was a shift in the world's environmental issues and awareness, that the issues to be tackled were not limited to local, specific pollution or destruction with relatively apparent stakeholders (i.e., polluters and victims), but were broader in scope, including global environmental deterioration with a wide range of stakeholders, such as global warming and biodiversity losses. This paradigm shift in environmental issues (Matsushita, 2002) inevitably led to a fundamental change in environmental policy ideas, that is, from regulatory policies such as setting environmental standard or constructions of preservation area, to integrated and holistic social strategies aiming for wise use and conservation of society's scarce resources. The CBD and other global environmental conventions and declarations

adopted at UNCED in 1992 were an offshoot of this trend.

When it comes to wildlife issues, the traditional approaches as found, for example, in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) of 1973 or the Ramsar Convention on Wetlands of 1975, are basically species-specific or sectoral approaches, in which interactions among ecosystem components including human activities are not taken into account. As a consequence of international trends in environmental policy concepts as summarized above, ecosystem management has attracted wide attention as a way to redeem these shortcomings. Ecosystem management is defined as management driven by explicit goals, executed according to policies, protocols, and practices, and made adaptable through monitoring and research based on our best understanding of the ecological interactions and processes necessary to sustain ecosystem structure and function (Christensen *et al*., 1996). It is worth noting that ecosystem management is not only about the sustainability of ecosystem structures and processes necessary to deliver goods and services. It also includes concepts such as the conservation of biodiversity, sustained yield of multiple resources and ecosystem health (Salwasser, 1994; Washitani, 1998).

The Ecosystem Approach of the CBD has many aspects in common with ecosystem management. It is not a set of guidelines tailored to the management needs of various ecosystem types. In fact, the Ecosystem Approach under the CBD is a framework for holistic decision-making and action which links biological, social and economic information and aims to achieve a socially acceptable balance between nature conservation priorities and the use and the sharing of the benefits of resources (Smith & Maltby, 2003). Therefore, in addition to the bottom line for managing ecosystems, such as Principles 3, 5, 6, 7 and 8, it also highlights socio-economic factors. It firmly recognizes people as an integral component of ecosystems and puts them at the center of management, and engages the widest range of sectoral interests via a participatory approach and decentralized institutional framework (Principles 1, 2, and 12). In addition, it takes adaptive measures to deal with uncertainty (Principle 9), and lays emphasis upon the economic context such as through incentive measures in an appropriate way (Principles 4, 10). In doing so, all kinds of information from scientific, administrative, local and indigenous levels are considered (Principle 11), and social investment to empower these actors is highly encouraged. To sum it up, the Ecosystem Approach is not a replacement, but an extension of conventional species/area-specific management practices, and can be understood as a new environmental policy framework to achieve ecosystem management.

Although the development of the ecosystem concept in environmental conservation is still in its infancy, there are several global conventions, agreements and mandates which specifically deal with its application to marine ecosystems. The first global convention that adapted the ecosystem concept to ocean management was the 1980 Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). Ch.17 of Agenda 21 also deals with marine ecosystems and recognizes integrated coastal zone management (ICZM) as one of the most effective tools. ICZM is defined as 'a mechanism for bringing together the multiplicity of users, stakeholders, and decision-makers in the coastal zone in order to secure more effective ecosystem management whilst achieving economic development and intra- and intergenerational equity through the application of sustainability principles' (the Ramsar Convention, 2002). Although there are several similar terminologies such as integrated marine and coastal area management (IMCAM), integrated coastal management (ICM), or integrated coastal area management (ICAM), they are all based upon almost the same idea. To sum it up, the ICZM and other approaches such as IMCAM, ICAM or ICM, are social strategies to achieve marine ecosystem management and are recognized as the most effective tools for implementing the CBD (AID Environment, 2004).

