

Selection Criteria and Co-management Guidelines for River Fishery Harvest Reserves



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Executive Summary

These guidelines provide advice on the selection and co-management of harvest reserves for sustainable community benefits in floodplain river fisheries. They are based on the output of a 1997-2000 United Kingdom DFID-funded project based in Indonesia, and on general knowledge about the co-management of natural resources.

Depending on their objectives and on local hydrological factors, floodplain river harvest reserves may either be closed year-round, or just for certain seasons, or for certain gears. At project study sites with effective local management, partially closed harvest reserves were found to increase the numbers of fish surviving to breed each year, prevent local species extinctions, and increase local catches. However, although harvest reserves are central to these guidelines, they are clearly not the only management tool which may give benefits to floodplain river fisheries. The guidelines thus emphasise the need for a combination of locally appropriate management rules, developed on the basis of local knowledge and an integrated, inter-disciplinary understanding of fishery resources. A participatory co-management style is promoted drawing on the skills and capacities of local communities, government officers, local development NGOs and other stakeholders in specified sub-units of the river system. The Indonesian government's recent Regional Autonomy Act, UU No. 2/1999, clearly promotes such decentralised management of fisheries and other resources at provincial, kabupaten and even more local levels. Finally, the guidelines promote a long-term, 'adaptive' management style, recognising that the optimum management rules for different local fisheries can not be predicted in advance, and need to be developed by a process of learning and experience.

The guidelines are intended for use by national and provincial fishery managers, planners and other stakeholders. They may either be used directly, or as a basis for the development of more detailed guidelines or strategies for specific areas. They provide guidance on the *process* of developing new collaborative institutions and technical management plans for specific sites rather than prescribing their exact contents. Such specific management plans should be designed in collaboration with local stakeholders to be appropriate for local conditions.

Chapter 2 of the guidelines provides general advice for the development of co-management practices for floodplain river fisheries. Firstly, advice is given on where co-management may best be developed, based on a number of factors known to improve its chances of

success. Following this, guidelines are given on the institutional, technical and adaptive strategies for management. The institutional strategy includes both the formal processes of policy and legislation, and the more informal 'rules of the game'. Such rules define who should be involved in management, and the standard practices, routines and customs by which they should interact and co-operate. The technical strategy briefly outlines how the fishery may be assessed, and how alternative management tools (reserves, gear licensing, gear bans etc) may be used for its management. The adaptive strategy then describes how the benefits from different management practices may be monitored, assessed and improved, initially by simple 'moves in the right direction', or in the longer term by a more formal, analytical approach.

Chapter 3 of the guidelines concentrates on the use of harvest reserves in river fisheries. Both social and technical criteria are given for the selection of appropriate water-bodies, and for their management. Both the general criteria described in Chapter 2 for the development of co-management institutions and the specific criteria given in Chapter 3 will be necessary for the successful co-management of harvest reserves.

The final step-by-step guidelines in Chapter 4 summarise where co-management practices and reserves may best be developed and where capacity building and training will be most required for success. The final two sections summarise the types of activities that may be most usefully undertaken at the village level and the catchment level respectively. The selection of such activities should be developed in collaboration with stakeholders, and not imposed 'top-down'. 'Menus' of possible activities are thus described for each level. In the villages these activities include:

- (1) identifying the stakeholders, their perceived problems, and their objectives for the fishery;
- (2) assessing the local fishery;
- (3) designing a management plan;
- (4) implementing the plan; and
- (5) monitoring outcomes and adapting the plan.

At the catchment level, they include:

- (1) co-ordinating the village units and promoting new units;
- (2) representing the fishery in its interaction with other sectors; and
- (3) facilitating the adaptive learning process.

1 Introduction

These guidelines provide advice for the management of floodplain river fisheries in Indonesia. They focus particularly on the use of **harvest reserves**, and the basic principles of **co-management** and **adaptive management**. These terms and the guiding principles behind them are explained in the following sections of this introduction. General guidelines on the co-management of river fisheries are given in Chapter 2, followed by specific guidelines on the use of harvest reserves in Chapter 3. This material is summarised in Chapter 4, in which the key steps towards successful co-management are described in four sections.

