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SESSION 4 REVIEW

PEOPLE AND FISHERIES MANAGEMENT

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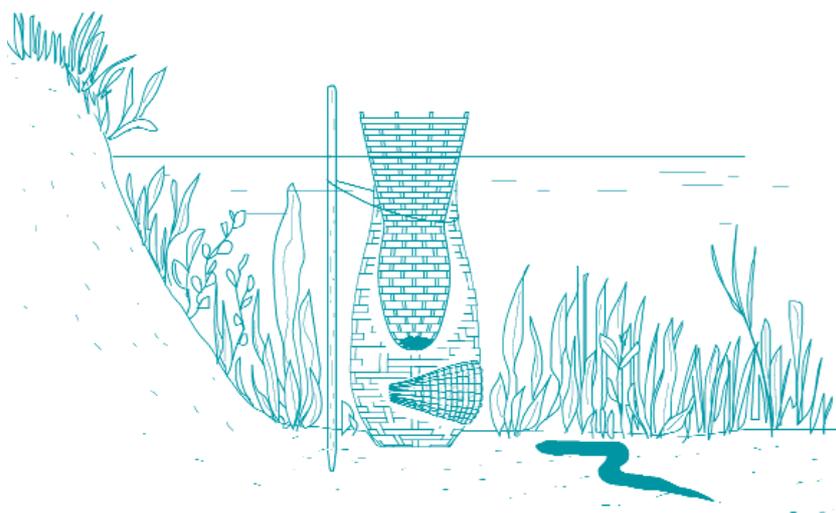
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¹ According to Collins English Dictionary (1992) the word 'to manage' comes from Italian *maneggiare* - to control, train (esp. horses), ultimately from Latin *manus* - hand.

▶ WHAT IS MANAGEMENT?

DEFINITIONS

Most definitions of management¹ are not specific as to who is doing what. They tend to be limited to a broader or narrower description of management tasks. Broader definitions are those which describe management as almost any activity that aims at conservation and sustainable utilization (Jensen, pers. comm.), comprising multiple decisions and actions affecting the magnitude and composition of fishery resources and the distribution of benefits from its products (Welcomme 2001). Narrower definitions present manage-

ment as set of important tasks that may or may not include such activities as research, marketing, education of fisheries managers and others as important and integral parts of management² (Arlinghaus, Mehner and Cowx 2002; Degnbol and Nielsen 2002; Welcomme 2001). These definitions are important as they may answer questions as to who or what is managing or being managed and how and why this takes place. For the purpose of discussions in Panel 4 of this conference, we tend to agree with Blanckenburg (1982) that management is to utilise, guarantee and protect, increase production from and improve (inland fisheries) resources.

WHY MANAGE AND WHAT ARE MAIN MANAGEMENT FUNCTIONS?

According to Charles (1994) controlling the exploitation of fisheries through management is necessary for the following reasons: a) an increasing demand for fish and an increasing number of resource users may not only deplete resources but have the potential to drive them to extinction; b) conflicting ecological, social, economic and social goals inherent in many fisheries must be balanced through management and c) controls are needed over the rate of exploitation, to balance present-day needs with the maintenance of the resource at suitable levels in the future.

For our purposes, management functions in inland fisheries comprise the following (Pinkerton and Weinstein 1995): Policy decision-making (including researching the resource, planning, organizing users etc.); data collection/monitoring; regulating access; regulating harvest; enforcement (including awareness creation and policing); habitat and resource protection and enhancement; resource use coordination; and benefit maximization (harvest planning, product development, etc.).

IS INLAND FISHERIES MANAGEMENT UNIQUE?

Inland fisheries management is part of natural resource management and shows many similarities with that of artisanal and industrial coastal and marine fisheries, as well as other natural resources, such as forestry, wildlife, irrigation, etc. with which it shares a number of important features, attributes and characteristics. Inland fisheries also depend on a package of resources, primarily water/water bodies and fish stocks, but also land, wood, forest, etc. The use of both aquatic and terrestrial resources is frequently governed by the same or similar values, customs and beliefs (COFAD GmbH 2001; Jackson 2003). Furthermore, inland fisheries are also subject to similar management policies and practices and are frequently under the jurisdiction of the same management agency as these other resources (e.g. Ministries of Agriculture, Livestock and Forestry, etc.)³.

According to Degnbol (1998), fisheries management is just one of many manifestations of the management of social systems. There is, therefore, no reason to expect that inland fisheries management should be radically different from or that it may have evolved completely independent of the general historical development of social management. We will therefore, wherever adequate, compare and contrast inland fisheries management with the management of common-pool resources in general.

RESOURCE TYPES, PROPERTY RIGHTS AND MANAGEMENT REGIMES

Two important characteristics of natural resources such as fish, game, forests and rangelands are the degree to which exclusion of users is difficult and the degree to which the use by one user subtracts from the benefits of others. In fact, such resources may provide a pool of benefits to be withdrawn from more

² The FAO defines 'management' as an "Integrated process of information gathering, analysis, planning, consultation, decision-making, allocation of resources and formulation and implementation, with enforcement as necessary, of regulations or rules which govern fisheries activities in order to ensure the continued productivity of the resources and accomplishment of other fisheries objectives" (1995; 2001).

³ See Koehn and Nicol for special (specific resources) and standard management strategies (all natural resources) of the Murray-Darling Basin Commission (MDBC) in Australia. There, a special effort to rehabilitate native fish communities through the implementation of a long-term *Native Fish Strategy*, focussing on fish, is being carried out within an Integrated Catchment Management Policy (Koehn & Nicol 2003).

than one user and are thus called common-pool resources (Ostrom 2000). Resources with low excludability and high subtractability may be held under a variety of property rights and management regimes, but, due to their particular nature, are frequently held not in private property, but in state or common property or no property at all (also called ‘open-access’ and particularly prone to that phenomenon called “tragedy of the commons”⁴), or any combination thereof. Property rights⁶ are frequently subdivided into *use rights* (right of access to and withdrawal from the resource) and *control rights*, which, in fact, are rights to manage. Corresponding management regimes are *laissez-faire* (virtually no governance nor effective market-based regulation in the management of open access or common-pool resources); *market regulation* (management of non-common and common-pool resources determined by market mechanisms); *communal governance* (existence and potential of user-

governance and local-level systems of common-pool resource management); *state governance* (central role of state in management of non-common and common-pool resources); and international governance (common-pool management that differs from state governance by features such as lack of centralised enforcement and reliance on persuasion and indirect penalties for breaking the rules) (McCay 1993).

HOW DO PEOPLE FIGURE IN MANAGEMENT AND WHAT ARE THE CONSEQUENCES?

The way in which resource users have been and are seen by resource managers has consequences for management. Table 1 is based on experiences taken mainly from forestry and identified three historical phases in the evolution of natural resource management (NRM).

Table 1: Resource users, approaches and consequences (Uphoff 1998)

Resource users	Approach	Consequences
“Adversaries”	Prohibitive approach	Limited effectiveness; needs ample government capacity
“Beneficiaries”	Integrative (conservation and development) approach	Rural communities offered incentives to desist from resource degradation; paternalistic; need to continuously reward to ensure cooperation; management goal perceived as serving interests of outsiders rather than communities
“Partners”	Integrating conservation and development goals by focusing on needs, interests, knowledge, values, capabilities of local populations, which are considered starting points in design and evolution of management regimes	As many accommodations are made to local interests and needs as well as modes of organization and management as compatible with conservation

⁴ According to Hardin (1968) the users of common-pool resources are caught in an inevitable process that leads to the destruction of the very resources on which they depend. The rational user of a commons makes demands on a resource until the expected benefits of his or her actions equal the expected costs. Because each user ignores costs imposed on others, individual decisions cumulate in tragic overuse and potential destruction of the resource in question. This problem of the commons has also been called “the fisherman’s problem”, because open-access fisheries provided important early illustrations of it (McCay 1993).

⁵ *Private property*: Individuals, families or legal entities have the right to undertake socially acceptable uses and exclude others from using the resource. *State property*: Property over which the state exercises management rights and defines access rules. State property is in most cases used by the citizens, within the given legal framework. *Common property*: ‘Private’ property of a group, which jointly uses the resource and has the right to exclude non-members. Management is usually undertaken by all group members or their representatives. *Open-access*: Everybody has a right to access a resource and withdraw from it; nobody has a right to exclude others from using it. Whether or not property rights are established over a natural resource and, if so, which property and management regimes are chosen, is influenced by various reasons within or outside of the resource (McCay 1993).

⁶ Property rights are sets of socially-defined rights to a resource; they determine “who may be where doing what and when”.

Paraphrasing Murphree (on wildlife management in Southern Africa) Murombedzi (1998) distinguishes between the following three historical stages and their respective outcomes⁷:

Management against the people (colonial/immediate post-colonial era): Weakening or demise of local management institutions and mechanisms, with simultaneous incapacity of colonial and post-colonial state to manage at all levels; management based on imposed European laws and practices; individual user becomes focus of resource use regulations; local ecological knowledge (LEK) is not considered; local users loose control of resources; natural resource management in state of crisis (no substantive regulatory capacity at any level, resource use with little or no management)⁸.

Management for the people (the 1970s): Promulgation of new legislation (conservation agencies to engage in the provision of extension services and environmental education to the people in addition to traditional policing and enforcement efforts); no efforts however to include local people in the management decision-making, neither taking into account LEK or traditional regulations in developing the laws; no substantial break with European management approaches of the colonial epoch, but change in implementation of legislation away from policing and enforcement to accommodation; attempts were also made in some cases to elicit local support for the state's management initiatives through provision of handouts; no attempt was made to devolve rights to natural resources to the local communities; no significant improvement of natural resources management, as governments did not develop the additional capacities required to implement new programs and the absence of a rights for community participation in natural

resource management meant that local communities themselves did not develop the capacities necessary to fill in the vacuum.

Management with the people (from late 1970s onwards): With governments crumbling under a heavy debt burden accrued from the earlier attempts at modernization and rural development, economic structural adjustment policies were implemented, designed to assist these economies to recover from the devastation of the debt burden; this required that governments downsize and initiate popular participation in development planning and implementation, seeking to co-opt the managerial capacities of the people; community participation in natural resource management becomes the pre-eminent natural resource management paradigm; the market is emphasized as the single most important regulatory mechanism; interestingly, in Southern Africa, the devolution of management control from the state first occurred to private land owners before it was extended to land-holders in other tenure regimes. The fundamental institutional reforms that made management with the people possible have included the devolution of government, tenure reforms, market reforms and the production of some form of benefit for individuals and communities engaging in natural resources management.

The fourth dimension in management would be “managing by the people” (Murombedzi 1998), “users as owner-managers” (Uphoff 1998), or “managing (with) the fishers” (adapted from Welcomme 2000, 2001).

PHASES AND TRENDS IN MANAGEMENT

Various authors have described the history of natural resources management, highlighting different

⁷ There is a fourth stage, “managing by the people”, which he views as the broadly desirable objective of current policy initiatives in sub-Saharan Africa (see Towards a Fourth Dimension in Management, below).