Other major international documents relating to marine ecosystem management include the United Nations Convention on the Law of the Sea (UNCLOS) of 1982, FAO Code of Conduct for Responsible Fisheries and Kyoto Declaration at the Conference on the Sustainable Contribution of Fisheries to Food Security of 1995, Jakarta Mandate on Marine and Coastal Biological Diversity in 1995, and Johannesburg Declaration on Sustainable Development at the World Summit on Sustainable Development (WSSD) in 2002, to list a few (FAO, 2003; Hanna, 2003). Based on the above, Wang (2004) concluded that, at that point in time, the obligation to adhere to ecosystem management of the marine environment and resources had been established in international law.

3. Institutional Features of Fisheries Management in Japan

Marine fisheries are industry which uses marine ecosystem services. Therefore, the sustainability of the fisheries industry is ultimately dependent upon the sustainability of marine ecosystems. Consequently, fisheries management and marine ecosystem management must be, by nature, inextricably linked. Based on this recognition, this section introduces the institutional features of Japanese fisheries management. This is then examined, in the next section, from the viewpoint of the Ecosystem Approach of the CBD. Note that this paper primarily focuses attention on marine fisheries management, but the basic logic is also applicable to inland freshwater fisheries management.

Marine fisheries are classified into three categories

in Japan: (1) fishing rights for coastal fisheries; (2) fishing licenses for offshore and distant water fisheries; and (3) free fisheries. Fishing rights are classified, in turn, as (1a) common fishing rights granted to Fishing Cooperative Associations (FCAs, explained later), (1b) large-scale set-net fishing rights, preferentially granted to FCAs, and (1c) aquaculture (demarcated) fishing rights (Kaneda, 1995; JIFRS, 2004). Although the expiration period is fixed in law, fishing rights are regarded as real rights, and the provisions of the territorial rights law are applied *mutatis mutandis*. However, they do not include the right to privatize the sea surface into portions. Fishing rights are rather similar to use rights in their attributions, i.e., the right to conduct fishery operations exclusively in specified areas by specified methods. Fishery licenses, on the other hand, are not real rights, but taking the large capital investments of the license holders into account, they are also strongly protected under the law.

The fundamental concept of fishery management in Japan is 'the holistic utilization of the sea surfaces' by resource users themselves, as stated in the Section 1 of the current Fishery Law of 1949. Under this concept, the wide range of fishing operations conducted within an area are to be arranged and coordinated with the overall impact of usage in mind, and not simply from the viewpoint of each individual economic unit. As a result, various levels and scales of coordinating organizations have been created to act as instruments to facilitate holistic fisheries coordination; these include the Fishery Policy Council at the national level, Wide-Area Fisheries Coordinating Committees (WFCCs) at the multi-jurisdictional level, Area Fishery Coordinating Committees (AFCCs) at the prefectural level, and local Fisheries Cooperative Associations (FCAs) at the local level.

In addition to these formal coordinating organizations, a number of new operational ideas have been developed since the late 1970s, largely on the initiative of fishermen. These developments include the institution of what is known as Resource Management-type Fisheries, or 'Shigen Kanri-gata Gyogyo.' More specifically, in order to maintain and improve their incomes, as well as to sustain resources, autonomous bodies of local fishermen known as 'Fishery Management Organizations' (FMOs) have initiated various management measures. FMOs are often formed by a group of fishermen within an FCA. According to the biological nature of the target species, FMOs are sometimes organized by members from several neighboring FCAs, or even by members of FCAs from several prefectures (Hasegawa *et al*., 1992; FAO, 1993) (Table 2).

Within such a framework, the principal decision-makers with regard to management are the local fishermen. The Fishery Law provides a framework for fishery management through a system of fishing rights and licenses. In order to achieve holistic utilization of ocean surfaces, these coordinating organizations have been granted wide-ranging authority and power. For example, the AFCCs, which consist mainly of local fishermen, may determine allocation of, and restrict applications for fishing rights and licenses by means of their Fishery Ground Plan and Committee Directions. A variety of fishing restrictions have been stipulated by Prefectural Fishery Coordinating Regulations, FCA regulations, and FMO rules. Prefectural Fishery Coordinating Regulations broadly stipulate fishing restrictions, and these regulations apply throughout the prefecture. FCA regulations stipulate fishing restrictions in more detail, and these are applicable only locally. In particular, FCA regulations consider the restrictions set out in the Prefectural Fishery Coordinating Regulations and make additions to them. Similarly, the FMO rules constitute a further refinement of the FCA regulations. Therefore, the resource conservation is an integral part of the resource use by local fishermen. In other words, the exercise of full fishery rights and licenses is restrained by inherent legal requirements for resource conservation (Makino, 2001; 2002).