1.1 Guiding principles

While this manual focuses on the use of reserves, it must be noted at the outset that the high variability of natural, physical and social characteristics between different river systems will always demand **locally-appropriate** management solutions. Different types of reserves will be needed in different situations, and reserves may not be useful at all in some other situations. Alternative or additional management rules will be needed to improve benefits from certain types of fish species (particularly ‘whitefish’, as described below). There is thus no single ‘right’ answer for floodplain river fisheries management, which may be applied universally in a ‘top-down’ way.

While there are no universal ‘blueprint’ solutions, these guidelines are nevertheless based on a number of core principles by which effective local solutions may be found. Firstly, the approach is **people-centred** and **participatory**. Fishery management is more about managing people than about managing fish. Solutions developed in partnership with local people, and building on their existing strengths, are far more likely to succeed than those which simply aim to suppress any activities seen as undesirable by fisheries officers. Successful management will require strong support both from national and regional policy makers, and good leadership at the local level.

Secondly, it is clear that effective management of these complex resources requires **integrated** and **inter-disciplinary** approaches. This means taking a broad view of the fishery and the wider river system, and being aware of the many different factors that may affect outcomes. Floodplain resources are vulnerable to a range of different impacts, both from local sources and from upstream. They also provide a range of alternative livelihood opportunities, not all of which may be compatible. Understanding these threats and opportunities, and resolving conflicts, will require integrated study from a

range of perspectives.

Thirdly, the guidelines promote flexible management solutions for coping with **dynamic** situations. Floodplain river systems change continuously, due to both the normal annual flood cycle and to longer-term trends. Communities and their impacts on the environment change gradually over time and sometimes shift dramatically (e.g. with the introduction of a new irrigation scheme or an effective new fishing gear). The recommended **adaptive** approaches seek to learn from both intended changes (i.e. management actions) and these other external trends and shocks, and to improve management gradually, based on the lessons learnt.

Finally, the key principle behind these guidelines is the long-term **sustainability** of fishing **livelihoods** in rural communities. This means managing the fishery to produce benefits year after year, without destroying the underlying fish stock. It does not necessarily mean that fishing practices must be sustained in future exactly as they are today. New fishing practices or alternative ways of using the river system may be introduced so long as they do not reduce the long-term potential of the resource base. The guidelines are thus designed to enable people to sustain their livelihoods by adapting to changing conditions in flexible but positive ways.

In practice, these guiding principles may be followed by always asking the following questions during the development or implementation of any new management measures:

