FIGURE 2.6

Members of a fishermen's union at *Mina Bada Lestari* are maintaining *Rasau* as a kind of fish attracting device

REHABILITATION OF KERINCI LAKE THROUGH BIOMANIPULATION

Since 1995, the waters of Kerinci Lake in the Province of Jambi have become nutrient rich and oxygen starved, largely as a result of the fact that 80 percent of the lake's surface was covered by water hyacinths (*Eichhornia crassipes*). This condition resulted in a decrease in fishery production, the loss of indigenous fish and, as a result, many fishers lost their livelihoods. The fisheries provincial services of Jambi Province and the government of Kerinci District, in cooperation with the community around the lake, seeded the lake with thousands of Koan fish (*Ctenopharyngodon idella*) with the objective of clearing water hyacinths from the lake. The fishing community refrained from catching Koan fish, even going so far as to release them if they were unintentionally caught in fishing nets. Initially, the Koan fish ate the roots of the hyacinth until the plant fell into the water. Then the plant itself was eaten by the fish. All that remained was a hyacinth stump. Finally, after only two years, the water hyacinths had been completely destroyed by the fish. The lake waters became fresh and clear and the Koan fish had grown large. As a result, the people of the region have been able to conduct their traditional Lake Festival once more (Figure 2.7).

Figure 2.7

Following the successful rehabilitation process, the Festival of Kerinci Lake, which is beloved by the community, could be conducted once again. The first Festival after the clearing of the Lake was conducted in 1999.

SOCIAL FACETS OF FISHERIES CO-MANAGEMENT

THE IMPORTANCE OF VIEWING FISHERIES AS A SYSTEM

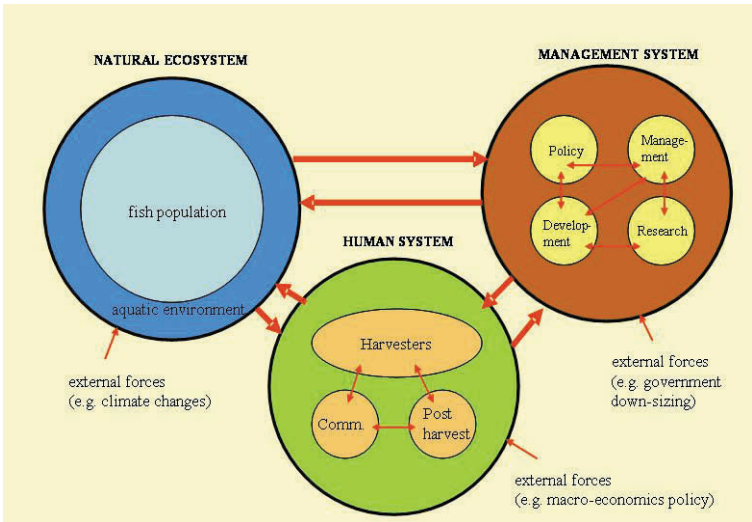
The perception by the public and even academics, that fisheries and marine resources are mere commodities, is flawed. This misconception is closely related to the classical opinion that the primary production sectors of fisheries, agriculture, forestry and animal husbandry are merely commodity producers. History has proved that fishing is an economic activity that is directly related to the ecosystem, the economy, the community and its related institutions. These four dimensions cannot be separated when one deals with the subject of fisheries and the marine environment (Hanna, 1999).

In the comprehensive book entitled "Sustainable Fisheries Systems", Charles (2001) describes the importance of a systems approach to marine fisheries management. Meanwhile, Hall and Day (1977) consider that: "…any phenomenon, either structural or functional, having at least two separable components and some interactions between these components may be considered a system". In this context, fisheries are, by nature, a system comprising many related and interdependent factors and phenomena (Figure 2.8).

Furthermore, Charles (2001) confirms that the fishery system is a union of three main components, namely the natural system comprising the ecosystem, fish and biophysical environment; (2) the human system consisting of fishers or fish farmers, market agents and consumers, fishing communities and coastal communities as well as social, economic and cultural environments related to this system; and (3) the fishery management system comprising elements of policy and fishery planning, fishery development, fishery management and fishery research.