The government also plays a vital role in fishery resource management. In fact, the co-management literature makes it clear that neither local fishermen, nor the organizations to which they belong, can function efficiently without government cooperation or

Table 2 Coordinating organizations in Japan (for more detail, see Makino & Matsuda, 2005)

Level	Organizaion	Function
National Level	Fishery Policy Council	The advisory body to the government for national level fishery coordination, design of national fishery policy, etc.
Multijurisdictional Level	Wide-Area Fisheries Coordinating Committees (WFCCs)	Coordination of resource use and management of highly migratory species. Also addresses Resource Restoration Plans.
Prefectural Level	Area Fishery Coordinating Committees (AFCCs)	Mainly composed of democratically elected fishermen. Coordination through the Fishery Ground Plan, Prefectural Fishery Coordinating Regulations, and Committee Directions.
Local Level	Local Fisheries Cooperative Associations (local FCAs)	Composed of local fishermen. They esablish operational regulations (FCA regulations) that stipulate gear restrictions, seasonal/area closures of fishing grounds, etc.
More Specialized Purposes	Fishery Management Organizations (FMOs)	Autonomous bodies of fishermen. FMO rules are more detailed and stricter than FCA regulations.

intervention (Pomeroy & Berks, 1997; Dolsak & Ostrom, 2003). Such is the case also for the Japanese institutional framework. For example, the prefectural fisheries division is responsible for the issuance and renewal of fishing rights and licenses, and bases its decisions on advice from the AFCC. Scientific information or administrative guidelines presented by the prefecture often form the basis for the regulations and rules devised by local fishermen. Furthermore, the 'Resource Management Agreement System' in the Marine Fisheries Resource Development Promotion Law of 1971 legislatively encouraged autonomous fisheries management among fishermen. When a local agreement between fishermen prevails at a certain level within the area, the government can affirm the agreement, and then it becomes an official rule. Therefore, it constitutes an official support system for autonomous resource management by the fishermen. Also, in relation to the United Nations Convention on the Law of the Sea, the 'Law Regarding Preservation and Management of Living Marine Resources' was enacted in 1996. With this law, a total allowable catch (TAC) and a total allowable effort (TAE) system were introduced. Based on advice from the Fishery Policy Council or WFCCs, the central government sets TAC and TAE, and controls total fishing pressures. However, the allocation of quotas and the determination of access rules are basically the responsibility of fishermen's organizations.

In short, Japanese fisheries management is a decentralized co-management between local fishermen and the government, rather than compulsory, top-down regulation by the government, or a market-oriented management based on property rights and their efficient utilization by economically rational resource users. The transaction costs for fisheries management, which constitute the strongest counter-argument for top-down management systems, are also shared between the government and the local fishermen. Makino and Matsuda (2005) analyzed a case in Kanagawa Prefecture, and found that the transaction costs, especially the monitoring, enforcement and compliance costs, were remarkably low (about 0.6 % of production).

Given the above, is the Japanese fisheries management framework capable of playing a role in marine ecosystem management? Can fishing rights and licenses be consistently adjusted to be included into the ICZM? Alternatively, is it fundamentally inconsistent with ecosystem management? Sakuma (1995) noted that Japanese fisheries management can be understood as a case of decentralized environmental management in the sense that it involves flexible response by the local people as one of the parties in charge who autonomously and voluntarily participate in the decision-making process. Also, based on the recognition that the local fishermen are one of the central interested parties in establishing coastal use prioritization, Nakayama (1994) purported that environmental duties and obligations should accompany fishing rights. Accordingly, if the Japanese institutional system has a potential to extend its scope to ecosystem management, how should it be revised or adjusted? In the next section, the institutional characteristics of Japanese fisheries management as an environmental management system are examined from the viewpoint of the Ecosystem Approach of the CBD.