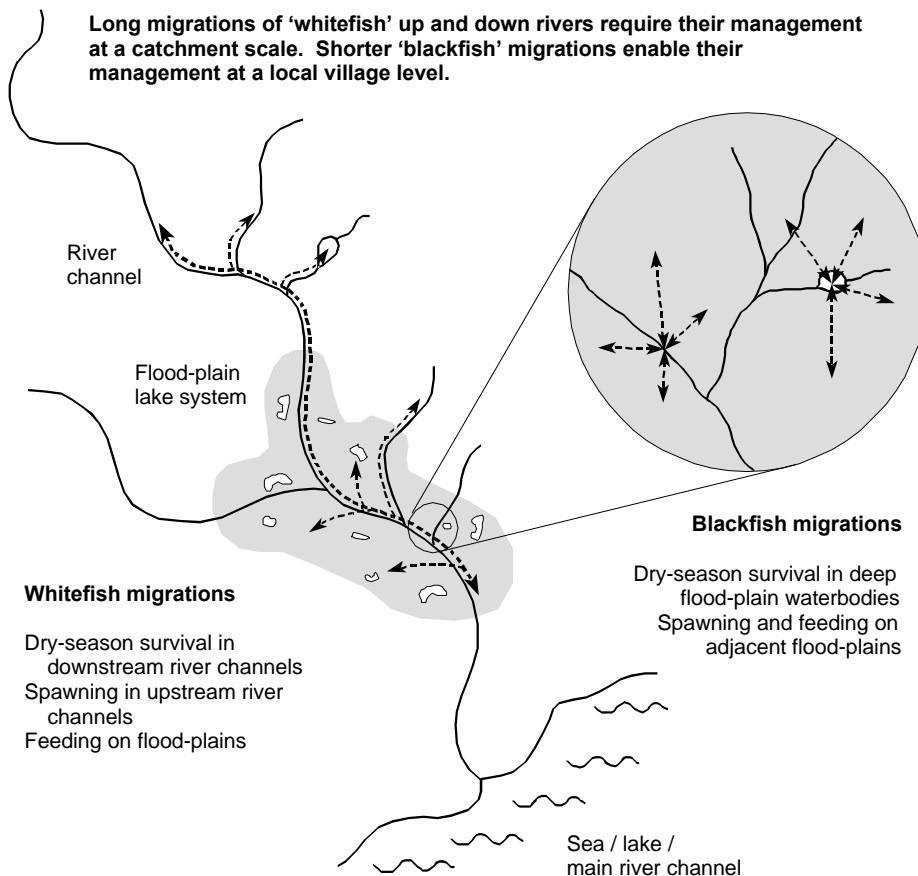
Guiding principles checklist

- Are these new measures well **adapted** to local characteristics and current influences?
- Have they been developed by (or in collaboration with) **local people**, using their local knowledge?
- Do they take account of the range of different potential **influences** on the fishery?
- Are they based on both a **biological** and a **socio-economic** understanding of the fishery?
- Are they **flexible**? Could they be easily and quickly modified, if local circumstances change in future?
- Will the new measures give **sustainable benefits**, both to local fish stocks, and local livelihoods?

1.2 What is a harvest reserve?

A ‘harvest reserve’ is a fishery management tool, which may be defined as follows:

- a spatially defined area of water, ...
- managed with a specified (but flexible) set of



tembakan) will mainly increase fish catches within a small local area (see figure). Reserves designed to protect the breeding populations of more migratory 'whitefish' species (e.g. baung, semah) may give benefits to the whole river catchment due to their much wider dispersal patterns. In general, blackfish reserves should be located in dry season waterbodies in floodplain areas, while whitefish reserves should be located in spawning grounds, usually in upstream parts of the catchment. Whitefish may need additional management tools (e.g. controls on barrier traps) to ensure that some fish can get back to the reserve each year to spawn. Blackfish reserves are more likely to be supported by local communities since the extra fish produced by their management efforts will stay mainly within their own waters.

- technical regulations, ...
- intended to sustain or increase the potential fish yield, ...
- available from existing, natural fish stocks, ...
- for the benefit of fishers.

Harvest reserves are thus primarily intended to give benefits to **fishers**. They mainly achieve this function by increasing the numbers of fish which survive the fishery to breed, resulting in many more young fish for capture in the following year. Harvest reserves are *not* designed purely to conserve fish stocks for their own sake, though this may be a beneficial side-effect. This alternative objective is achieved by other non-harvest or '**conservation reserves**', including various types of national parks and wildlife reserves. In Indonesia, such reserves are generally gazetted under the authority of the PHPA (ministry-level) and KSDA (province-level) Forest Conservation Agencies. Co-managed harvest reserves are more likely to be introduced by fishing communities with the support of the provincial or kabupaten-level Dinas Perikanan.

The distribution of **people who benefit from a reserve** depends on the dispersal patterns of the extra fish produced. Reserves inhabited by relatively non-migratory, local 'blackfish' species (e.g. gabus and

While conservation reserves are usually permanently closed areas, **harvest reserves may not always need to be closed for the whole year**. They may be managed instead with a flexible combination of regulations adapted to maximise local benefits. In some situations (e.g. where the reserve water-body is the main fishing place for a village), more benefits may be achieved by closing the reserve for only part of the year, and allowing fishing in the reserve at other times. Closing the reserve all year may leave virtually no fishing opportunities for the village, who may then be irresistibly tempted to fish illegally in the reserve. In other situations, year-round closure may be more effective (e.g. in particularly vulnerable habitats, or where fully closed 'taboo' areas are traditional practices). Guidelines on the alternative management options for reserves are given in Section 3.2.

Should fishing be allowed inside reserves?