FIGURE 2.8

Fisheries as a system (Charles, 2001)



Fisheries are complex as noted by Walters (1986: p.167) "...most fisheries problems are complex and contain human as well as biological dimensions. Too frequently we see the consequences of trying to deal with complexity in a fragmentary or narrow way. Management plans based on the soundest of biological information fail when it is discovered that fishing pressure cannot be controlled because of unforeseen political or economic constraints. Economic policies fail when unforeseen biological limits are exceeded. In short, fisheries represent dynamic (time varying) systems with interacting components....". In this regard, fisheries have degrees of diversity, complexity, dynamics and scale (Kooiman *et al.*, 2005)

A complex fishery system is characterized by four types of diversity, namely: species diversity, genetic diversity, function diversity and socio-economic diversity (de Young *et al.*, 1999). In practice, there are several sources of complexity in fishery systems (Charles 2001), namely (1) overlapping purposes that potentially raise conflicts between users and governments; (2) the numerous species and interactions between species at the tropical level context: (3) dynamic social and economics interests between the users; (4) the numerous types of catching devices and technology and the fishers' interactions with them; (5) the social structure and its effect on the fishery; (6) the dynamics of fishery data and dissemination of information; (7) the interaction between fishery resources, fishers and the environment; (8) the uncertainty of the respective components of a fishery system; and so on.

Therefore, perceiving a fishery as a mere commodity lessens the importance of the sector which is in fact a complex and dynamic system that plays a key role in supplying food for human beings.

From a co-management perspective we view fisheries as a system that comprises important parts, right from the planning to the implementation stage. The critical dimension in fisheries co-management is compatibility; meaning that the three elements of fisheries resources (a natural system), the public sector (a management system) and the private sector (a human system) constantly interact and cannot be separated from each other. This then, is the crux of fisheries as viewed from the perspective of a fisheries co-management framework (see Topic 1.1).

THE CONCEPT OF A SOCIO-ECOLOGICAL SYSTEM

One of the most important concepts underlying the implementation of fisheries co-management is the social-ecological system (SES). According to Anderies *et al.* (2004), a social-ecological system (SES) is defined as: "…a system of biological unit/ecosystem unit linked with and affected by one or more social systems". In this way, SES deals with ecosystem units such as coastal areas, mangroves, lakes, coral reefs, coasts and upwelling systems including fisheries systems as units

associated with a social process. Berkes and Folke (1998) and Carpenter and Folke (2006) define SES as an: "integrated system of nature and society with reciprocal feedbacks".

In the context of fishery co-management, this concept is very important. In this context, fishery agents provide a link between dynamic aquatic ecosystems and the fishery. In other words, the two dynamic systems need integration through fisheries co-management. It is this integration that provides an example of the social-ecological system in the coastal and marine management areas (Adrianto and Aziz, 2006).

In the context of fishery co-management, this SES approach is expected to increase resilience and better cope with vulnerabilities (for instance in case of natural disasters – Figure 2.9) through certain actions, either in the local or national frameworks. Adger *et al.* (2005) presents some examples of local and regional action scales in the context of enhancing SES resilience in Table 2.1.

TABLE 2.1

Examples of local action scales in the context of the increase in SES resilience linked with fishery vulnerability

Vulnerabilities	Local Action
Sensitivity to the disaster and damage of natural resources	Maintenance and functionality of the ecosystem through sustainable resource utilization
	Memory maintenance on the pattern of resources utilization, learning process to respond to environmental impact and social linkage
Adaptive capacity	Diversity in the context of an ecological system
	Diversity in the context of a socio-economic portfolio
	Social capital and community institution having legitimacy

Source: Modified from Adger *et al.* (2005).

FIGURE 2.9

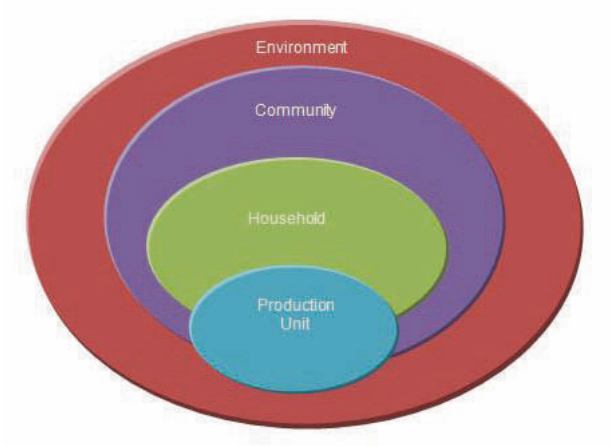
The vulnerability of natural resources to disaster: a case-study of the disaster affected Nanggroe Aceh Darussalam

SOCIAL ASPECTS OF FISHERIES

According to Townsley (1998), a social analysis of resource utilization, including fisheries activities, in the coastal and marine environment may be focused on several key levels. These are presented in Figure 2.10. It may be seen that the smallest unit or level of a fishery community system is the fisher community or production-unit household and that an occurrence at the household level will influence the community dynamics. In the context of fishery aquaculture, Jahncke *et al.* (2002) state that the impact of inappropriate fish diseases and environmental management will finally influence public health directly or indirectly. In the context of Townsley, an effect at the "production unit" level will generally affect the "community" level.