⁸ According to Murombedzi (Murombedzi 1998), the ‘King’s game’ concept was exported to define natural resource management in former British colonies. For most rural populations who had no legal access to natural resources, these resources actually became a liability, legally belonging to the state or some other powerful actor.

periods and trends of management development in marine and inland fisheries, or taking these as examples (Arlinghaus *et al.* 2002; Caddy and Cochrane 2002; McCay 2002; Welcomme 2001; Welcomme 2002). Based on these authors we suggest the following phases in fisheries management:

- Traditional⁹ (non-industrial/pre-scientific) management; beginning: several thousand years ago;
- Conventional (traditional¹⁰/scientific/modern) management; beginning: in latter half of nineteenth century;
- Recent (Post-modern/participatory, ecosystem, etc.) management; beginning: in the early 1980s.

In the following paragraphs we will concentrate on conventional management and compare it with traditional management, in particular. Experiences made with the implementation of conventional management will then be contrasted with perceptions and aims of more recent or “post-modern” management approaches (McCay 2002). However while some authors see these phases in an almost chronological sequence (Caddy and Cochrane 2002), in our view and in the view of others (COFAD GmbH 2001), these phases often occur concurrently but not necessarily on the same level. Thus, resource management science may see itself in one phase, management administration in another and actual practical management on the ground may be carried out according to practices of a third. For example, traditional management is still the predominant method of managing inland fisheries in sub-Saharan Africa and many other countries in the

South, with science, administration and other government services hardly having scratched the surface of the real fisheries. Obviously there are a number of reasons why the enlightenment gained on one level is not necessarily reflected on the others, such as the availability of information, reluctance to accept new ideas and paradigms, the intricacies of the policy process, the compatibility with the political system of the day, development priorities, the limited capacity or willingness of governments to implement management proposals on a significantly large scale, etc. (Almeida, Lorenzen and McGrath 2003; Batista 2003; Friend 2003; Hossain *et al.* 2003; McGrath, Cardoso and Sá 2003; Oviedo and Ruffino 2003a and b; Parveen and Faisal 2003; Ruffino 2003a and b;)

CONVENTIONAL MANAGEMENT

McCay (1998) characterizes conventional management as based on: utilitarian values; (commodity) production-oriented; single species and deterministic models and management; top-down; government- and expert-based scientific monopoly on data and analysis; the social level of resource use; and advisory, consultative roles for users. Experience has shown that as resource-based industries have developed and industrialized, resource management has tended to become specialized and centralized (Hanna 1998). Primary stewardship authority has accrued to the government at regional, state or national levels. Although various types of decision-making processes are possible in natural resource management, they have generally been top-down both in democratic countries and in others,

⁹ The term *traditional* has at least two connotations. The first connotation is that used by Scudder and Connelly (1985), for example, to describe fishing communities yet to be incorporated within a commercial fishery based on monetary transactions. However, they hasten to emphasize the dynamics brought about in traditional societies due to such phenomena as technical innovations (nylon, ice, engines, electronics), economic/social changes (commercialization, market integration, and social stratification: differentiation, specialization, changing gender roles, polarization, marginalization). Thus, traditional fisheries are (and always have been) parts of networks of commodity exchange, and are not static, since all societies, no matter how isolated, have histories which include both continuity and change as ongoing processes. This is the connotation that we use when we refer to *traditional*.

¹⁰ As explained by COFAD (2001), the second connotation of “*traditional*” (between inverted commas) describes a cultural continuity among a group of people, passed on in the form of attitudes, beliefs, practices, principles and conventions. It does not imply that such practices have been transmitted unchanged from pre-colonial or any other time, nor does it imply that a practice takes place in an overall ‘traditional’ context (see above). The continuity referred to here may relate to an individual practice and its appearance, the institutions governing and carrying out a practice, as well as their legitimacy, or the general cognitive background (the knowledge system) on which the practice is based (COFAD 2001). Thus, conventional fisheries management may very well classify as “*traditional*” management.

with decisions and rules developed centrally by government and communicated down to user groups. More specifically, the conventional approach to fisheries management was and still largely is to impose centralized regulations at national level through restrictions on gears, seasons, areas and access (through licenses and, in some marine fisheries, quotas). In addition to these classic measures, the introduction of stocking and environmental enhancement became important management instruments in inland fisheries since the latter half of nineteenth century (Welcomme 2001).

It was the demand for fisheries management that gave birth to fisheries science. The formation of national fisheries research organizations in the late nineteenth century resulted from politicians looking for ways to resolve disputes between fishers. These organizations brought together biologists from various backgrounds who formed the core of what later became a scientific discipline and community in its own right (Wilson 2000).

While the main emphasis was on marine fisheries, in inland waters investigations into lakes and small streams led to the development of limnology as a science in the early twentieth century. In the mid-1970s, research into reservoir fisheries received special attention as a result of dam construction. In 1985, LARS1 provided the first systematic presentation of investigations into large rivers with a worldwide coverage.

What is what in management?

A bewildering array of (often synonymously used) terms is being suggested in the specialist literature to describe the context and contents of fisheries

management. In order to provide some kind of system, the following paragraphs are subdivided into

- *Policy* issues (or the ‘why and what?’) – such as goals, policies, principles/paradigms, purposes and objectives
- *Operational* issues (or: the ‘how?’) – such as strategies, levels, options and tools

Management goals, policies, purposes and objectives

The overall goal of conventional fisheries management is sustainability, or conservation defined as sustainable use (Arlinghaus *et al.* 2002; Welcomme 2000; Welcomme 2001). Policies for fisheries development and management should therefore aim at extracting only that amount of fish from the aquatic system that is consistent with the continuity of supplies at suitable levels into the future (Welcomme 2001). Most fisheries management policies explicitly aim at an increase in production while, at the same time, sustaining the resource, in its widest sense (COFAD GmbH 2001). Christensen *et al.* (1999) give as the overriding objective (or goal?) of NRM that no resource¹¹ should become depleted. Jackson (2003) hints at conservation as a means of maintaining a regional identity, promoting characteristics of political and economic independence.

While fisheries sustainability is in the foreground, Nielsen, Degnbol, Ahmed and Viswanathan (2002) point out that the overall goal for fisheries management should be ecosystem sustainability, not fisheries sustainability *per se*.

According to Charles (1992), there are three sets of policy objectives, each based on different fishery *paradigms*¹²: (Table 2)

¹¹ The very concept of natural ‘resources’ contains a bias toward evaluating the components of ‘nature’ in economic terms, assessing their use value more readily than assigning them any intrinsic value (Wallace *et al.* 1996).

¹² Any more definitions? “Policy is a specific way of interpreting the world” and, “policy processes are essentially concerned with political decisions of access to and control over resources, and how benefits are distributed,” (Friend 2003).

Table 2: Fishery paradigms, policy objectives and concepts (adapted from Charles 1992)

Fishery paradigm	Policy objective	Concept ¹³
Conservation	Conservation / resource maintenance	MSY
Rationalization	Economic performance / productivity	MEY
Social/community	Community welfare / equity	OSY

According to Welcomme (2001) the three major principles governing modern fisheries management are:

- Sustainability of fisheries
- Conservation of diversity of living aquatic resources
- Equitable distribution of benefits from fisheries and aquatic ecosystems

Within these principles, most fisheries management aims at a mix of purposes or objectives, which may include:

- Extractive objectives (fish protein supply; recreation)
- Non-extractive objectives (control of disease vectors, control of water quality and aesthetic/moral benefits)
- Government/fiscal objectives (revenue, foreign exchange earnings)
- Social objectives (income; equity of distribution of benefits; reduction of social conflict)
- Conservation objectives (sustainability and ecological objectives such as biodiversity)

Some of these objectives may be mutually exclusive. Thus, a decision must be made as to which of them fit the particular social, economic and political development criteria, priorities, principles and goals of

the society in question. This also points to the concept that management is responsible for negotiating solutions in the light of diverging interests, a balancing act between the requirements for biologically sustainable resource use and economically optimal exploitation patterns, while being socially acceptable to all involved parties (Parveen and Faisal 2003; van Zaling *et al.* 1998; Welcomme 2001).

Strategies, levels, options and tools

Welcomme (2001) emphasizes regional differences in management strategies in inland fisheries. In developed economies, strategies aimed and still aim at a) conservation and b) recreational fisheries¹⁴ and management focuses on the mitigation of environmental degradation, through such measures as stocking and habitat maintenance and rehabilitation. In developing economies, the management approach is said to be production-oriented. Management measures focus on a) intensification of production from inland waters through stocking and extensive aquaculture and b) on containing fishing effort and access to the fishery. The following (Table 3) strategies for managing inland waters in developed and developing countries have been identified (Arlinghaus *et al.* 2002):

From a spatial point of view, inland fisheries are managed at several different levels: local, regional, national, international. At the regional and international levels fisheries management can be transboundary.

¹³ MSY: MSY provides a reference point that predicts the level of effort at which the maximum amount of fish can be sustainably captured from a stock. The utility of MSY is now largely discredited and, in fact, it never formed a major component of inland fisheries policy (Welcomme 2001); the alternatives Maximum Economic Yield and Optimum Sustainable yield have not found favour either.

¹⁴ This goes back into European history when fishing and hunting were the privilege of a few, and where conservation and recreational fisheries by the upper classes brought hardship to the rural poor and provoked political unrest and the long heritage of poaching (McCay 1987).

Table 3: Difference in management strategies

	Developed Economies	Developing Economies
Objectives	Conservation/preservation; recreation	Provision of food, income ¹⁵ (commercial) food fisheries; Habitat modification; Enhancement, through intensive stocking; Extensive, integrated, rural aquaculture;
Mechanisms	Recreational fisheries; habitat rehabilitation; environmentally sound stocking; intensive aquaculture	
Economic characteristics	Capital intensive	Labour intensive

From a fishery systems point of view, there are three management levels, each with its own distinct set of tools: Managing the fish; managing the fishery; managing the environment.

Managing the fish

Fish are managed to improve production, to make up for shortfalls in production arising from over-fishing and environmental change and for conservation of threatened species and stocks (Welcomme 2000). The tools for this include stocking, species introduction or elimination and genetic modifications of stocks. Aquaculture represents the extreme of this trend to improve and intensify production from inland waters through increasing control of the fishes life processes.

Problem areas and open questions relating to this level of management are: a) the motivations underlying these kinds of intervention, which are frequently cosmetic, political and even cultural or religious; b) the biological efficiency and cost effectiveness of interventions, which is frequently, but by no means always, not proven (Carvalho and Sobrinho de Moura 1998; Hambrey 2002; Hambry 2002) and c) the doubts as to whether or not lower levels of government or fishing communities will be able to pay for these interventions when management has been devolved and/or privatised are particularly relevant in connection with the

present trend to decentralise management and the responsibility for interventions.

Managing the fishery

Managing the fishery focuses on ensuring the sustainability of production and equitable distribution of benefits. Traditionally, inland fisheries management was approached using conventional models developed for marine fisheries, such as a strong centrally controlled management based on Maximum Sustainable Yield (MSY) and other population models. These conventional approaches have been found to be largely inappropriate due to the characteristics of inland fisheries and in particular those of floodplain rivers. Conventional approaches are also less useful in multi-species fisheries due to their data requirements. For the same reason modelling of inland fisheries is relatively absent.