Though harvest reserves *may* be fully closed all year round (giving a useful and clear message on their status), some types of fishing may also sometimes be allowed inside their boundaries. In the apparently effective harvest reserves studied in West Kalimantan, the communities only restricted certain gears, sometimes only for limited seasons. In Meliau village, fishing was permitted inside Danau Balaiaram reserve with hooks, portable traps and cast nets, while gill nets

and barrier traps were prohibited. In Sekolat village's Danau Batuk reserve, only gill nets were banned in the wet season but all gears were banned in the dry season. The capture of small fish (below consumption size) was also prohibited.

1.3 Why use harvest reserves?

Harvest reserves are recommended as a particularly useful management tool for floodplain river fisheries for the following reasons:

- they have been found to **improve fish stocks** and benefit local **catches** in floodplain river fisheries;
- their high **visibility** makes illegal fishing easier to detect (it is easier to see a poacher fishing in a reserve area than to see who is using illegally small mesh sizes, or using too many units of gear);
- they are **traditional** management tools in many places, with proven local acceptability; and
- they are conceptually **simple**, with easily understandable effects.

Seven different harvest reserves were studied by this project. At two of the study sites in West Kalimantan, harvest reserves were traditional practises, effectively enforced by local leaders and village communities. These two reserves were only closed to certain gears or over the dry season, but were found to provide significant biological benefits to fish stocks (see box below).

In the other studied reserves, including the fully closed reserves set up by the government in South Sumatra, fish stocks appeared to be much less effectively protected. These reserves were either placed in inappropriate locations or were ineffectively managed or enforced for a variety of reasons (they did not meet one or more of the criteria given in Sections 2.1 or 3.1). Clearly, harvest reserves need to be carefully selected and managed to achieve their potential benefits. The following guidelines are based on the lessons learned at the different study sites. They show how a co-management approach may deliver these requirements by drawing on the capacity and knowledge of local fishers, communities and government officers.

Biological effects of reserves on fish stocks

Fish stocks inside the Danau Balaiaram and Danau Batuk reserves in West Kalimantan were found to be much more abundant than those at the Danau Pulau Majang study site having no reserves and fished by poison in the dry season. Though the differences between these sites may be due to a range of factors (i.e. they are not *only* due to the existence of the reserve), the following figures are provided as an illustration of the possible biological effects of reserves.

Fish abundances were estimated as catch rates in

experimental gill nets set overnight, eight times per month. In the 1998-99 wet season, the nets in the reserves caught 12-15 times more fish (by number) and 15-16 times more weight than those set in Danau Pulau Majang. In the 1999 dry season, the Danau Batuk catch weights were an average 22 times greater than those at Danau Pulau Majang.

The West Kalimantan reserve water-bodies also contained more fish species (60-77 different types caught over the year) than in the fished Pulau Majang site (only 46 species). The average number of different fish species caught per night at the reserve sites was 1.5 to 2.4 times higher than in the fished site.

The additional species found in the reserves were nearly all of the blackfish type, confirming that the reserves studied protect *local* fish stocks. Fish stocks at Pulau Majang are currently maintained mainly by the more migratory whitefish species, that can swim in to the village from the main river with each new flood, at least until they also become depleted or extinct.

Though harvest reserves are central to these guidelines, it should be clearly understood that they are **not** the only management tool able to sustain livelihoods in floodplain river fisheries. Other tools, such as habitat restoration, water-body leasing and gear licensing, size limits, gear bans and fish stocking may also be useful in river fisheries in some circumstances, perhaps in combination with reserves. The guidelines given in Chapter 2 of this manual thus provide advice on the development of a general **management framework**, by which harvest reserves *or other management tools* may be implemented and assessed.

1.4 What is co-management?

'Co-management' approaches are increasingly being used for the management of natural resources. Co-management may be described as a **partnership** arrangement using the capacities and interests of the local fishers and their community, complemented by the ability of government to provide enabling legislation and other assistance. There are many important roles to be played, but there is no single blueprint solution for success. In addition to the two key **stakeholders** (government and local communities), NGOs, development projects and other agencies may also play valuable roles. The ideal combination of partners for each location will depend on the capacities of the different local stakeholders and the nature of the resources to be managed. Stakeholders, here, may be defined as those people, groups or organisations that are likely to *be affected* (either negatively or positively) by a proposed management intervention, and also those that *could influence* the outcome of the intervention (again either negatively or positively).