FIGURE 2.10

A framework of social levels in a fishery system (Townsley, 1998)



In most cases, a community is defined as a social group of any size whose members reside in a specific locality, share government and often have a common cultural and historical heritage (Hart, 1998). Nevertheless, Townsley (1998) states that community does not always have a connection with a specific area, but with the concept of livelihood. For instance, and in the context of marine and coastal resource use, a group of fishers or fish farmers who live in different administrative areas may be categorized as a fisher or fish farming community because they share the same livelihood. Therefore, a government that takes responsibility for fisheries management should be able to identify various levels within the coastal community, especially where they relate to the fishery household. Box 2.3 presents other definition of community.

BOX 2.3

Other definitions of community

Pameroy (2006) defines the community geographically, defining it by means of political or resource boundaries, and socially as a community of individuals with common interests.

Source: Pomeroy and Rivera-Guieb (2006)

From this perspective, the social dimension in fisheries co-management includes socio-cultural and economic and institutional aspects. In the following paragraphs, these important parameters are explained in detail. Local knowledge and conflict will be discussed under the subject of the socio-cultural dimension, while transaction costs in co-management will provide an example of the economic dimension. Under the subject of institution, fishing rights will be discussed.

SOCIO-CULTURAL DIMENSIONS

Local knowledge

Local knowledge is one of the socio-cultural dimensions that are important in fisheries co-management. As was mentioned earlier, the fishery co-management framework has two dimensions, namely a government dimension (the regulator and facilitator) and a community dimension (the fishery community as users of fisheries resources). Therefore, the implementation of co-management provides an opportunity for the fishery community to contribute to fishery management in partnership with the government. It is in this context that local knowledge becomes important in co-management systems.

Local knowledge is defined as knowledge derived from local fishing practices and used over generations by a community or fishery community. In the framework of co-management, local knowledge becomes a basis for the community to manage fishery resources (a management right).

BOX 2.4

Characteristics of local fisheries knowledge

1. Local knowledge is long term, empirical and based on local observation.
2. Local knowledge is practical, behavior oriented, and focused on certain fisheries resources.
3. Local knowledge is instructive and may always be validated using systematic evidence.
4. Local knowledge has a dynamic character and adapts to change.

Source: Ruddle (2000)

Conflict and resolution

In the fishery co-management framework, the understanding of conflict and how to resolve it is very important. This is because co-management is a process of sharing authority and responsibility for fisheries resources management which involves more than one actor, i.e. the government on one hand and the stakeholders on the other hand.

In general, conflict is defined as a clash of interest between two or more parties, in which at least one party insists that their interest is met by the other party (Bennet *et al.* 2001). However, conflict does not necessarily have a negative connotation or have to cause harm. Conflict may provide an opportunity for two or more parties, with two or more incompatible goals, to come together to reach a solution that is to the satisfaction or benefit of all.
Bennet *et al.* (2001) expresses theoretically that conflict is formed by various causes. Sociology views conflict as a dynamic of social structure, political views conflict as a function of power relations, while economic views conflict as a result of rational decision-making when the goal of maximizing profit is faced with limited resources. See Box 2.5 for example.

In the context of fisheries, Charles (2001) classifies conflict into four types, namely (1) conflict relating to jurisdiction; (2) conflict relating to management mechanism; (3) conflict relating to internal resource allocation; and (4) conflict relating to external resource allocation. Table 2.2 presents some examples of these four types of conflict.

As explained in the previous module, co-management constitutes a process (not a result) that emphasizes reaching consensus among stakeholders with different interests. In this context, conflict and its resolution become one of the key issues for implementing fisheries co-management.

TABLE 2.2

Typology of fishery conflict

Fishery jurisdiction	Conflict relating to the issue of resource ownership – who has the right of access to the resource
Management mechanism	Conflict relating to the management mechanism and fishery policy, such as the conflict surrounding fish quotas
Internal allocation	Conflict relating to interaction between fishery stakeholders
External allocation	Conflict relating to the interaction of fishery stakeholders with parties outside the fishery

Source: Modified from Charles (2001)

There are at least two matters that need to be considered in conflict resolution, namely: (1) the process of conflict resolution; and (2) the type of conflict resolution that is adopted. Efficiency in the conflict resolution process plays an important role since it determines the type of strategy that is to be adopted. Efficiency will be improved if the conflicting parties conduct the resolution process independently, with or without a mediator. Agreement between the parties is based on the independent satisfaction of each party; even if there is a mediator, his/her role is limited to communicating the interests of one party to the other.