The strategies, options and tools of inland fisheries management differ somewhat between inland waters in temperate zones and those in the tropics and sub-tropics. In temperate zones, water bodies show a limited number of species and a lesser biodiversity and here strong centrally controlled management was based on MSY. However, in the multi-species/multi-gear fisheries more common in the tropics management of the complex assemblages of fish is mainly

¹⁵ Kaunda and Chapotoka (2002) sources including riverine fisheries in poverty-stricken communities, due to pressures on catchments, river bank alterations, capture of spawning fish etc. "At the height of poverty the challenge to manage fisheries is great".

based on the control of effort and length of fish caught when subject to fishing and environmental pressure.

The main goal of management regulations is to influence the behaviour of the fishery. Options for management depend to a large extent on the characteristics and context of the fishery. Main management options are:

- To maximise economic yield
- To maximise yield, but retaining the quality of the fish
- To manage for large species of high commercial value
- To maximise employment (increasing effort) and accept that the fishery will become fished-down

Management tools are:

- Input controls (which regulate fishing effort through such measures as gear restrictions, closed seasons and closed areas).
- Output controls (which regulate access to the fishery through such measures as licensing, auctioning off/contracting of temporary use rights/granting of permanent ownership rights, as well as such measures as quotas and bag limits and size restrictions on fish landed/marketed).

Problem areas for the management at this level are: a) the difficulty to legislate for different approaches to different fisheries; b) that the imposition of single legislation creates social inequalities and enforcement problems. This “crisis of fisheries management” has led to the idea of involving fishing communities in regulating processes, making possible a more flexible and localized approach to management.

Managing the environment

Environmental changes resulting from human activities may cause many different kinds of impacts

on fisheries. For example, construction of reservoirs favours lentic over lotic species, pollution may favour those species that are more tolerant and reduction in physical habitat diversity or reduced water flows will tend to reduce overall abundance, diversity, productivity and the average size of fishes in the fishery. Of most immediate concern is the ongoing alteration of large river systems in the tropics for exploitation by other sectors, principally agriculture and hydroelectricity. Such river systems are species-rich and often support large, valuable and under-recognised river fisheries. Dams cause multiple effects on rivers and their fisheries and the negative effects are usually not internalised as costs in development projects, nor are they usually mitigated. Similarly, isolation of the floodplain (flood control/irrigation systems) via regulators and levees causes direct losses to the river fishery that are usually unaccounted and not mitigated.

Welcomme (2000, 2001) outlines typical strategies, measures and tools which can be applied under certain conditions to manage the environment for fisheries. These are:

- Do nothing (when pressures from competing uses are excessively strong);
- Protection (where there are natural or acceptable environmental conditions, legislation on reserves and protected areas may be important measures);
- Mitigation (where competing users are economically important, but the aquatic environment still benefits from long-term interventions, such as operation of water-treatment plants, maintenance of environmental flows, stocking, etc.)¹⁶;
- Rehabilitation (where pressures from other users have eased, restoration of aquatic habitats to natural/quasi-natural conditions may be an option, through such measures as restoration of channel

¹⁶ Mitigation of the impacts of water management projects should be carried out when it is cost-effective. Worldwide there has in fact been very little mitigation of the impacts of dams and other WMPs. For example, in the lower Mekong Basin, there are many thousands of dams or weirs on tributaries, which disrupt fish migrations, yet there are only three fishways (in Thailand), despite their demonstrated effectiveness at low barriers. Also in the lower Mekong Basin, stratification causes well-documented impacts both within and downstream of many larger reservoirs, and the wildly fluctuating discharges from several hydroelectric dams cause major impacts downstream, yet there are no dams with measures to mitigate the impacts of seasonal stratification, nor with re-regulating ponds for hydroelectric discharges. Worldwide the situation is similar, with fishways in place on relatively few barriers, and destratification or multi-level offtakes, and re-regulation of discharges only recently becoming more common in the West. Mitigation of the impacts of floodplain isolation by improved design and operation of regulator/levee systems are now well-documented, but have yet to be acknowledged or applied outside Bangladesh, despite their low cost and likely high return. The reasons for the failure to incorporate mitigation in water management are complex, but are clearly not primarily technical.

diversity and longitudinal and lateral connectivity);

- Intensification through physical measures to supplement biotic measures (stocking, species introduction), such as fertilization of water bodies, brush parks, bunding of floodplains to create fish ponds, etc.

FROM TRADITIONAL TO CONVENTIONAL MANAGEMENT: A COMPARISON

Objectives, instruments and differences

Comparing goals, objectives and tools of traditional and conventional fisheries management show many similarities. In fact, few tools are new in inland waters and fisheries management (Rettig, Berkes and Pinkerton 1989; Welcomme 2000; Welcomme 2001).

Attempts at managing NRM and inland fisheries are ancient. There are many Biblical teachings against waste of natural resources and Pliny the Elder comments on soil erosion in ancient Rome. In Europe fishing regulations began early. The Romans limited the lengths of sturgeon landed in Rome as early as 400 BC. In England laws were passed in 1000 AD against the proliferation of fish fences in the major streams. Colbert limited the size of fish landed in the Loire fishing pressure in the 1600s. More recently habitat modifications led to overfishing and negative impacts on fish resources, giving rise to the development of privatized fishing rights, legislation aimed at preserving fish populations by controlling exploitation, definition of minimum sizes of fish caught, gear and temporal restrictions and other regulations. (Arlinghaus *et al.* 2002; Rettig *et al.* 1989; Welcomme 2001).

While fishing pressure worldwide may have been less than today, the very existence of fishing regulations are proof that there was an awareness of the limited nature of fish resources and the need to control and conserve inland fisheries (Welcomme 2001). Fisheries sustainability seems to have been an important concern of many traditional inland fisheries in Africa (Scudder and Conelly 1985)¹⁷, South Asia (Soeftestad 2000) and the Americas (Rettig *et al.* 1989)¹⁸.

Goals and objectives

Most traditional fisheries management systems contain goals and objectives similar to those found in modern fisheries management. The objective of sustainable resource use and resource conservation, for example, appears to be a feature common to both traditional and modern fisheries management¹⁹. Based on local knowledge and interlinked with traditional beliefs, customs and rules, traditional management systems may entail more than one objective, however. Equally common are objectives that reflect economic and social postulates. While aiming at optimising resource utilisation, these still contain elements of resource sharing and often aim to reduce conflict. Under most traditional regimes, for example, fishing for subsistence is open to all members of a group, a concession often made use of by women and children. The traditional method of regulating resource use in African inland fisheries is based on a social consent, which gives property rights over the resources to individuals, groups or communities. Based on such consent, property regimes are established, which determine the rights and responsibilities of the stakeholders and provide incentives to preserve the resource or even

¹⁷ Interestingly, Scudder and Conelly report from only 73% of their 91 analyzed cases of 'inland fishing societies' the existence of management strategies, of which about 90% are inadvertent, and the rest intentional.

¹⁸ However, reflecting on her observations during fieldwork in Western India, Baviskar (1995) comments: "While reverence for nature is evident in the myths and many ceremonies which attempt to secure nature's cooperation, that ideology does not [necessarily] translate into a conservationist ethic or a set of ecologically sustainable practices."

¹⁹ This doesn't mean, however, that there are no cases of resource depletion and extinction under traditional management regimes (McGoodwin 1990).

to invest into it. Property regimes, together with other prevailing norms and values, provide the framework within which management measures can be undertaken. The most common regime in inland fisheries in Africa and elsewhere is based on common property, where the right to use a resource is vested with a social entity. This does not mean, on the other hand, that traditional patterns of resource allocation would always be equitable: in some cases, it benefits privileged sub-groups or keeps benefits from others. Political and institutional objectives, for example may pursue aims such as the preservation of the power status of traditional rulers or the allocation of economic benefits to specific individuals and groups within the community. If, for example, fees, tributes, or shares of the yield are demanded to access a fishery, their payment may serve to stabilise the institutions in charge of fisheries management or serve social purposes; for example, if they are used to support the needy. Similarly, traditional management approaches accommodate spiritual, religious and related objectives, often interwoven with the objectives previously mentioned. (COFAD GmbH 2001).

Managing the fish

Systems or measures for enhancement of fisheries and aquatic environments are found in many countries and regions of sub-Saharan Africa (COFAD GmbH 2001). Some presumably evolved over centuries, others have emerged fairly recently. Traditional fisheries enhancement systems and measures are implemented within frameworks of traditional resource management. As such, they are linked to a variety of objectives but the economic objectives of increasing physical and economic yields still have much greater. All systems and measures have in common a degree of management and intervention which goes beyond that of traditional capture fisheries property rights which are defined more narrowly than in capture fisheries. Traditional fisheries enhancement usually includes one or more of the following areas of intervention: movement of fish stocks, extent of water

retention, water quality (fertility) and/or availability of fish feed. Often enhancement techniques are rooted in and combined with methods of fish catching, as for example the attraction or confinement of fish (see for example brush park fisheries as described by Welcomme 2002)

Modern fisheries enhancement depends largely on the introduction of non-native species to enhance commercial production or to improve sports fishing. These measures, most of which date back to pre-independence times, aimed at enhancing artisanal capture fisheries, but also led to the establishment of semi-industrial fisheries. Furthermore, some carp, bass and trout species have been introduced in African countries, mostly to enhance sport fishing. Other species, for example tilapias, have been introduced into areas where they were not endemic for pond culture or in the context of culture-based fisheries. Modern aquaculture technologies were first brought to sub-Saharan Africa by colonial powers, in particular the German, Belgian and French administrations. They involved freshwater pond culture only, to produce protein-rich food for the labour force. However, after the breakdown of colonial rule, most ponds were abandoned and pond culture retained the stigma of colonialism for some time. (COFAD GmbH 2001)

Managing fisheries

Traditional fisheries of South America, Africa and Asia apply management strategies and tools which include both inadvertent and intentional practices. The former including a wide range of behavioural patterns, customs and beliefs which indirectly conserve fish populations by restricting access to fishing, the latter were enforced with the explicit purpose to conserve fish populations through such measures as closed seasons and prohibition of certain gears (Scudder and Conelly 1985). The rationale of many management measures may be obscured by the socio-cultural and religious context in which they take place; their effect on the resource may sometimes appear to be a side-

effect rather than intentional. Often, for example, rituals and magic are interwoven with fisheries management measures. Means, which are justified on primarily metaphysical grounds, may, in the knowledge system of African inland fishers, be part of goal oriented and intentional resource management. (COFAD GmbH 2001; Scudder and Conelly 1985; Soeftestad 2000; Welcomme 1979).

Managing the environment

Measures to conserve and improve the environment are well known in African and South Asian systems of traditional fisheries management, such as brush parks, etc. (COFAD GmbH 2001; Soeftestad 2000; Welcomme 1979; Welcomme 2002). Such measures aim to modify a habitat by introducing structures, which not only attract fish (such as fish aggregating devices (FADs) in capture fisheries), but also additionally provide periodic shelter, thereby improving stock recruitment, survival rates of juvenile fish and/or natural food supply. Other systems aim to retain water and fish with the help of physical structures. These systems are referred to as retention systems, e.g. through the creation of barriers, placement of fences and traps and construction of drain-in ponds or fish holes. In addition, modern management must deal with large-scale alterations to river systems, for which the principles of traditional management may apply, but which are of much larger scale.