Though flexibility will always be required, effective co-management arrangements for *river fisheries* will usually

require both local and catchment-level committees (or some other type of management body). A **local committee** would enable the necessary stakeholder representation for effective management of a small, local 'unit' of the fishery. A 'catchment' is the land area that feeds into a river system, and may thus affect its productivity. A **catchment committee** would therefore represent the interests of fishery stakeholders during negotiations with other interacting sectors that occur at a catchment-wide scale (e.g. the effects of agricultural policies or urban expansion on the different fishery units). If the catchment is large, intermediate sub-catchment management units may be more effective. In either case, the catchment or sub-catchment committee should also be responsible for providing training and leadership, as required to implement new co-management units and to communicate the lessons of management between different units. These requirements are described further in Section 2.2.

1.5 **Legal and cultural basis for co-management in Indonesia**

For the first five of its five-year national plans (*Pelita* I to V), Indonesia's fishery management strategies were 'top-down' in character, allocating responsibility for the resources to the government fisheries service (*Dinas Perikanan*). In the Fisheries Act, *Undang-undang* No. 9/1985, the central government declared some universal rules for Indonesian fisheries, including bans on the use of electricity and poisons. It also declared the government's right to identify water bodies as protected conservation areas. These rules have proven difficult to enforce due to the limited capacity of the government fisheries services. At the government's Teluk Rasau reserve in South Sumatra, for example, poaching was found to occur on 35% of the nights studied by the project, and fish stocks were sometimes even lower than in a normally fished water-body nearby. Partly in response to these problems, the government's sixth five year plan (*Pelita* VI, 1994-99) promoted a shift in policy towards the **decentralised management** of fisheries and other sectors at lower levels. This ambition was realised in 1999 with the adoption of the Regional Autonomy Act, UU Otonomi Daerah No 22/1999.

With the increasing **autonomy** of Indonesian provinces and districts (*Kabupaten*), it is now possible for the 'bottom-up' decisions from village discussions to become recognised local laws. Such legal confirmation of the village committee's right to manage the fishery may be granted either as Decision Letters issued by the *Kabupaten* level chief (*Bupati*), or as *Perda* regulations issued by the *Kabupaten* administration (*Pemda* Tk II).

On the cultural side, **community-based** or **traditional** management of fisheries has been practised in many parts

of Indonesia since at least the 16th century. Known practices include the use of '*sasi*' in Maluku's marine fisheries; and reserves, protected species, ceremonial fishing days, and the control of access by auctions and lotteries in freshwater fisheries in North, South and West Sumatra, Jambi, Riau and West Kalimantan. Such traditional management practices have often been developed by the long-established Indonesian tradition of making communal decisions by a process of discussion (*musyawarah*) until unanimity (*sepakat*) is achieved. During such discussions, either the details of the proposed solution may be altered, or reluctant community members may be persuaded of its desirability. As a result of these discussions, community decisions are usually widely accepted. Where they exist, such traditional practices provide a strong basis for the proposed co-management of river fisheries in Indonesia by the village and catchment committees.

Indonesia therefore currently has an **enabling cultural and legislative environment** that potentially favours the introduction of co-management approaches. The challenge now for regional officials is to adopt these new government policies, and accelerate moves towards co-management. The publication of this manual reflects the Indonesian Government's commitment to these new principles and policies.

1.6 **What is adaptive management?**

Adaptive management recognises that the outcome of different management actions can not be clearly predicted for complex and locally variable resources like floodplain rivers, and therefore:

- actively **monitors** the effects of any management intervention or change;
- **evaluates** the outcome by comparison with other places or previous times; and thus
- develops management strategies continuously, based on **learning and feedback**.

Adaptive management represents a significant shift from the more traditional management practices. These have often been too rigid, and therefore not always suitable for the wide variety of local environmental and stock conditions. Such rigid management frameworks may thus have declared *in advance* exactly what management measures were needed (e.g. that 10% of floodplain water-bodies should be set aside as reserves), and then proceeded to apply this rule in all areas. An adaptive approach would instead acknowledge that the optimum management regulations are not really known (should the figure be 10%, 20% or 2%?), and would attempt to find the best answer in each location by experimentation and feedback.