Meanwhile, the type or pattern of conflict resolution that is selected plays an important role in the effective implementation of a co-management framework. For example, a formal system of conflict resolution that is adopted by a government can improve the effectiveness of the conflict resolution process.

BOX 2.5

An accident

From 13 to 14 January 2006, several purse seine fishing boats from Juawa, Central Java entered Balikpapan port in East Kalimantan after catching fish in the waters around Makasar Strait. The fishermen sold their catches in Balik Papan City. On 16 January 2006, traditional fishers from Balikpapan attacked those purse seiners because they thought the boats from Juwana were disrupting their livelihood.

Kinseng (2006) gives this example as a case of class conflict between modern and traditional fishers. Kinseng also determined that the class conflict was not on the level of exploitation, but only on the level of domination.

Source: Kinseng (2006)

ECONOMIC DIMENSION: TRANSACTION COST

The economic aspect of co-management is important, particularly when talking about the effectiveness of planning and implementing fisheries co-management itself. The concept of transaction costs is often used to describe the economic aspect of fisheries co-management (Box 2.6).

Kuperan and Pomeroy (1998) categorize the transaction costs associated with fisheries as (1) information costs; (2) collective decision-making costs; and (3) collective operational costs. Table 2.3 shows the components of these three transaction costs.

TABLE 2.3

Components of transaction costs in fisheries

No.	Kind of transaction cost	Components of transaction cost
1	Information costs	Knowledge sources
		Information gathering
		Information organization
2	Decison making costs	Meeting
		Policy and regulation developments
		Policy and regulation communication
		Coordination between authorities, e.g. central and local government
3	Collective operational costs	Monitoring and evaluation
		Resource preservtion
		Resource distribution

Source: Kuperan and Pomeroy (1998)

Box 2.6

Definition of transaction cost

Transaction cost is defined as the cost that emerges from the development, planning and implementation of institutional arrangements; for example, the establishment of a fisheries co-management institution.

Source: Mburu *et al*. (2003)

In the context of fisheries co-management, there should be a rational relationship between benefit and costs. In other words, the benefit that is derived from initiating a system of fisheries co-management must outweigh the cost of establishing that system. By using this rationale, it becomes feasible to initiate or replicate a system of fisheries co-management.

INSTITUTIONAL DIMENSION: RIGHTS-BASED FISHERIES

One of the key factors in understanding the dynamics between fishers, fish farmers and the economic and social environment is the concept of fishing rights. Prior to introducing a fisheries co-management arrangement, and in order to ensure fairness and sustainability in the management of fishing communities, the rights-based fisheries concept must be considered.
According to Ostrom and Schlager (1996), there are two types of rights that are important in the context of managing and utilizing natural resources, including fishery resources. These are (1) use (operational level) rights and (2) collective-choice rights. The difference between the two is that the former involves merely exercising a right, while the latter involves participation in the definition of future rights.

The operational level rights are associated with the process and dynamics of fishing i.e. rules that govern the course of day-to-day activities. These rights include
(1) access rights – the right to enter the fishing business, either by catching fish or by establishing a fishery business, such as a processing plant; and (2) withdrawal rights – the right to obtain the "products" of a specified resource (e.g. catch fish, appropriate water, etc). The right to gain access to fisheries and the right to harvest fisheries resources are a crucially important element in the sustainability of fishing communities. Without these rights, the goal of establishing new fisheries management arrangements, such as fisheries co-management, cannot be achieved.

The second type of right defined by Ostrom and Schlager is a collective-choice right. Collective-choices are the rights to regulate internal use patterns and transform the resource by making improvements. This type of right is usually assigned to authorities that exist outside the fishing community. In most cases the authority is local government which, in terms of Law No. 32/2004, Article 18, plays an important role in fishery management in Indonesia. In the fishery management context, this second right type is very important. It accounts for the element of "who manages" as opposed to the element of "what is managed" which is described by the first type of right (use rights). Included in the definition of collective-choice rights are the management, exclusion and alienation rights:

- management rights give the holder the authority to determine how and where harvesting of a resource may occur and whether and how the structure of a resource may be changed;

- the holder of a right of exclusion can regulate the access to the resources and how this access right can be transferred;

- the right of alienation gives the possibility of transferring part or all of the collective choice rights to others.