4. Examination from the Viewpoint of the Ecosystem Approach

In this section, an analytical framework is applied consisting of six interconnected themes provided by the UNEP CBD (2003) in order to deepen the discussion and understanding of the CBD's Ecosystem Approach; these are, (1) provision of environmental goods and services (what is being managed within ecosystems and for what purpose?); (2) building consensus (who will undertake the management?); (3) providing incentives for management (what are the incentives for management?); (4) balancing conservation and use of biotic resources (how can different management objectives be reconciled and integrated?); (5) cross-scale integration (how best to integrate management across multiple scales of interaction and response?); and (6) building adaptive capacity (how best to develop the capacity to initiate, learn from and thereby sustain activities?).

4.1 Provision of environmental goods and services (Principle 5)

Marine fisheries are industry which uses marine ecosystem services. Consequently, the conservation, use and management of fisheries resources take place in an ecosystem context. These activities have potentially consequences in terms of changes in the structure and functioning of the marine ecosystem of which the fisheries resources are part. This can affect the production of goods and services, either positively or negatively. Whether such impacts arise, and with what effects, depends greatly on the particular structure of the ecosystem concerned, the nature of the linkages among its components and the resulting processes and functions.

The main focus of Japanese fisheries management has been on target species, especially highly valued ones, and it has not paid much attention to the ecosystem context, *per se*. The reason simply relates to the principal aim of the current fishery law enacted shortly after World War II, that is, to develop fisheries productivity in order to cope with domestic food shortages and to improve the economic status of fishermen actually engaged in fishing operations (Makino & Matsuda, 2005). However, in the Fisheries Basic Policy Plan of 1999, it is clearly stated that ecosystem conservation is a prerequisite for fisheries management. Also, Article 2 of the Basic Law on Fisheries Policy of 2001 recognizes that fisheries

resources are a component of the marine ecosystem, and require conservation. Therefore, in recent years, ecosystem management has become an important policy task in Japanese fisheries administration.

In order to achieve marine ecosystem management, first of all, scientific understanding should be facilitated with regard to the relationship and interactions between target resources and ecosystem, the impact of fishing operations on the ecosystem, and effective measures for its conservation. For example, Matsuda and Abrams' multi-trophic food web model (in printing) shows that simple yield or profit maximization may lead to extinction of a significant fraction of the species. Therefore, in order to conserve the ecosystem structure of the system, there will be a need for institutions to coordinate decision-making between fisheries targeting prey species and that targeting predator species, based on monitoring results of the ecosystem structure in concern.

To sum up the above, there are no institutions for conservation of the marine ecosystem structure and functioning under current Japanese fisheries management. Progress should be facilitated in scientific understanding of the interrelationship between fishing activities and marine ecosystems. Then, appropriate institutional frameworks should be installed to achieve marine ecosystem management.

4.2 Building consensus (Principles 1, 11, 12)

Human society is diverse in the kind and manner of relationships that different groups have with the natural world, each viewing the world around them in different ways and emphasizing their own economic, cultural and societal interests and needs. In addition, fisheries are a food providing industry and have a particularly important social role in terms of the food security of Japan. Hence, determination of the ways of use or conservation objectives of marine ecosystems inevitably becomes a highly social issue. Therefore, the objectives of marine ecosystem management should be a societal choice (Principle 1). In this regard, marine resource users and local communities are especially important stakeholders, as they live on the resource and can more directly affect its future. Their rights and interests have to be appropriately recognized and incorporated into management planning. At the same time, the involvement of all relevant stakeholders and technical expertise in planning and carrying out joint activities, sharing management resources, is essential for effective management. (Principle 12).