Major differences between traditional and conventional management are the knowledge base for fisheries and fisheries governance, the former being based on science and the latter being based on centralized systems of management decision-making and enforcement (command and control). While much management was based on linear, deterministic science, fisheries scientists were already recommending the application of a more flexible and learning-oriented approaches and adaptive management in the 1970s. This was nothing new as it was quite common in traditional management systems with their emphasis on

feedback learning and the treatment of uncertainty and unpredictability intrinsic to all ecosystems (Berkes, Colding and Folke 2000; Welcomme 1979).

Utilization and conservation

One of the major issues in natural resource management is to balance the demand for food by an ever-increasing population with the need to conserve natural resources for the future. In inland fisheries management there is therefore an increasing concern about the conservation of fisheries resources and their biodiversity and the perception of fishery decline and extinction of species. Strongly conservationist attitudes have emerged particularly in developed countries, while in the more food-hungry developing countries pressures continue to maintain high levels of harvest and utilization that might jeopardize the sustainability of the resource. However, in developing countries there is a growing realization that there is a need to protect resources from over-harvesting and conservation policies are being adapted to an increasing degree. The shift towards conservation is driving rapidly escalating attention towards river rehabilitation (reflecting social and cultural priorities) and restoration.

Past experiences and future needs in natural resource management, including management of inland fisheries, have been addressed by a number of international conventions and agreements, of which some are binding legal instruments and some not, such as:

- The Convention on Biological Diversity/CBD 1993
- The FAO Code of Conduct for Responsible Fisheries (FAO 1995)
- Agenda 21/UNCED 1992, a non-binding strategy for action to move countries towards sustainable development

Experiences and consequences

In the late 1970s and early 1980s, a number of authors declared that government management strategies had been shown to be completely ineffective (Scudder and Conelly 1985; Welcomme 1979). Welcomme (2001) later suggested that centralized management systems have proven impractical for the following reasons:

- Difficulties in enforcing the regulations
- Overcapacity generated by open-access nature of resource
- Inconsistencies inherent in trying to impose blanket legislation over diverse resources
- Lack of information, leading to arbitrary management prescriptions, leading to disregard of regulations by fishers

These deficiencies have caused a crisis in fisheries management in both marine and inland waters (Haraldsdottir 2000; McGoodwin 1990; Welcomme 2000). Similar crises were also reported from the management of other common-pool resources, such as irrigation etc. (Groenfeldt 1998).

In addition, actors both from within and outside the systems have increasingly challenged conventional management. For both main actors, i.e. government and users, limitations were identified. This led governments to contemplate the recognition of and support to traditional, community management arrangements. However, such arrangements were hampered by the heterogeneity of the user community and scale issues of the fishery, necessitating the existence of an actor operational at various levels. This again led to recognition of a need for co-management.

Changing patterns of resource use and management can be attributed to four main areas of change: public perception (such as environmental awareness,

an awareness for our dependency on nature and the need for equitable benefit sharing as well as need for devolution of management to local levels); use patterns (in particular the conflict between use- and conservation-orientation, food vs. recreational fisheries and changes from pressure of social interest groups); demography (pressures from increasing population numbers and population distribution with consequences for urbanisation, pollution and utilisation of riparian areas); and changes in the nature of the resource from changing land-use patterns and climatic variations, orientation of fisheries [from subsistence to commercial], eutrophication and resulting changes of fish population patterns and last but not least from damming of rivers with the known consequences on up- and down-stream ecosystems (Schouten 2003; Welcomme 2000).

Due to these rapid changes, decisions in fisheries management can no longer be regarded as long-term and management is now seen to require flexibility and responsiveness. What is needed are consultative/adaptive systems in a co-operative effort between strong organizations of local fishermen and supportive outside agencies (both governmental and non-governmental), able to accommodate change (McGrath *et al.* 2003; Scudder and Conelly 1985; Welcomme 1979; Welcomme 2001).

Participatory management is the current philosophy in natural resource management (NRM). Its implementation will weaken government's centralised control and place a considerable part of the task of management with local communities. This process of devolution of management needs to be carried out in an orderly manner and hand in hand with the establishment of proper institutional infrastructure (Welcomme 2001).

POST-MODERN MANAGEMENT

What is new?

McCay (1998, 2002) characterizes post-modern approaches to management as based on utilitarian and land ethics values; multiplicities (species, habitat, ecological interactions, truths, discontinuities); humbler science; accepting uncertainty; adaptive and bioregional management; bottom-up, collaborative approaches; recognition of knowledge and expertise of users; acceptance of active, engaged user groups and communities.

She further highlights changes in language and discourse, the importance of community, diversity, participation and governance (McCay 2000) and scale (McCay 2002).

Discourse

In 1976, a federal government policy paper declared, "Fishing has been regulated in the interest of the fish. In the future it is to be regulated in the interest of the people who depend on the fishing industry" (Rettig *et al.* 1989).

In 1979, Welcomme declares the concept of MSY as inappropriate in river fisheries and advocates 'adaptive management'. However, there is a conspicuous absence of any mention of user, participation, stakeholder or gender.

Scudder and Conelly (1985) emphasize the importance of participation of users in collaboration with government agencies in fisheries management. Fisheries management has moved away from an emphasis on fish stocks to a greater concern about livelihoods of the communities dependent on the fishery. There is an increased social and economic dimension in fisheries management and an increasing concern with equitable distribution of benefits from the fishery, conflict reduction within fishing communities and between fishing communities and others and gender participation in the fishery.

Scale

Changes in scales are suggested on various levels:

1. From fish to sector to system, including ecosystem²⁰ (McGrath *et al.* 2003; McGrath and Castro 2000).
2. From local to regional, national and international; migratory species have to be managed with a micro-regional perspective, while community management emphasizes a smaller geographical scale; therefore, scaling up of local to regional co-management is necessary; local (co-) management of regionally relevant habitats, e.g. deep pools (Abell, Thieme and Lehner 2003; Hartmann 2002; McGrath *et al.* 2003; Ruffino 2003b).
3. From users to stakeholders to general public involvement^{21,22,23}. Stakeholders also include groups which previously were marginalized due

²⁰ The five principles of ecosystem-based management are (Wallace *et al.* 1996):

- 1) Desired ecological states and means to achieve them are socially defined; ecosystem boundaries are social constructions; managing human societies is part of maintaining healthy ecosystems; ecosystem-based management has a large social component.
- 2) Focus on protecting restoring critical components while viewing the system as a whole; views resource base in its entirety, holistic or integrated entity.
- 3) Ecosystem-based management requires larger spatial and temporal scales than has been the norm, in order to avoid near term resource management decisions that may overly restrict or foreclose future management options.
- 4) Ecosystem management characterized by open communication and collaborative decision-making.
- 5) Adaptable institutions – dynamic nature of ecosystems and experimental nature of adaptive ecosystem management. Given the complexities and uncertainties, sustainable management can only be achieved if management entities have strong learning capacities. An ecosystem approach to resource management requires administrative flexibility, for "no set of goals should be so firmly adopted that institutional adaptability is lost".

Few embrace all themes/principles, some might even be considered contradictory. For example, the need to address resource management on larger spatial/temporal scales and the need to integrate data collection and monitoring seem to conflict with calls for decentralization of power and authority. Ecosystem management calls for open communication and decision-making, community and organizational learning, and co-operative approaches to management that cross jurisdictional boundaries.

to an emphasis on involvement of users/fishers in local management (Haraldsdottir 2000), as well as privileged groups, such as large landowners, representatives of other economic sectors, which so far were not contemplated under collaborative arrangements for local community management (Ruffino 2003b); stakeholders are also consumers, who may be influencing management through preferential shopping; McGrath *et al.* (2003) are suggesting a form of 'eco-labelling' to support co-managed fisheries²⁴.

Diversity and sustainability

Diversity and complexity is a major feature in riverine fisheries (Haraldsdottir 2000; McCay 2000; McGrath, Cardoso and Sá 2003; McGrath and Castro 2000).

While sustainability has been seen mainly as ecological sustainability, it has become clear that definitions of sustainable fisheries vary widely. The concept of sustainability must involve multiple use options, human concerns and objectives in addition to conservation goals. Thus, Charles (1994) suggests the simultaneous pursuit of four sustainability components:

- Ecological sustainability by maintaining stocks and species at levels that do not foreclose future options and maintaining or enhancing the capacity

and quality of the ecosystem and the environment.

- Socio-economic sustainability focussing on well-being at the individual level.
- Community sustainability focussing on the well-being at the group level, maintaining and enhancing group welfare of participating and affected communities.
- Institutional sustainability, which is a prerequisite for the other three sustainability components, focussing on the maintenance of suitable financial, administrative and organizational capabilities and the manageability and enforceability of fishery regulations over the long-term.

Sustainable development policy would have to serve to maintain reasonable levels of each component. System sustainability would decline through a policy seeking to increase one element at the expense of another. That there will always be trade-offs between objectives. Long-term sustainability probably requires adaptive short to medium-term (adaptive) flexibility. Suitable policy approaches are: living with uncertainty (adaptive management, management planning), coping with complexity (multidisciplinary research; integrated development and management strategies), improving local control (decentralized management, co-management) and establishing appropriate property rights and combining internal planning with suitable external diversification.

²¹ The need for public participation in natural resource decision making has been addressed by a number of international conventions and agreements, of which some are binding legal instruments and some not, such as Agenda 21/UNCED 1992, Principle 10: It was affirmed that the public's right of access to information, participation and justice in decision-making is instrumental in protecting the environment and in integrating environmental values into development choices; and UNECE (United Nations Economic Commission for Europe) Convention on Access to Information, Public Participation in Decision-making, and Access to Justice in Environmental Matters, "Aarhus Convention", 1998.

²² (Fuller 2002) describes in detail the process of stakeholder/public participation, including provision of information, mediation of views and interests and managing public communications as an important ingredient of this process.

²³ See also Koehn and Nicol (2002) on stakeholder involvement in the MDBC's Native Fish Strategy.

²⁴ 'Eco-labelling' or 'green labelling' is a new fisheries management instrument by which consumers can influence fisheries management by bringing pressure on manufacturers and exporters to buy fish only from certified fishers. It is a way to market a company as a responsible organization, contributing to the notion of sustainability (Constance 2001; Hersoug, Holm, & Ranes 1999).

Women in fisheries management

While previously most authors concentrated on women in fisheries emphasizing their roles in fish marketing etc., more recently attention is given to their involvement in fisheries management (Bunce, Townsley, Pomeroy *et al.* 2000; Haraldsdottir 2000; Hartmann 2002; Welcomme 2001). Women's involvement in fisheries management is increasingly being recognized. Women are involved in capture fisheries for home consumption or small-scale marketing. Where fishing is the major source of (monetary) income, women predominantly engage in fish processing and selling (including through large-scale operations). Women are involved in fisheries enhancement, for example in West Africa, where some women run larger enhancement facilities (brush parks, fish holes), requiring considerable investment and management efforts. Similarly, women also stock fish in confined water bodies. Women have played a role in aquaculture, although many of the aquaculture development programmes, in Africa for example, focussed on men regardless of the fact that their objective was subsistence production, i.e. production for home consumption, which is the domain of women in rural Africa. Women are important source of fisheries information and play leading roles in organising user unions in Southern India (Nieuwenhuys 1989).