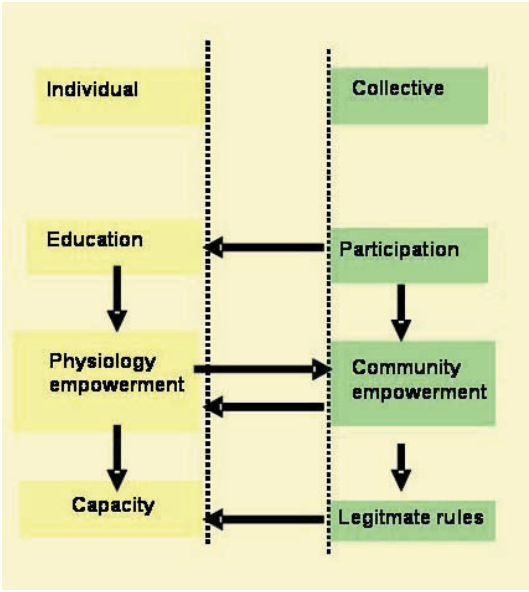
The assignment of the collective right to the fishing communities is a central issue in the implementation of a system of fisheries co-management.

INSTITUTIONAL DIMENSION: THE EMPOWERMENT PROCESS

Quite apart from the question of rights, one of the most important factors in fisheries co-management is the empowerment process as explained by Jentoft (2004). Essentially, co-management strives to ensure that stakeholders are able to participate in fisheries management on an equal footing with government. Diagrammatically, the empowerment process in fisheries co-management constitutes interactions at the individual level, as well as at the collective level. Figure 2.11 shows the empowerment process in fisheries co-management.

Figure 2.11

The empowerment process in fisheries co-management



In the above figure, it can be seen that the empowerment process constitutes a cycle which begins at the individual level with education and reaches a level of capacity which is followed by collective action and participation until a level of legitimate fisheries co-management is achieved (Figure 2.12 and Box 2.7 below).

BOX 2.7

Definition of empowerment

There are several definitions of empowerment. One is proposed by Torre (1986).

Empowerment is a process through which a person is strong enough to participate in and influence the institution that is related to his or her livelihood.

The empowerment process constitutes a key element of fisheries co-management because it relies on the capacity of stakeholders to participate at all levels.

FIGURE 2.12

Training is one example of the empowerment process

CRITERIA FOR THE SUCCESSFUL INTRODUCTION OF CO-MANAGEMENT PRACTICES TO INDONESIAN FISHERIES

MEASURING SUCCESS

A fishery management activity may be considered a success if it achieves its objectives. In the context of fishery co-management, those objectives must constitute a choice on the part of the community. If the community decides on the objectives of the fisheries management activity, and if their decision is conducted jointly with the government, then the decision-making process constitutes a form of fisheries co-management. According to the principles of science and technology, fisheries management should be conducted in such a way that its success can be measured. In a fisheries co-management regime, the objectives of fisheries management must be formulated with due consideration for the ecological and socio-economic dimensions of fisheries resources.

Fishery management in Indonesia is currently implemented in a way that is prescriptive rather than measurable and quantifiable. In order to move towards a more quantitative fisheries co-management system, it may be necessary to implement a "process control approach" (Hartoto, 1992). Almost all fisheries management plans lack the quantitative criteria that would allow for their implementation to be measured against their objectives. As a result, it is difficult to measure the success of these management plans.

The process control approach may be defined as the effort of humankind to manage a system in order that its variables can realize desired values (standards or set points). There are four main factors involved in implementing the process control approach, namely; identification of the system, system monitoring, system evaluation and application of control factors (Box 2.8). The process control approach must be implemented continuously and is best explained by using the process control loop as shown in Figure 2.13.

By utilizing the process control approach, fisheries co-management will be better understood by the users of fisheries resources. It is a method that can help them to contribute to fisheries management. Local users of fisheries resources can play an active role in defining fisheries area boundaries, determining the monitoring system that will be applied, determining the criteria that will be used to measure the success of the fisheries management system and determining the system of fisheries control that will be used.

BOX 2.8

Major elements of fishery co-management using the process control approach

Fishery system: The sets of variables that are characteristic of the fishery (both for capture fisheries and aquaculture).

External Function: The factors outside the fishery system that influence the characteristics of the fishery system. There are two external systems, namely:

1. **Artificial external function:** derived from human activity, such as pollution, deforestation, damming of rivers, etc.
2. **Natural external function**: derived from natural elements such as rainfall, changes in the water level, wind patterns, etc.