Indeed, fisheries have long been the central industry in many coastal communities, and hence, fisheries coordination has had a lot in common with local social needs for the use of marine ecosystems. However, there are no other interests taken into account in this decision-making process. For example, recreational angler's interests are relatively important around urban areas, but there is no official institution for the inclusion of their interests into fisheries management.

There is a broad range of users in marine ecosystems. This means there are varieties of interests related to marine ecosystems, such as non-use value for citizens, or afflux of land-oriented pollutants or nutrients through material circulation. Also, the availability of the fishery resources as a bequest to future generations, or their potential to provide new goods such as pharmaceuticals can have value as options. In order to take these all into account, the viewpoint of watershed management is needed, and a decision-making system should be devised which transparently reflects all the relevant stakeholders' interests. This system can be established as an extension of the current fisheries coordinating organization by incorporating various stakeholders into the organization, or separately established with the fisheries industry as a constituent.

There are specific marine ecosystem functions and structures in each geographical and seasonal condition. They are actually infinite in variety. The local fishermen and their organizations have a lot of explicit and tacit knowledge of the local area which has accumulated for generations. As explained in the last section, fishery management in Japan has been conducted by local fishermen themselves. Therefore, the local knowledge cultivated by local fishermen should be utilized in ecosystem management (Principle 11). Daily catch data are also an important source of ecosystem information. However, information provided by local fishermen is not sufficient to achieve the conservation of ecosystem functions and structures. Therefore, as a first step, priorities for additional information or data necessary for ecosystem management should be identified from a scientific point of view. Subsequently, a role-sharing scheme should be devised for data collection and monitoring among local fishermen, the government and other citizens.

4.3 Providing incentives for management (Principle 4)

Marine ecosystems provide economically valuable goods and services, thus predicating the need to understand and manage ecosystems in an economic context (Principle 4). In that sense, organization of local fishermen as resource managers provides an incentive to manage the resource effectively so as to cut associated costs or gain additional benefits from enhanced ecosystem services. Indeed, in Japan, there have been traditional activities which can be appraised from the ecosystem point of view. For example, in some coastal areas, fishermen have voluntarily planted sea grasses, and established coastal nursery grounds and protected areas. Some others have afforested upper stream hills. These activities have long history, and are worthy of remark and research. However, they are motivated mainly by potential effects to the target species which directly relate to the concerned ecosystem. In other words, these activities could be understood as 'fishery ground conservations,' and conducted in economic contexts.

There are several advantageous features of the Japanese institution with regard to promoting ecosystem management in line with Principle 4. Legally protected rights / licenses mean high security of their interests. This high security can then lead to an economic motive for sustainable use of the area which they are coordinating, because the incentive to conserve the long-term ecosystem health of that area may be higher than, for example, individual transferable quotas (ITQs) that are defined for each target resource *per se* (Dolsak & Ostrom, 2003). This difference in the characteristics of interests, i.e., area-based and target resource-based, may be more influential under uncertainty, where permit rights such as ITQs are redefined as new information becomes available, and decreases the security of rights, which then reduces economic motivation for long-term decision making. Therefore, in Japan, if a proposed ecosystem management plan can demonstrate economic benefit for the fishermen, then they will be willing to play a positive role using their knowledge and abilities.

In addition to these incentives at the production stage, distribution stage-oriented incentives such as Marine Stewardship Council programs (Izawa & Makino, 2005) are now being introduced into Japan, and expected to be an additional measure to reduce adverse effects on ecosystems. In sum, Japanese fishery management has a potential to expand its scope to ecosystem management in line with the Principle 4.

However, the high rate of fishing gear depreciation and very high uncertainty in fishery income will raise the discount rate, and the future term considered by each fisherman during the decision-making process tends to be relatively short. Negative externalities from other fisheries operations as well as land-oriented pollutants and recreational fishing may complicate the situation. In order to resolve this time-scale inconsistency in decision-making, reference to long-term performance indicators (section 4.5) and adaptive attitudes in decision-making (section 4.6) are important.