Similarly, in reservoir fisheries co-management in the Mekong Basin, women have jointly developed fish marketing activities as a first step to address women's practical concerns and priorities in fisheries management planning and implementation. In fact, such practical concerns are directly interlinked with strategic women's concerns. The fact that additional income may be earned, which can change the situation for a woman and her family and even the community in which she lives, makes it an important management

issue. Women in Thailand's Northeast have understood the link between lake management and fish marketing: They are interested in cage-culture in order to maximize benefit from the fisheries resource and guarantee supplies of raw material for their processing unit. In the Central Highland of Viet Nam, savings activities taken up prominently by women in fishing communities address a major problem in participatory management, funding and allows families, among other things, to improve living standards and reduces dependency on non-sustainable fishing methods, as well as to develop sources of income supplemental to fishing as a management measure. The involvement of women in natural resources management decision making is significant: almost 40 percent of participants in fisheries management planning and about 25 percent of leaders of fisheries management associations are women.

Governance²⁵

It has been said that participatory fisheries management and, in particular, co-management, which are prominent features of post-modern environmental and fisheries management, is not about fisheries at all, but about governance. Thus, possibly the major difference between conventional and post-modern fisheries management is the way in which the fishery is governed. Interestingly, the same could be said about differences between traditional and conventional management, where at least one of two major differences are related to governance as well. Basically, this is not surprising, as fisheries management is not distorted by politics, as many complain, but is politics. Politics is how people decide things, or management is decision-making (Mikalsen and Jentoft 2001; Wilson 2000).

As we have seen, post-modern approaches to management focus on the involvement of fishers in participatory systems of power sharing between

²⁵ 'Governance' is defined as "The process of decision-making and the process by which decisions are implemented" (UNESCAP 2002 cit. in Petkova *et al.* 2002). 'Governance' is the sum of the institutions, processes and traditions which determine how power is exercised, how decisions are taken and enforced and how citizens have their say.

governments and fishing communities. It is expected that, in this way benefits can be drawn from modern scientific approaches as well as traditional, pre-scientific management systems (Welcomme 2001). Management still concentrates mainly on restrictions, but increasingly involves stakeholders, in particular fishermen, in management decision-making (planning) and management implementation (Welcomme 2002).

As Hanna (1998) observed, the top-down style of management has resulted in frequent problems and has shown itself frequently to be ineffective in the promotion of long-term sustainability. There are many cases of centralized decision-making that have led to poorly designed regulations, a lack of acceptance by user groups, low levels of compliance and ineffective controls on exploitation. Worldwide, the past several years have seen a growing interest in alternative institutional arrangements, in particular those that emphasize the periphery as a centre of authority, such as community-based (CBNRM) and co-management (CM).

Community-based management

The term 'community-based' distinguishes the emerging approaches from an earlier, possibly romantic, concept of community natural resource management, which refers to communities having full and generally autonomous responsibility for the protection and use of natural resources, that is, where local stakeholders take direct control of the resource allocation and exploitation, derived from or been modelled after indigenous systems of natural resource management, where local knowledge, norms and institutions have co-evolved over long periods of time with the ecosystem in question (Uphoff 1998). He however points out that such community NRM may be difficult to implement: where human populations and ecosystems are under stress and confronted with new conditions or new pressures, for example, from climate change, rapid population growth (natural or due to in-migration), availability of new technologies, weakening of local institutions, new tastes and demands within com-

munities, or changed legal regulations and policy directions, etc.

Uphoff (1998) characterizes CBNRM as follows:

- It addresses both human and natural resource issues, such as the long-term benefit of present and future generations given the inefficiency of state management and objectives such as equity, poverty alleviation and empowerment of marginalized user communities.
- CBNRM as a strategy reflects in social and policy terms the parallel nestedness and connectedness of organisms, species, associations and ecosystems in the natural universe and the interdependence between micro and macro levels.
- CBNRM starts with communities as a focus for assessing natural resource uses, potentials, problems, trends and opportunities and for taking action to deal with adverse practices and dynamics, with cooperation and support from other actors linked horizontally (e.g. other communities) and vertically (e.g. higher level or external entities, such as local or district governments, regional bodies, government agencies, non-governmental organizations (NGOs), universities, or other organizations that have an interest in resource conservation and management).
- While in the past NRM was seen as the domain of either state sector institutions endowed with appropriate authority, expertise and other resources, or private sector institutions pursuing individual economic interests and benefits, CBNRM operates mostly in a middle sector of organizations such as user groups, community management committees, local councils, producer co-operatives and similar, though it works best when there are complementary, supportive public and private sector activities.

- While management by a central government agency will not qualify as CBNRM, any organization, governmental or other, either on its own or in combination, can undertake CBNRM. CBNRM is management at the local, community level.
- CBNRM is the management of natural resources under a detailed plan developed and agreed to by all concerned stakeholders. The approach is community-based in that the communities managing the resources have the legal rights, the local institutions and the economic incentives to take substantial responsibility for sustained use of these resources. Under the natural resource management plan, communities become the primary implementers, assisted and monitored by technical services²⁶.

Co-management

While other participatory relationships include consultative and advisory roles for local communities, co-management (CM) involves power sharing (Jentoft 1989). Co-management strategy is distinct from community-based management in that it explicitly recognizes that government agencies often must be involved in a community's affairs, for a variety of reasons including needs for resources not available in the community, while, at the same time, it recognizes the importance of community control over and responsibility for many aspects of resource management (McCay 1998). Thus, co-management is the sharing of authority and responsibility among government and stakeholders in a decentralized approach to decision-making that involves user groups as consultants, advisors, or decision-makers with government (Berkes *et al.* 1991; Pomeroy and Williams 1994; Sen and Nielsen 1996). By involving users and considering community aspirations in decision-making CM is expected to provide conditions for increased equity, efficiency and sustainability and thus offers the

prospect of relief from some of the more negative aspects of centralized decision-making (Pomeroy and Williams 1994; Hanna 1998).

Co-management is especially applicable in river fisheries management because, like artisanal coastal fisheries many preconditions for CM are in place in rivers, such as locality, history and traditions. There are also specific needs for effective management due to the proximity to other sectors and to spillover effects such as pollution, habitat destruction, competition for space and population shifts. Though important pre-conditions, traditional tools/processes are inadequate to cope with pressures of entry whereby the fishery is expected to absorb excess labor.

Other conditions for successful co-management are: clear boundaries; membership criteria; scope and scale; management systems that intercept or overlap, that the fishery is embedded in general rural usage; the existence of organizational platforms such as a local all-stakeholder board or similar; linkages to scaled-up organizations, such as a coordinating regional board; cost-sharing in kind and out-of-pocket between co-managing partners; voluntary action; local autonomy, legal definition (Hanna 1998; Pomeroy, Katon and Harkes 2001).

Important background conditions and issues to be taken into account when promoting/implementing CM are (Hanna 1998):

- Property rights – some form of property rights are necessary for co-management, because without them there is no definition of legitimate participation or of the conditions that link user groups to each other and to the government. As long as rights are assigned and clearly specified, any type can provide the appropriate background for co-management. Without property rights, actions taken under co-management will be undermined.

²⁶ <http://www.cbnrm.net/resources/terminology/cbnrm.html>

- Uncertainty – background conditions for all fisheries (ecological systems vary, markets expand/contract, policies change). Kind of uncertainty shapes expectations/behavior, affects links between users and government. Co-management can minimize the effects of uncertainty (broadening source of information, creating coordination between users, maintaining consistency in rules/incentives, clearly specifying procedures of decision-making).
- Boundaries – CM must be applied within clearly defined boundaries where decision-making is brought into line with ecological/political systems; define/limit number of legitimate users, areas of control, reference decision-making to an ecosystem. Costs of coordination/information gathering/monitoring/enforcement all affected by specification of boundaries.
- Scale – CM should be nested within larger institutional jurisdictions, requiring that co-management processes build compatible incentives at different levels.
- Participation and representation – linking stakeholders into management process. Defining and identifying stakeholders is a complex process, involving both traditional and emergent users. Task: Maximize representation strengthens links between stakeholders, so that decisions reflect full array of interests. Various levels/types of participation, depending also on human capital, decentralization policies, resources available for management.

There are two different main points of departure for the installation of participatory and co-management in natural resources in general and fisheries in particular. These main points can again be looked at from different angles, that is, the government's and the users' point of view:

- In developed countries, there is a trend to regain access to fisheries²⁷ on the part of excluded groups; there is a demand for less government and CM is seen as a corrective or alternative to overly centralized management systems (Kearney 1989; McGrath *et al.* 2003).
- In developing countries there is a co-option of the public by government to shift management costs to communities and improve management efficiency. This also increases legitimacy and compliance with management measures and reduces conflicts. There is also a demand for more government presence, resources and a lack of application of conventional fisheries management models (McGrath *et al.* 2003; Nielsen, Degnbol, Ahmed *et al.* 2002; Ruffino 2003b).

The main steps aimed at when setting-up co-management systems are (Welcomme 2001):

- Development and legitimating of local management capacity
- Development of overarching (multi-level) institutional structures
- Agreement on responsibilities, rights and relationships (definition of roles of co-managing partners)

Juinio-Meñez (2002) found that the immediate

²⁷ The term "co-management" was first used in the late 1970s by US treaty tribes in western Washington State USA to describe the relationship they aspired to have with state managers, after having won court recognition of rights to fish. However, tribes had been barely able to exercise these rights, because the harvest was managed by the state in such a way that little fish (in this case, mostly salmon) remained by the time this migratory species reached the territories in which the tribes could legally fish. Only by recognizing the tribes' right to participate in planning and regulating the entire harvest (which he called "concurrent management") would their allocation right ever be exercised. There has been a tendency to apply the term co-management to mere operational rights, an inappropriate watering down of the term to a narrower, less powerful right. Co-management is misnamed unless it involves the right to participate in making key decisions about how, when, where, and how much fishing will occur (Pinkerton 2003).

objective of most of the 47 CBNRM fisheries projects in the Philippines was to organize small fishers in order to empower them to develop socially and integrate management interventions as part of the development process. The objective and aim of direct resource users being resource managers while attractive, is difficult to realize given the inherent constraints in resources and skills, the complexities of resource use and heterogeneity of riverine communities.

Participation depended on whether the activity had a positive or negative impact on the individual's interests. Participation in decision-making is mostly through consultation and its function is frequently recommendatory only, where decisions are subject to adoption/rejection by higher administrative units. Most members in the surveyed projects were passive participants. The tasks they participated in were data gathering, information provision and implementation of agreed-upon activities. Material incentives (food allowances etc. were important. Participation in 'strategic' activities of groups, committees etc. depended on individual skills and time availability. At higher levels participation was through representation (village elected officials, etc.). In short, project-initiated CBNRM was generally a leader-centered local institution with limited collective participation by a significant portion of local primary resource users and stakeholders. (Juinio-Meñez 2002)

Communities do not constitute legal entities in most jurisdictions, thus decentralization of management responsibilities is to local government bodies rather than to resource users themselves, yet this may be expected to be more efficient in eliciting community participation²⁸. Local government authorities rarely devolve control over resources to levels below themselves (Juinio-Meñez 2002; McGrath *et al.* 2003).