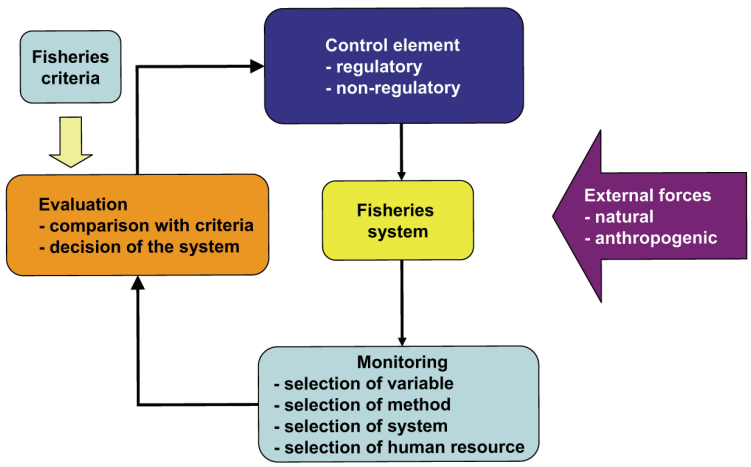
Monitoring: the effort to understand the characteristics of the ecosystem by way of measuring the **fishery indicators.**

Evaluation: the effort to determine the function of the fishery system. Fishery quality control (expected standards) and a logical framework can assist with evaluation.

Control factors: the activities that change the system in order to derive the desired characteristics. For example, control factors can be in the form of **regulatory measures** or direct physical activity (**non regulatory**).

FIGURE 2.13

The process control loop



SUSTAINABILITY OF THE FISHERY SYSTEM

A successfully managed fishery system is not only one that yields good harvests, but a holistic system that performs well with respect to ecosystem health and human wellbeing. There are four steps that must be followed in order to analyze the sustainability of a fishery management system (Box 2.9).

BOX 2.9

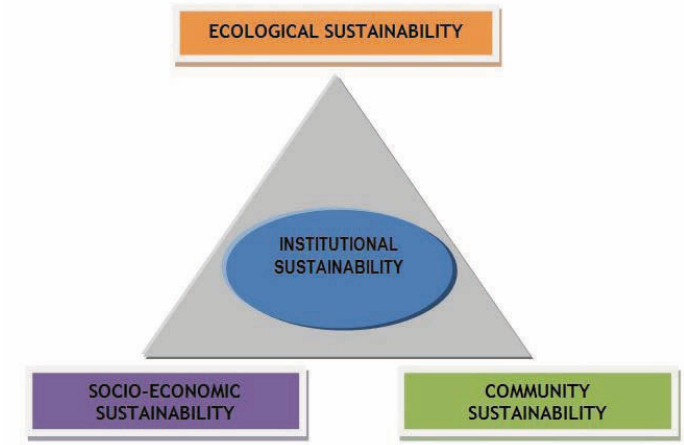
Four steps for analyzing the sustainability of a fishery system:

1. Determine or discuss the factors that may affect a sustainable system.
2. Develop a list of criteria that can be used to analyze the sustainability of the fishery system.
3. Determine the sets of indicators that reflect the sustainability of the fishery system. The indicators allow for each criteria to be measured and to make a comparison between the criteria.
4. Formulate of a way to group the indicators so that they may provide an index of the sustainability of the fishery system.

In fishery co-management, there are four indicators of sustainability, namely ecological sustainability, socio-economic sustainability, community sustainability and institutional sustainability (Charles, 2001; Figure 2.14). These indicators are collectively referred to as Components of Sustainability Indicators. Each of these four indicators has a subset of four components as described below:

FIGURE 2.14

The triangle of sustainability is the logical framework for analyzing the sustainability of a fishery system (Charles, 2001)



Indicators of ecological sustainability

The indicators of ecological sustainability include (a) understanding that fishery production (capture fishery or aquaculture production) will be sustainable in the long term; (b) preserving the current resources, i.e. satisfying current needs and aspirations without jeopardizing future needs; and (c) preserving or building the health and resilience of the ecosystem. Some examples of ecological sustainability indicators are shown in Table 2. 4 and Box 2.10.