4.4 Balancing conservation and use of biotic resources (Principles 6, 10)

Principle 10, the appropriate balance between conservation and use, is the very same concept of resource-management type fisheries as presented in the last section. But its main scope is, again, limited to economically valuable species. Economic incentives are critical and must be fully utilized for efficient conservation, but the scope of management should be broadened to include ecosystem structures and functions to the extent feasible. Likewise, limits to their functioning (Principle 6) are deeply acknowledged in fisheries management as far as the target resources are concerned. The TAC or TAE system is a formal institution to keep fisheries pressures within the limits. The task is to incorporate ecosystem perspectives into TAC/TAE formulating protocols.

As may be necessary, a system of marine protected areas (MPAs) may be one of the most effective measures to ensure the conservation of marine ecosystems. Within a system of MPAs, a range of measures can be applied along a continuum from ecosystems that are strictly protected, through mixed resource-use systems, of which ecosystem conservation and sustainable use are both part, to areas that have been wholly utilized by human activities including fisheries.

Note that, the term 'MPAs' does not necessarily mean 'no-take zones'. No-take zones are just one form of the MPA system. In fact, they can range from small closed areas or harvest refugia designated to protect a specific resource or habitat type, to extensive multiple-use MPA areas that integrate the management of many species, habitats and uses in a single, comprehensive plan (Agardy *et al*., 2003). Misunderstandings of the meaning of MPA often lead to negative reactions, especially where local communities sense that something is being taken away from them in order to preserve endangered species or ecosystems. As Sanchirico and Wilen (2001) implied by their metapopulation bioeconomic model, according to the nature and price of the resource and the level of its overexploitation, an appropriately designed system of MPAs can improve both fishery income and ecosystem health. Therefore, a system of MPAs is not antagonistic to fisheries operations, but can be understood as an ecosystem-based resource enhancement system which enables multiple and responsible use of ecosystem services, including fishery operations.

The limits of ecosystems are not static but may vary across sites, through time, and in relation to past circumstances and events. There is considerable uncertainty and ignorance about the actual limits (thresholds for change) in different ecosystems. The impact of the MPAs is also uncertain and difficult to predict. The externalities raised from other sectors add more complexity. Under such circumstances, management, whether for conservation or planned sustainable resource use, should be adaptive and flexible (see section 4.6).

4.5 Cross-scale integration (Principles 2, 3, 7, 8)

Principle 2 states that natural resource management is best carried out at the level of the resource production system. This is a variation of the subsidiarity principle, which states that higher-tier authorities should not assume functions that can be carried out more appropriately by lower-tier associations; or, alternatively, problems are best resolved at the level of organization at which they occur. This principle is in line with the current trend towards increasing devolution of responsibility for natural resource management to local institutions, on the grounds of greater efficiency, effectiveness and equity (UNEP CBD, 2003).

As described in section 4, the basic concept of Japanese fisheries management is that of resource management by resource users themselves. Therefore,

the challenge is to incorporate ecosystem viewpoints into the management system on an ecologically meaningful scale of area and time.

Scale, however, is a serious matter in ecosystem management (Principles 7, 8). How the components are perceived to be arranged spatially depends partly on the scale of observation. There is no single level of organization at which to understand and best manage ecosystem functioning. Each level-genetic, population, species, community or landscape-is important or irrelevant, depending on the nature and scale of the problem being addressed and on the perspective and aims of the managers.

Likewise with time: an one time scale (*e.g.* monthly, annually) a component or process may appear to exhibit constant periodicity; an another, longer or shorter time scale, the temporal dynamics may appear to be episodic or chaotic (unpredictable). In addition, ecosystems are not closed systems (Principle 3). They are largely open, connected to other systems through the flow of energy, matter and information, and the movement of organisms. In order to cope with these scale problems, effective management institutions should be devised at multiple levels that are connected (McGinnins & Ostrom, 1996).