Costs of resource management for co-managers and communities are the reduction in area of fishing grounds in the case of reserves, restrictions of use of regulated gears and limitations on access for fishers outside the immediate communities from water bodies such as in the Brazilian Amazon (Almeida *et al.* 2003). Active project local partners bear a greater cost in terms of participation in project initiatives. The greatest cost to project co-operators are the time and effort spent on various activities including training, meetings, conducting research, monitoring, which would have been otherwise been spent making a living (i.e. opportunity costs). These costs are borne differentially by various resource user groups depending on the degree of dependence on the fishing ground or fishing gear. Moreover, social and economic status has a bearing on the relative costs to participants and non-participants. In general, the most marginalized among the fisher groups (e.g. landless migrant fishers) are least able to participate in resources management initiatives. They are unable to forego opportunities to fish or spend time attending meetings instead of earning a living. They are also not likely to join organizations if more prominent individuals and/or families dominate these. Thus, where membership in a local organization is necessary to obtain project benefits as discussed below, they are effectively excluded from these opportunities.

Conflicts are mainly experiences by people who actively participate in management activities (e.g. threats from illegal fishers). These social conflicts lead to disruption of normally peaceful familial and communal relations and are high costs to participants. In Canada, consultative processes in externally-initiated CBNRM and co-management activities the projects analyzed consisted mainly of advice provided to line agencies, that is, "communication-up" to those who make decisions and "communication-down" to those

²⁸ This form of decentralization is also called 'deconcentration' or 'administrative decentralization' to local branches of state agencies only, and is considered a weak form because the downward accountability from which many benefits are expected are not as well established as in democratic or political (strong) forms of decentralization ('devolution') (Ribot 2002).

who are affected; there was only limited degree of self-determination; implementation and enforcement by users of government regulations was perceived as beneficial; however, fishermen were not really involved in decision-making (Kearney 1989).

Participatory strategies

Juinio-Meñez (2002) proposes the following strategies to improve participation by local communities:

Local capacity building: including environmental education, livelihood training, community organizing, participatory research and monitoring.

Provision of incentives for participation: while many participants in co-management activities have remained positive despite the lack of immediate tangible benefits at the household level, e.g. increases in fish catch/income²⁹, the primary motivation for participation is personal socio-economic gain, which may lead to conflicts within organization in terms of prioritization of economic activities.

Livelihood development: in participatory projects is commonly rationalized with the premise that provision of alternative or supplemental livelihoods to fishers can contribute to resources management by reducing fishing pressure, allowing a recovery of depleted resources; alternatively, it is viewed as a means to address poverty; frequently, initiatives in livelihood development involve some form of enterprise development, often aiming specifically at attracting women to participate in aquatic management activities, conservation or development efforts; generally these are externally facilitated and funded often land-based micro enterprises and aquaculture trials; however, as many fishers like their occupation, the development of sup-

plemental rather than alternative occupations may be a more realistic goal; this also builds on the existing occupational multiplicity of fisher households: among the constraints to livelihood development as a fisheries management measure are socio-cultural factors such as a mismatch of any introduced enterprise with the existing interests and skills of fishers and the economic scale of a livelihood intervention necessary to take people out of fishing.

Provision of use rights: provide important incentives to participate in such NRM activities as habitat protection/rehabilitation etc. in contrast to reforestation activities for example, formalized use rights for water bodies mostly lacking; however, there are cases were, recently, rules devised by local communities may be formalized and enforced by government agencies (Almeida *et al.* 2002).

Identification of sources of funding for CBNRM: The lack of financial resources to support CBNRM activities is the major constraint to their sustainability; income-generation options that contribute directly to resources management or enhancement should be explored and given priority in participatory aquatic management; apart from community-based fish culture, the suitability of market-based incentive systems, which are “environment and community friendly”, should be explored (Phillips 2002).

Strengthening/support to co-management arrangements: Experience indicates that local communities and governments will continue to need support from external agencies particularly in capability building and resource generation; local governments are constrained with human and financial resources to effectively execute their mandate to manage natural

²⁹ Similar reactions were observed in co-management initiatives in the Mekong Basin, where, though no increase in fish production could be observed after only one year, participants easily spell out such perceived benefits as ‘improved communication’, ‘being taken serious by government agents’ etc. (Hartmann 2002). From the Amazon it is reported that floodplain communities now reap, after 10 years of improved fisheries management, the benefits of significantly increased production (Oviedo & Ruffino 2003).

resources; communities and other local sectors are similarly constrained; the limited capabilities and resources of both local government and communities in effect severely hamper the ecological and socio-economic sustainability objectives; thus, despite potential conflicts in interest, workable mechanisms for co-management of aquatic resources have to be pursued earnestly).

Scaling-up and integration into a broader framework: Solutions to problems of NRM cannot be provided by fisheries or through community-based initiatives alone. Goals and objectives are best pursued within a holistic, integrated and multi-sectoral framework; furthermore, CBNRM and co-management should be placed within a broader framework of integrated river basin management, which takes into account ecological processes and connectivities and attempts to harmonize conflicting uses of various stakeholders in the basin; at the very least, village- or water body-level initiatives should be integrated within district/municipal/provincial or similar development plans; the formation of higher forms of alliances and networks built on common interests and aspirations is important in scaling up local impacts (e.g. network of co-management initiatives, communities managing deep pools, etc.) (Juinio-Meñez 2002; McGrath *et al.* 2003; McGrath and Castro 2000).

Community-based management and co-management: Initiated or emergent properties?

Ruitenbeek and Cartier (2001) question whether participatory NRM is an emergent property of complex bio-socio-economic systems which would develop without outside help, or if such systems have to be initiated.

If such systems are emergent properties, the questions then arise as to what this would mean for the relationship between the co-managing partners, what would the role of government be and how and by whom should such independent initiatives be supported.

Juinio-Meñez (2002) clearly states that, in the Philippines, CBNRM initiatives are largely externally initiated. Local communities are considered disempowered by outside agents, governmental or other, lacking capacity to initiate change; external agents to facilitate active and meaningful participation; the process are influenced by goals, objectives, biases of facilitators (Pomeroy *et al.* 2001).

From his Canadian example, Kearney (1989) learnt the lesson that co-management may depend on social movements already in progress (more than on institutional arrangements); it may be difficult to initiate co-management into a co-operative vacuum; co-management frequently is a second stage in the evolving struggle of a social movement; self-determination of a social group is not the starting point but instead the outcome of a long process. Any attempt by government, for whatever motives, to initiate co-management in the absence of a cooperative social movement among fishermen risks transforming co-management into co-optation (Oviedo and Ruffino 2003; Ruffino 2003a).

Government support

In CBNRM and more so in co-management, local communities work in partnership with local government units at village, district or municipal levels. Local government support for community initiatives may be through allocation of funds for the implementation of various management activities and the passing of legislation for harvest reserves or sanctuaries and gear regulations (Juinio-Meñez 2002). Frequently, government support through legislation, funding and enforcement is crucial to sustaining the co-management initiative. In particular, government support is essential for the sustainability of protected areas, which is a key element in many participatory management schemes. The extent to which local community initiatives and use rights are institutionalised through local government policies and budget allocations may be considered indicators of success of community ini-

tiatives in coastal resources management. The main role of government may be the provision of 'enabling conditions'. However, in actual fact, many governments are resource-starved and are unable and sometimes unwilling, to fulfil their supportive role (Juinio-Meñez 2002; McGrath *et al.* 2003; Nielsen *et al.* 2002).

CONCLUSIONS AND RECOMMENDATIONS

PEOPLE AND MANAGEMENT

Definitions of fisheries management are essential to identify the managers. These may include primary users and women in fishing communities. Broader definitions include conservation and sustainable utilization, while the narrower ones emphasize only certain sets of main management tasks.

There are several types of management, including traditional, conventional (centralized, science-based); those based on ecosystem management and participatory management (community-based management and co-management). Frequently these types co-exist, but on different levels. Where centralized management exists, policy makers and fishery managers should be aware of the need for flexibility in management plans. However, there is a wide recognition that conventional, centralized management has failed and there is a need for a general shift to more people-centered, participatory forms.

There remains a question as to what extent participatory management can be introduced externally as policy interventions. Successful forms of participatory management are frequently based on social movements. Thus, while it seems easy to give policy advice to introduce co-management, it should be kept in mind that this may be more disruptive than productive. It is important, therefore, to define the role of governments as providing appropriate conditions for participatory management.

There is an urgent need for training of co-managers, such as users and government staff, in new management roles; strengthening local government capacity; access to credit, strategic research; policy development and improvement of communication amongst all stakeholders.

AQUACULTURE AND ENHANCEMENT IN RIVER FISHERIES

One important difference between aquaculture and inland fisheries is that individual ownership of the aquaculture operation reduces the interactions that arise from multi-user common-pool resources. Aquaculture is typically less variable than a capture fishery since there is a higher degree of control over the system.

As relationships with the fishery change, aquaculture may become more attractive as a livelihood strategy for both fishers and farmers. There is a range of factors that may cause this including declining catches and the associated increased effort or time for fewer returns. Opportunities for income generation, market opportunities and the ability to control the system without the interference of others are also highly attractive. Aquaculture does provide livelihood opportunities, although the cost of entry may be too high for the very poor. Aquaculture can co-exist with fisheries providing fish during seasons when the wild fishery is low.

There is a lack of clarity of national policies (export income versus sustaining livelihoods) regarding aquaculture and inland fisheries. The result is a skewing of policy and development resources towards aquaculture.

There are opportunities for creative use of aquaculture tools in fisheries management such as broodstock replacement or enhancement of floodplains, small water bodies or rice fields.

Enhancement is the use of aquaculture technologies in natural aquatic systems, usually common pool resources. Enhancements can be highly effective

in raising production and generating income if carefully matched to local ecological, institutional and socio-economic conditions. However, enhancements can have significant negative impacts on resident biota through ecological and genetic interactions, while they can add value to natural aquatic systems and provide incentives for their conservation.

The most important role for governments in enhancements is to support system development through research and adaptive learning to provide for better success of future enhancement applications in large river systems.

PEOPLE AND THEIR RIVER RESOURCES

Along most of the world's large tropical rivers rural households harvest a wide range of river resources, including crops, livestock, fish and wild animals and plants. Access to these resources and their contribution to livelihood strategies vary greatly with season, wealth, gender, ethnic group, household size and a wide range of other factors. River based livelihoods are dependent on the maintenance and sustainable use of these complex production systems. Efforts to improve management of river fisheries through greater engagement of rural people need to take explicit account of this resource and community complexity. Specifically it is recommended that:

- Improved management of river fisheries needs to be based upon explicit recognition of the complexity of river resource use and pursue appropriately integrated approaches.
- Development of such integrated management approaches for individual river systems needs to be rooted in detailed understanding of the livelihood strategies of the resource users.
- Improved understanding of rural households and their livelihood strategies requires effective interaction between these households and researchers. More active engagement by researchers with rural households and explicit gathering of information

through participatory approaches involving these people is essential if this understanding is to be achieved.

- Household-based participatory research should be designed so as to inform management approaches with improved understanding of the political economy of river resources and the specific expectations and influence of different users and wider stakeholders. Information that is gathered on river resources and their use by different communities and households needs to reflect these resource-power relations.