TABLE 2.4

Examples of ecological sustainability indicators of inland water fishery management

Sustainability criteria	Indicator	Range	Minimum indicator value
Catch level	(MSY-fishing catch)/ MSY	-∞ to 1	Catch exceeds maximum sustainable yield
Biomass	Biomass (relative to historical average)	0 to 1	Total biomass or spawning stock biomass below a critical level
Biomass trends	Multiyear average annual percentage rate of change	-1 to 1	Biomass declining rapidly (or predicted to do so due to lack of recruitment)
Fish size	Average fish size (relative historical average)	0 to ∞	Average size at capture very low relative to optimal capture size
Environmental quality	Quality (relative to historical average) + (% rate of change)	0 to ∞	environmental quality low and declining
Diversity (harvested species)	[(No. species)/(historical average)] + [(diversity)/(historical average)]	0 to ∞	Number of species in catch and diversity index both low relative to historical average
Diversity (ecosystem)	[(No. species)/(historical average)] + [(diversity)/(historical average)]	0 to ∞	Number of species in catch and diversity index both low and declining
Rehabilitated area	Area rehabilitated as % of total area	0 to 1	A growing closed area due to contamination, etc.
Protected area	Area protected as % of total area	0 to 1	Decrease in areas protected from exploitation
Ecosystem understanding	Level of understanding relative to full knowledge (subjective)	0 to 1	No clear understanding of resources and its ecosystem

Source: Charles (2001)

BOX 2.10

An example of a list of questions used to evaluate the sustainability of a fishery

ECOSYSTEM SUSTAINABILITY

1. Is the level of exploitation of a specific species creating ecosystem resilience?
2. Is the indirect biological impact widely understood?
3. Is the impact on the ecosystem as a whole widely understood so that resilience may be maintained?

SOCIO-ECONOMIC SUSTAINABILITY

1. In the long term, will the activity create jobs?
2. What is the impact of the fishery project on local and regional economic growth?
3. Is the impact of price on inputs and outputs widely understood?

COMMUNITY SUSTAINABILITY

1. Does the fishery contribute to the stability of the community in the long run?
2. Is the access of local people towards the existing resources unhindered?
3. Is the traditional value system preserved?

INSTITUTIONAL SUSTAINABILITY

1. Is the institutional ability maintained in the long run?
2. Is the economic growth receiving support from the community?

Source: Charles (2001)

Socio-economic/community sustainability indicators

The socio-economic sustainability indicators focus on the macro level in order to preserve or encourage long term economic welfare. These indicators are a combination between economic indicators and social indicators that focus on the sustainability of net benefit, the distribution of the net benefit among the fishery user groups, and the long term preservation of economic viability at the local and regional levels. The measurement of socio-economic indicators is carried out individually, but the conclusion must encompass the fishery system as a whole.

In contrast, community success indicators are focused on the micro level, especially the need to maintain the community as a valuable human system, more than just a simple grouping of people. The emphasis here is on the welfare of the human component of the fishery system, through the preservation or improvement of economic and socio-cultural welfare and community cohesiveness. This is important because fishery sustainability must occur together with community sustainability. Examples of socio-economic/community sustainability indicators are shown in Table 2.5.

TABLE 2.5

Socio-economic/community sustainability indicators of inland water fishery management

Sustainability criteria	Indicator	Range	Minimum indicator value if
Community resilience	Index of diversity in employment	O to 1	Lack of livelihood alternatives (low diversity in employment)
Community independence	Percentage of economic activity based locally	0 to 1	Highly dependency on external economic activities
Human carrying capacity (livelihood)	Current (or potential) sustainable employment (relative to population)	0 to 1	Sustainable economic or employment base is substantially below current (or predicted) population
Human carrying capacity (environment)	Natural absorption of capacity/ human waste	0 to ∞	Generation of human waste far exceeds the absorptive capacity of the environment
Equity	Ratio of historical to current Gini Coefficient of income and/or food distribution	0 to ∞	Dispersion in income and/or food supply is substantially above traditional norms
Sustainability of fleet capacity	Ratio of capacity for harvesting at MSY to current capacity	0 to ∞	Current capacity exceeds that required to harvest at MSY
Appropriate investment	Investment/capacity (when stock < optimal)	-1 to 1	Investment above replacement level when stock is fully exploited or when stock is declining
Food supply	Food supply per capita (relative to minimum nutritional needs)	0 to ∞	Food available per person is below minimum nutritional requirements
Long term food security	Probability of sufficient food being available over next ten years	0 to 1	Stability of food supply is low or food supply is declining rapidly

Source: Charles (2001)

Institutional sustainability indicators

The institutional sustainability indicators focus on the capacity to maintain financial ability, administration and organization in the long term. Institutional

sustainability points towards the sustainability of the rules that govern the fishery, the organization that implements the rules and the institutions that implement the management. The main indicator of institutional sustainability is whether the rules concerning the utilization of marine resources can be implemented and managed and whether they match or fit the characteristics of the resources. Examples of institutional sustainability indicators are shown in Table 2.6.