In Japanese fisheries management, there are various levels of management organizations from the local community level to the national level, as shown in Table 2. In particular, in order to surpass jurisdictional boundaries, FMOs are organized by members from several prefectures according to the biological nature of the target species. Therefore, the Japanese management system has the potential to cope with geological-scale problems. However, again, the current system mainly focuses on the target species. For example, in regard to Principle 3, nearly 80 species are being artificially propagated and released along Japanese sea coasts in order to enhance fisheries resources (JIFRS, 2004), but the potential effects on adjacent and other ecosystem are now under investigation.

As for time-scale problems, fishermen tend to follow short-term incentives. Political interests have also tendency to be a few years in length. Hence, some institutional arrangements should be delivered to guarantee long-term conservational objectives. In order to resolve this time-scale inconsistency in decision-making, performance indicators which summarize data on complex environmental issues to indicate the overall status and trends of marine ecosystems would be a useful tool. Competitive fisheries operations based on economic incentives should be utilized as long as these long-term performance indicators are within scientifically and transparently determined ranges. The TAC / TAE system in Japan can be understood as one form of ceiling limit in current fisheries management, but the ecosystem perspective is not included, and the decision-making formula is not transparent enough for the moment.

4.6 Building adaptive capacity (Principle 9)

Change in ecosystems is both natural and inevitable. Ecosystems change, with regard to species composition, population abundance and human- resource interactions. Hence, management should adapt to the changes. Building the flexibility and capacity to adapt to new situations is critical for success of the management.

In Japanese fisheries management, in which local fishermen are the principal decision-makers, any management decisions can be changed according to information gained via daily operations. In other words, there is some flexibility in management decision-making. In addition, the local FCAs or FMOs offices are used as capacity building and information centers for management. Hence, Japanese fisheries management is potentially capable of adaptive decision-making.

For example, one of the most successful cases of adaptive resource management in Japan was the trawling fishery conducted off Kyoto Prefecture. Two kinds of management measures were in place there: voluntary restraint in fishery operations and a no-take zone constructed at public expense. In both cases, a small-scale trial was implemented before full expansion. Based on the information from daily fishery operations during the trial period, local fishermen agreed on expansion of each measure. Makino (2004) modeled this sequential decision-making process under a real options framework, and empirically showed that adaptive strategies can decrease considerably economic risks for fishermen, and hence can bring benefits to both fisheries and the government.

The future task is to develop infrastructure for data collection and monitoring, in which local fishermen and their organizations should play an important role, and to incorporate ecosystem perspectives into these adaptive decision-making processes.

5. Conclusion

There are more than 200,000 fishermen operating all along the coasts/offshore of Japan, and they live directly on marine ecosystems. Fishing rights and licenses have played a central role in the prioritization of resource use. Their knowledge of the local seas has accumulated for generations, and should be fully utilized along with scientific knowledge for ecosystem management. This article points out that, from the viewpoint of the Ecosystem Approach of the CBD, Japanese fisheries management has many advantages such as a decentralized management system, adaptive management process, use of local and scientific knowledge, multi-scale and interlinked management, and promotion of sustainable resource use in an economic context.

Thus, what modifications and upgrading should be made to the Japanese fisheries system in order to achieve marine ecosystem management? Based on the

results in the last section, key issues to be tackled are summarized as follows.

Firstly, as repeated many times, the fundamental weakness is the lack of concern for the impact of fisheries operations on marine ecosystems. This is the most crucial issue for Japanese fisheries management. Progress should be facilitated in scientific understanding of ecosystems' structure, function and processes, and consistent institutional reform should be carried out. However, in the process of reform, full consideration must be given to institutional contexts and background of Japanese fisheries management. We cannot transfer an institutional design that worked well at one place to another place and expect to repeat the success. The unique characteristics of fishing rights/licenses and coordination systems in Japan may logically be conductive to a different ecosystem management framework from, for example, that of the Iceland, where Individual Transferable Quotas (ITQs) are the central policy tool. Therefore, what is required is careful examination of the appropriate nature of the fishing rights/licenses, and deliberate discussions of the role of the fisheries industry in marine ecosystem management. The formulating protocols for TAC and TAE can also include ecosystem perspectives.