MITIGATION AND MANAGEMENT OF THE IMPACTS OF WATER MANAGEMENT DEVELOPMENTS

Technical solutions exist for mitigation, but are very rarely implemented, especially in developing countries. Measures include, for example, fishways, which are often effective on low barriers, destratifiers in lakes and re-regulating ponds downstream of hydroelectric dams. Some frameworks for improvements include: international agreements, national statutes, including EIA legislation and Codes of Practice for civil engineering works and state or local-level instruments, including fish passage and fish habitat regulations. International agreements are not well implemented in protecting river fisheries and EIA legislation is also poorly implemented in developing countries and rarely results in effective mitigation of fisheries impacts. In part, poor outcomes for river fisheries arise because planners and engineers rarely hear about fisheries issues and do not receive clear advice on impacts and their mitigation from biologists. On a broader level, the most significant issue facing inland fisheries is competition for water. Irrigation, domestic water supply and electricity all compete directly and are subsidised worldwide, particularly in developing countries. A major reduction in per-capita water usage worldwide through more efficient water use is needed to meet the projected increases in world water demand and if any water is to be allocated for inland fisheries clear information on the importance and value of

inland fisheries needs to be effectively communicated.

PEOPLE AND CONSERVATION

The concept of complexity implies that we have to live with uncertainty, that we are unable to accurately predict systems behaviour and that we cannot expect to be able to 'optimise' a system. This conclusion was challenged on the basis that natural systems could be predictable if we understand system functions. It was agreed that prediction of natural systems is possible and desirable to enable better management. However, empirical models are based on a range of observed, historical system states or configurations. Outside the observed range of configurations, the system may behave differently and predictions become increasingly unreliable and potentially misleading. River systems are currently under severe, unprecedented pressure from human activities. Under these circumstances, excessive reliance on prediction models based on historical observations is hazardous.

It was pointed out that uncertainty dominates our interaction with socio-ecological systems and that management should aim at maintaining system diversity and resilience rather than strive for optimisation. It was also noted that there is an abundant source of information already available from the World Commission on Dams regarding assessment of dams using a risks and rights based approach (www.dams.org).

- It is recommended that the potential consequences of using erroneous predictions for management are given due attention before final decisions are made.
- There is generally insufficient emphasis on ecosystem services and a tendency to value fisheries on a commodity basis. This ignores the complexity of inter-relationships between people and the resource. It was therefore recommended to raise this question at the World Water Forum.

RIVER REHABILITATION

In many existing situations we are forced to mitigate the impacts of other users. Once a river is modified, we have to rehabilitate it for some purpose, usually on a small scale. It was pointed out that to rehabilitate is very expensive and to avoid this we have to be more precise in talking to engineers. People already have the valuable knowledge and this should be used in new situations. A question was raised that due to the now mostly private developments, we have no more options to influence them. This opinion was rejected, as in allocating construction licences agreements must be signed on proper approach. In a number of countries large projects are strictly regulated.

Every effort should be made to rehabilitate the damaged ecosystem and every possible measure taken to prevent such damage in future water resource developments.

LEGAL ISSUES

Law can inhibit or facilitate effective management. Law is also needed to provide legitimacy for management action. Where CBFM is pursued as a participatory form of management, it is important that the formal legal environment be examined before or when CBFM is being considered for utilization or trial. Specific legislative issues relating to CBFM include the need to ensure that the legal framework clearly states security and enforceability; the creation of ability and opportunity for rights holders to seek redress for violation; the nature and extent of recognition of locally promulgated rules; rules for interaction with other stakeholders, including the government. Protection of individuals against abuse of "local" power and protection of wider interests e.g. environment should also be considered. Other important features of an optimal legislative framework are: flexibility and integration of CBFM in the general fisheries management legal framework.

The following suggestions are made:

- CBFM should have a legal basis.
- There should be clear elaboration of the nature and extent of the powers, functions and rights allocated under CBFM in enabling legislation or regulations.
- Legal issues of CBFM should be dealt with in a multidisciplinary manner.
- Legal considerations and elements identified and presented could guide the design of reasonable legislative frameworks for CBFM.

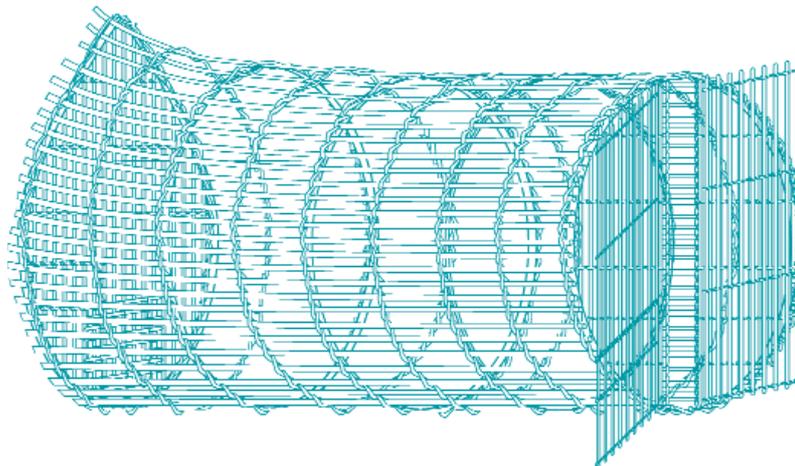
However the actual nature and scope of such legislative frameworks depends largely on local circumstances and should be tailored to such circumstances.

COMMUNITY MANAGEMENT

Demand for co-management arrangements often arises in response to either excessive government control or the absence of government involvement in local resource use. Development of co-management systems is a long, slow process that requires major inputs of funds and the active involvement of user groups, NGOs and state agencies. In developing co-management systems there is often a conflict between equitable allocation of resources among different user groups and the need to insure that benefits of management go to those who bear the costs of managing the

fishery. Institutional resistance to community participation in enforcement is another major problem. Considerable investment is required in training both state agency personnel and community leaders so they understand their new roles and have the skills needed to effectively perform them. While NGO involvement is often critical to developing co-management systems, it cannot substitute the role of either community groups or state agencies, since the long-term sustainability of the co-management system will depend on the degree to which these two groups have assimilated their roles. It was emphasized that:

- Co-management systems typically have high transaction costs for user groups compared to conventional management systems, therefore long-term sustainability will depend on providing user groups with the material conditions and institutional support needed to make their efforts as efficient as possible.
- Efficient institutional mechanisms for resolving conflicts are especially critical.
- Where restrictions on access are not feasible, effective mechanisms must be developed to control free riders and reward the efforts of those involved in maintaining the management system.
- Fisheries legislation and policies must be designed to provide a legal base for the co-management system.



REFERENCES

- Abell R., Thieme M., & Lehner B. 2003. Ecoregion conservation for freshwater systems, with a focus on large rivers. In R.L. Welcomme & T. Petr, eds. *Proceedings of the Second International Symposium on the Management of Large Rivers for Fisheries Volume 2*. Food and Agriculture Organization & Mekong River Commission. FAO Regional Office for Asia and the Pacific, Bangkok. RAP Publication 2004/17. pp 1-14.
- Almeida O., Lorenzen K. & McGrath D. 2002. Impact of co-management agreements on the exploitation and productivity of floodplain lake fisheries in the Lower Amazon.
- Almeida O., Lorenzen K., & McGrath D. 2003. The commercial fishing sector in the regional economy of the Brazilian Amazon. *Abstract submitted to the Second International Symposium on the Management of Large Rivers for Fisheries. Phnom Penh, Mekong River Commission*.
- Arlinghaus R., Mehner T. & Cowx I. 2002. Reconciling traditional inland fisheries management and sustainability in industrialized countries, with emphasis on Europe. *Fish and Fisheries*, Vol. 2002, No. 3: 261-316.
- Batista V. 2003. Spatial and temporal distribution of the fishery resources exploited by the Manaus fishing fleet. *Abstract submitted to the Second International Symposium on the Management of Large Rivers for Fisheries. Phnom Penh, Mekong River Commission*.
- Baviskar A. 1995. *The belly of the river: Tribal conflicts over development in the Narmada Valley*. Delhi, Oxford University Press.
- Berkes F., Colding J. & Folke C. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications*, Vol. 10, No. 5: 1251-1262.
- Berkes F., George P. & Preston R. 1991. Co-management: The evolution in theory and practice of the joint administration of living resources. *Alternatives*, 182: 12-18.
- Bunce L., Townsley P., Pomeroy R. & Pollnac R. 2000. *Socioeconomic manual for coral reef management*. Townsville, Australia, Australian Institute of Marine Science.
- Caddy J. & Cochrane K. 2002. A review of fisheries management past and present and some future perspectives for the third millennium. *Ocean & Coastal Management*, Vol. 2001, No. 44: 653-682.
- Carvalho R.C.D.A. & Sobrinho de Moura J.H. 1998. Aspectos econômicos benefícios e custos de produção pesqueira - Pesquisa em açudes povoados com alevinos de Tilápia do Nilo, Tambaqui, Curimatã e outras espécies, Vale do Curú, Estado do Ceará, 1991-1996. PAPEC, Fortaleza/Ceará.
- Charles A.T. 1992. Fishery conflicts. A unified framework. *Marine Policy*, Vol. September 1992: 379-393.
- Charles A.T. 1994. Towards sustainability: The fishery experience. *Ecological Economics*, Vol. 11: 201-211.
- Christensen S., Lassen H., Nielsen J. & Vedsmand T. 1999. Effort regulation: A viable alternative in fisheries management? In D. Symes, ed. *Alternative management systems for fisheries*. Oxford, UK, Fishing News Books, Blackwell. pp. 179-187.
- COFAD GmbH 2001. *Back to basics. Traditional inland fisheries management and enhancement systems in Sub-Saharan Africa and their potential for development*. Deutsche Gesellschaft, Eschborn/Tutzing.
- Collins 1992. *Collins English Dictionary and Thesaurus*. Harper Collins Publishers.