TABLE 2.6

Institutional sustainability indicators of inland water fishery management

Sustainability criteria	Indicator	Range	Minimum indicator value if
Management effectiveness	Level of success of stated management and regulatory policies	O to 1	Existing management structure is insufficient to control exploitation levels and regulate resource users
Use of traditional methods	Extent of utilization	0 to 1	Traditional resource and environmental management methods are not utilized
Incorporating local input	Extent of incorporation	0 to 1	Management activity/planning does not incorporate local socio-culture factors (tradition, community decision-making, ecological knowledge, etc.)
Capacity-building	Extent of capacity-building	0 to 1	Lack of capacity building within relevant organizations
Institutional viability	Level of financial and organizational viability	0 to 1	Management organization lacks long-term financial viability, or there is a lack of political will to support such structures

Source: Charles (2001)

SUPPORT FOR THE SUCCESSFUL IMPLEMENTATION OF FISHERIES CO-MANAGEMENT

There are four pillars that support the successful implementation of fisheries co-management. These are (1) the availability of policies and sets of law that support fisheries co-management; (2) the availability of participants and the strength of the community; (3) effective interaction between fisheries users and institutions; and (4) availability of resources which may be well suited to co-management methods. Fisheries co-management has the potential to contribute effectively if these four pillars are in place. To ensure that these pillars are made available, certain prerequisites are required as shown in Box 2.12.

BOX 2.12

Prerequisites that support the success of fishery co-management

1. An enabling policy and legal framework that support fisheries co-management.
2. The participation and empowerment of communities (and other users) in the co-management arrangement.
3. Effective linkages and institutions.
4. The existence of a resource worth managing and people and money to do it.
5. Fisheries areas are clearly demarcated.
6. Stakeholders have the capacity to implement fisheries co-management through providing information, education and training.
7. A clearly defined hierarchy of fisheries co-management arrangements is available.
8. Research activities support fisheries co-management.
9. Fisheries co-management is related to the community and economic developments.
10. An environment that is suited to community participation is available.
11. Lines of communication between resource users and the government are open.
12. Monitoring methods which provide feedback for fisheries management are available.

CHARACTERISTICS OF A SUCCESSFUL CO-MANAGEMENT INSTITUTION

A society must really value and want to achieve successful fisheries co-management. This condition is the most important element for developing and maintaining
co-management initiatives between fishing communities and government. It is also a prerequisite for enforcing fisheries laws and regulations.

Box 2.13 details a number of characteristics that contribute to the successful implementation of fishery co-management.

BOX 2.13

Characteristics of a successful co-management institution

1. There are problems associated with the sustainability of available resources.
2. There is a legal system in place that recognises the right to manage natural resources and the right to limit the use of resources by communities.
3. The community plays a role in project planning and their participation influences the characteristics of the co-management project.
4. There is good cooperation between local leaders and among stakeholders.
5. There is sufficient understanding of the purpose of developing a co-management regime.
6. There are positive attitudes towards the prevailing fisheries law.
7. There is an enforcement process in place which supports policies, rules and regulations.
8. There is good cooperation within the community.
9. The users of fisheries resources are satisfied with their livelihood.
10. There is strong dependence on fisheries activities as an important source of income.
11. There are tangible benefits associated with the implementation of a co-management regime.
12. Monitoring and evaluation systems are in place.
13. There is an incentive to participate in co-management.

Source: Katon *et al*. (1997)

CONCLUSION

From the examples provided in this chapter, it is obvious that fisheries co-management has the potential to contribute to almost every sphere of fisheries management in Indonesia and to incorporate the ecosystem approach. The examples show that fisheries co-management has proved to be effective in applying conservation activities, including protection, mitigation and rehabilitation.

The criteria which may be used to assess a fisheries co-management regime are determined by many factors, including the type of water ecosystem, the exploited species, the existing socio-political and economic system and the prevailing rules and regulations. However, the most important criterion that is used to measure the success of a co-management system is how the decision-making takes place. The process of establishing a fishery co-management system must be discussed intensively by the main stakeholders in the process, namely the community users of fisheries resources and government.

It must be noted that scientists from the universities and research institutes, as well as non-governmental organizations, only play the role of mediator during the development of a co-management system. During the discussions around the subject of co-management, the mediator must be able to place him or herself in a neutral position in order to provide a true consultation service. Decision-making, its implementation, as well as other matters related to fisheries co-management must be conducted hand in hand by community users of fisheries resources and concerned government representatives.