Secondly, the scope of coordination or stakeholder participation is limited to the fisheries sector only, and no other marine ecosystem users are included in the decision-making process. An appropriate coordinating system corresponding to the material-circulation within a watershed should be established along with the necessary legal framework. What also needs to be seriously considered is a transparent decision-making procedure which reconciles and integrates the wide range of management objectives.

Thirdly, the adaptive management is needed in order to deal with uncertainty. As mentioned in section 4.6, adaptive management can be an economically rational and efficient strategy for both resource users and the government. The first step toward expansion to adaptive ecosystem management is to identify priorities for necessary information, then determine the role which fishermen can additionally take on and develop supplementary data gathering and monitoring systems to fill the gap. Also, measurable management indicators of the overall status and long-term trends of the ecosystems need to be developed and continuously referred to.

Fourthly, marine protected area systems can be one of the most effective tools for marine ecosystem management. Note that 'MPA' is not a synonym for 'no-take zone'. Economically and ecologically meaningful MPA systems can be devised, and should be introduced where necessary.

Table 3 summarizes the institutional advantages, shortcomings and necessary policy measures for Japanese fisheries management.

Several issues in the Japanese institutional framework merit recognition and discussion. In fact, there are many structural defects in Japanese fisheries management. For example, autonomous decision-making by local fishermen could sometimes leads to inflexibility or reclusiveness. For example, vested interests may be overprotected or egalitarianism pressure may prevent efficient use of the resource. Local organizations may also prove to be unwilling to introduce new technologies, thereby retarding technical progress. A decentralized approach is not a versatile prescription. In addition, coordination by local fishermen is vital to the current institutional framework, but it inevitably becomes very complex and locally specific. Sometimes fishermen cannot play their expected roles as coordinators.

By the same token, the advantages listed in Table 3 do not hold in every area in Japan. They are just general descriptions of the Japanese institutional potentialities. At successful sites, there are peculiar and site-specific conditions which enable the full realization of the institutional potentials. For example, in the case of the trawling fishery presented in section 4.6, very active information exchange has continued

Table 3 Institutional advantages and shortcomings of Japanese fisheries management assessed by the Ecosystem Approach of the CBD.

Institutional Advantages - Decentralized management systems by local resource users. - Use of local and scientific knowledge for management. - Multi-scale and interlinked coordinating organizations. - Adaptive management process based on daily fishery operations. - Promotion of sustainable resource use in an economic context.
Shortcomings and necessary policy measures - Ecosystem perspectives: progress in scientific knowledge should be facilitated. Careful examination of appropriate nature of fishing rights/licenses and deliberate discussion of the role of the fishery industry in marine ecosystem management is required. The formulating protocols of TAC and TAE can also include ecosystem perspectives. - Stakeholder involvement: new institutions should be introduced to allow a wide range of stakeholders to be involved in a transparent decision-making process. The viewpoint of watershed management is also important. - Data collection and monitoring: identification of priorities in ecologically necessary data, and role-sharing in data collection and monitoring should be established. - Indicators: Development and reference to long-term indicators should be promoted. Fisheries can be competitively operated within the allowable ranges of the indicators. - Use of MPA systems: MPAs are not a synonym for no-take zones, but can be understood as an ecosystem-based resource enhancement system which enables multiple and responsible use of ecosystem services including fishery operations. Economically and ecologically meaningful systems of MPA can be devised and should be installed where necessary.

among local fishermen, the local research station, and prefectural governmental officials. This is a form of cross-sectoral communication in Japanese fisheries management. In addition, long cross-generational acquaintances among fishermen operating in the area are one of the most important factors in building a relationship of mutual trust and a high compliance rate with regard to management measures. Therefore, in addition to the institutional framework analyzed in this article, the capacities, functions and relationships of the people concerned should constitute the very core of marine ecosystem management.

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