- Constance D. 2001. From “dolphin-safe” tuna to the Marine Stewardship Council: Ecolabelling in the fisheries sector. *The Common Property Resource Digest*, Vol. March 2001, No. 56.
- Degnbol P. 1998. *Fisheries research in development*. Oslo, The Research Council of Norway.
- Degnbol P. & Nielsen J. 2002. Educating fisheries managers as an integral part of management. Discussion note for the IIFET 2002 special session on building human capital. International Institute of Fisheries Economics and Trade IIFET 2002 Conference, August 19-22, Wellington, New Zealand.
- FAO 1995. Guidelines for responsible management of fisheries. In *Report of the Expert Consultation on Guidelines for Responsible Fisheries Management*, FAO Fisheries Report No. 519. Rome, FAO.
- Friend R. 2003. Fisheries data and policy. In R.L. Welcomme & T. Petr, eds. *Abstract submitted to the Second International Symposium on the Management of Large Rivers for Fisheries*. Phnom Penh, Mekong River Commission.
- Fuller B. 2002. Mediating apparently irreconcilable conflict - agricultural water use efficiency, CALFED, and California. *Abstract submitted to the Second International Symposium on the Management of Large Rivers for Fisheries*. Phnom Penh, Mekong River Commission.
- Groenfeldt D. 1998. *Organizing effective community-based groups: Lessons from the irrigation sector*. Washington, DC, Economic Development Institute, The World Bank,
- Hambrey J. 2002. *Economic evaluation of some interventions in aquatic development*. Phnom Penh, Cambodia, Mekong River Commission.
- Hambry J. 2002. *Financial analysis and risk assessment of selected aquaculture and fishery activities in the Mekong Basin*. Phnom Penh, Cambodia, Mekong River Commission.
- Hanna S. 1998. Co-managing in small-scale fisheries: Creating effective links among stakeholders. In *International CBNRM Workshop*. Washington, DC, May 1998.
- Haraldsdottir G. 2000. Tradition, co-management, diversity and the FAO in small-scale fisheries in Africa. In E.P. Durrenberger & T.D. King, eds. *State and community in fisheries management*. Westport, USA and London, Bergin & Garvey. pp. 131-148.
- Hardin G. 1968. The Tragedy of the commons. *Science*, Vol. 1968, No. 162. pp. 1243-1248.
- Hartmann W. 2002. *Fisheries Co-management in the Lower Mekong Basin*. MRC/FIP Annual Meeting, My Tho, Viet Nam, 11-12 June 2002.
- Hersoug B., Holm P. & Ranæs S.A. 1999. Three challenges to the future of fisheries management in Norway: ITQ's, regional co-management and eco-labelling. In D. Symes, ed. *Alternative management systems for fisheries*. Oxford, UK, Fishing News Books, Blackwell. pp. 136-144.
- Hossain M.A., Pareween S., Rahman M.A. & Mortuza M.G. 2003. Fish and fisheries of the major river system in the western part of Bangladesh in relation to fisher and socio-ecological sustainability. *Abstract submitted to the Second International Symposium on the Management of Large Rivers for Fisheries*. Phnom Penh, Mekong River Commission.
- Jackson D. 2003. Fisheries dynamics in the Yazoo River Basin. In R.L. Welcomme & T. Petr, eds. *Proceedings of the Second International Symposium on the Management of Large Rivers for Fisheries Volume 2*. Food and Agriculture Organization & Mekong River Commission. FAO Regional Office for Asia and the Pacific, Bangkok. RAP Publication 2004/17. pp. 103-116.

- Jentoft S. 1989. Fisheries co-management. Delegating government responsibility to fishermen's organization. *Marine Policy*, 132: 137-154.
- Juinio-Meñez M.A. 2002. Myths and realities of participation in Philippine CBNRM: Lessons from an analysis of who participates in what. Presented at "The Commons in an Age of Globalisation," the Ninth Conference of the International Association for the Study of Common Property, Victoria Falls, Zimbabwe, 2002.
- Kaunda E. & Chapotoka O. 2003. The conflict between poverty and river system management: The case study of Malawi, Southern Africa. *Abstract submitted to the Second International Symposium on the Management of Large Rivers for Fisheries. Phnom Penh, Mekong River Commission.*
- Kearney J.F. 1989. Co-management or co-optation? The ambiguities of lobster fishery management in southwest Nova Scotia. In E. Pinkerton, ed. *Co-operative management of local fisheries: New directions for improved management & community development.* Vancouver, University of British Columbia Press.
- Koehn J. & Nicol S. 2003. A strategy to rehabilitate native fish in the Murray-Darling Basin, South-Eastern Australia. *Abstract submitted to the Second International Symposium on the Management of Large Rivers for Fisheries. Phnom Penh, Mekong River Commission.*
- McCay B.J. 1987. The culture of the commoners. Historical observations on old and new world fisheries. In B.J. McCay & J.A. Acheson, eds. *The question of the commons. The culture and ecology of communal resources.* Tucson, USA, University of Arizona Press. pp. 195-216.
- McCay B.J. 1993. *Management regimes.* Stockholm, Beijer International Institute of Ecological Economics.
- McCay, B.J. 1998. Co-managing the commons. In International CBNRM Workshop, Washington, DC, May 1998.
- McCay B.J. 2000. Sea changes in fisheries policy: Contributions from anthropology. In E.P. Durrenberger & T.D. King, eds. *State and community in fisheries management*, Westport USA and London, Bergin & Garvey. pp. 201-217.
- McCay B.J. 2002. Post-modernism and the management of natural and common resources. *The Common Property Resource Digest*, Vol. 2000, No. 54: 1-8.
- McGoodwin J.R. 1990. *Crisis in the world fisheries. People, problems, and politics.* Stanford, USA, Stanford University Press.
- McGrath D., Cardoso A. & Sá, E.P. 2003. Community fisheries and co-management in the lower Amazon floodplain of Brazil. In R.L. Welcomme & T. Petr, eds. *Proceedings of the Second International Symposium on the Management of Large Rivers for Fisheries Volume 2.* Food and Agriculture Organization & Mekong River Commission. FAO Regional Office for Asia and the Pacific, Bangkok. RAP Publication 2004/17. pp. 207-222.
- McGrath D. & Castro F. 2000. From sector to system: Towards a multidimensional management in the Lower Amazon floodplain. In I.G. Cowx, ed. *Management and Ecology of River Fisheries.* Oxford, UK, Fishing News Books, Blackwell Science. pp. 388-399.
- Mikalsen K. & Jentoft S. 2001. From user-groups to stakeholders? The public interest in fisheries management. *Marine Policy*, Vol. 25, No. 2001. pp. 281-292.
- Murombedzi J. 1998. The evolving context of community-based natural resource management in sub-Saharan Africa in historical perspective. In *International CBNRM Workshop, Washington, DC, May 1998.*

- Nielsen J., Degnbol P., Ahmed M. & Viswanathan K. 2002. Fisheries co-management - an institutional innovation. *In Proceedings of the IIFET 2002 Conference, 19-22 August 2002, Wellington, New Zealand.*
- Nieuwenhuys O. 1989. Invisible nets: Women and children in Kerala's fishing. *MAST Maritime Anthropological Studies*, Vol. 2, No. 2. pp. 174-193.
- Ostrom E. 2000. Private and common property rights. *In B. Bouckhaert & G. de Geest, eds. Encyclopedia of Law and Economics. Vol. II: Civil law and economics*, Cheltenham, UK, Edward Elgar. pp. 332-360.
- Oviedo A. & Ruffino M. 2003. Addressing common demands of community fisheries in the Brazilian Amazon. Abstract submitted to the Second International Symposium on the Management of Large Rivers for Fisheries. Phnom Penh, Mekong River Commission.
- Oviedo A. & Ruffino M. 2003. Addressing common demands of community fisheries in the Brazilian Amazon. *Abstract submitted to the Second International Symposium on the Management of Large Rivers for Fisheries. Phnom Penh, Mekong River Commission.*
- Parveen S. & Faisal I. 2003. Open-water fisheries in Bangladesh: A critical review. *Abstract submitted to the Second International Symposium on the Management of Large Rivers for Fisheries. Phnom Penh, Mekong River Commission.*
- Petkova E., Maurer C., Henninger N. & Irwin F. 2002. Closing the gap: Information, participation, and justice in decision-making for the environment. Washington, DC, World Resources Institute.
- Phillips M. 2002. *Fresh water aquaculture in the Lower Mekong Basin*. Phnom Penh, Cambodia, Mekong River Commission.
- Pinkerton E. 2003. The conceptualization of fisheries co-management in social science. *In D.C. Wilson, J. Nielsen, & P. Degnbol, eds. The fisheries co-management experience: Accomplishments, challenges, and prospects*. Dordrecht, Kluwer.
- Pinkerton E. & Weinstein M. 1995. *Fisheries that work. Sustainability through community-based management*. Vancouver, Canada, The David Suzuki Foundation.
- Pomeroy R.S., Katon B.M. & Harkes I. 2001. Conditions affecting the success of fisheries co-management: Lessons from Asia. *Marine Policy*, 25: 197-208.
- Pomeroy R.S. & Williams M.J. 1994. *Fisheries co-management and small-scale fisheries: A policy brief*. Manila, International Center for Living Aquatic Resources Management.
- Rettig R.B., Berkes F., & Pinkerton E. 1989. The future of fisheries co-management: A multi-disciplinary assessment. *In E. Pinkerton, ed. Co-operative management of local fisheries: New directions for improved management & community development*. Vancouver, Canada, University of British Columbia Press.
- Ribot J.C. 2002. *Democratic decentralization of natural resources. Institutionalizing popular participation*. Washington, DC, World Resources Institute.
- Ruffino M. 2003a. Participatory management of fisheries in the Brazilian Amazon. Abstract submitted to the Second International Symposium on the Management of Large Rivers for Fisheries. Phnom Penh, Mekong River Commission.

- Ruffino M. 2003b. Provárzea - a natural resource management project for the amazon floodplains. *Abstract submitted to the Second International Symposium on the Management of Large Rivers for Fisheries. Phnom Penh, Mekong River Commission.*
- Ruitenbeek J. & Cartier C. 2001. *The invisible wand: Adaptive co-management as an emergent strategy in complex bio-economic systems.* Bogor, Center for International Forestry Research CIFOR.
- Schouten R. 2003. *Threats to healthy fisheries in the Lower Mekong Basin.* Phnom Penh, Cambodia, Mekong River Commission. (forthcoming)
- Scudder T. & Conelly T. 1985. *Management systems for riverine fisheries.* Rome, FAO.
- Sen, S. & J.R. Nielsen 1996. Fisheries co-management: A comparative analysis. *Marine Policy*, 205: 405-418.
- Soeftestad L.T. 2000. *Riparian right and colonial might in the Haors Basin of Bangladesh.* Presented at the 8th Conference of the International Association for the Study of Common Property IASCP, Bloomington, Indiana, United States, 31 May - 4 June 2000.
- Uphoff N. 1998. *Community-based natural resource management: Connecting micro and macro processes and people with their environments.* Presented at International CBNRM Workshop, Washington, DC, May 1998.
- Van Zaalinge N., Nao Thuok & Touch Seang Tana. 1998. *Where there is water, there is fish. Fisheries issues in the Lower Mekong Basin from a Cambodian perspective.* Paper presented to the Mekong Panel at the 7th Conference of the International Association for the Study of Common Property IASCP, 10-14 June 1998, Vancouver, Canada.
- von Blanckenburg P. 1982. *Handbuch der Landwirtschaft und Ernährung in den Entwicklungsländern.* Verlag Eugen Ulmer, Stuttgart.
- Wallace M.G., Cortner H.J., Moote M.A. & Burke S. 1996. Moving toward ecosystem management: Change in philosophy for resource management. *Politics & Society*, 3: 1-36.
- Welcomme R.L. 1979. *Fisheries ecology of floodplain rivers.* London and New York, Longman.
- Welcomme R.L. 2000. Principles and approaches for river fisheries management. In I. Cowx, ed. *Management and ecology of river fisheries,* Oxford, UK, Fishing News Books, Blackwell Science. pp. 331-345.
- Welcomme R.L. 2001. *Inland Fisheries. Ecology and Management.* Oxford, UK, Fishing News Books, Blackwell Science.
- Welcomme R.L. 2002. An evaluation of tropical brush and vegetation park fisheries Fisheries Management and Ecology, 9: 175-188
- Welcomme R.L. 2002. Data requirements for inland fisheries management. In Proceedings of the FAO/MRC/Government of Thailand/Government of The Netherlands ad hoc expert consultation on *new approaches for the improvement of inland capture fisheries statistics in the Mekong Basin*, 2-5 September 2002, Udon Thani, Thailand.
- Wilson D.C. 2000. Fisheries Management as a Social Problem. In C. Sheppard, ed. *Seas at the Millennium, Vol. III.* London, Elsevier. pp. 153-164.