Adaptive approaches clearly require a long-term commitment to management. They require **feedback** mechanisms to guide changes to the management strategy over time. At the catchment level, this may take the form of simple data on catches from village monitoring. At the village level, adaptation may simply involve regular discussion and sharing of ideas by members of the fishing community. While adaptive approaches may be more difficult to apply than the rigid, prescribed approaches, they have the advantage that the impacts of management will be **known**. Management practices may thus be **improved** over time. Where rigid approaches are applied without feedback mechanisms, managers may have no effective means of guiding their actions, or of ensuring that their actions are even beneficial.

While adaptive approaches do have clear advantages, they will also always be difficult to implement for floodplain river fisheries due to the complex mixture of local factors that determine the state of the fishery and the outcome of new management rules. Providing feedback on all of the important factors and interpreting the results will often be beyond the ability of both the village and the government-level managers. In the first instance, the adoption of an adaptive approach may therefore simply mean **keeping an open mind** to new ideas (e.g. based on the experiences of other villages), instead of sticking rigidly to any existing management strategy.

An adaptive approach is thus recommended as a long-term means of finding effective management solutions for floodplain river fisheries in different locations, and of ensuring that they are working as intended. Guidance notes for possible adaptive management strategies are provided in Section 2.4. It should be remembered, however, that the adoption of the more complex strategies should be seen as a lower priority than the more important first steps of developing local management capacity. Involving communities in the selection and implementation of their own management rules based on their local own knowledge will provide the greatest initial benefits for a river fishery. While such co-management skills are being developed, adaptive management can be based on basic exchanges of ideas between village units. The more ambitious adaptive management strategies described in Section 2.4 may be promoted in later years.

1.7 Structure of the guidelines

Following this introduction, the guidelines are presented in two main chapters, followed by a step-by-step summary in Chapter 4. In each chapter, the actual guidelines or recommendations are presented in a series of shaded blocks. Selected results from the project's case studies are presented in text boxes to illustrate key principles.

Chapter 2 provides general guidelines for the development of co-management practices for floodplain river fisheries. Firstly, advice is given on **where** co-management may best be promoted, based on a number of factors known to improve its chances of success. Following this, guidelines are given on the institutional, technical and adaptive strategies for management. The **institutional strategy**, described in Section 2.2, includes both the *formal* processes of policy and legislation, and the more *informal* or traditional 'rules of the game'. Such rules define *who* should be involved in management, and the standard practices, routines and customs by which they should interact and co-operate. The **technical strategy** (Section 2.3) briefly outlines how the fishery may be assessed, and how alternative management tools (reserves, gear licensing, gear bans etc) may be used for its management. Finally, Section 2.4 describes the long-term **adaptive strategy**, by which the benefits from different management practices may be monitored and improved by 'learning from experience'.

Chapter 3 of the guidelines then concentrates on the use of *harvest reserves* in river fisheries. Both **social** and **technical criteria** are given for the selection of appropriate water-bodies, and for their management. Both the general criteria described in Chapter 2 and the specific criteria given in Chapter 3 will be necessary for the successful co-management of harvest reserves.

The final step-by-step guidelines in Chapter 4 summarise where co-management practices and reserves may best be developed and where capacity-building and training will be most required for success. The final Sections 4.3 and 4.4 summarise the types of activities that may be usefully undertaken at the village level and the catchment level respectively.

2 General Guidelines for Co-Management of River Fisheries

2.1 Where should co-management systems be developed?

The following initial guidelines list a series of social, institutional and physical conditions that make some villages or localities particularly suitable for the introduction of co-management approaches. The conditions described are commonly found in communities that already have successful management systems for their natural resources, often based on traditional approaches. Where such *community-based* systems are already working well, there may be no need for government 'interference' or for the creation of new co-management structures. Such systems may instead provide many useful lessons for passing on to other new co-management units. In some cases, however, the formal or legal recognition of these units by government may reinforce their ability to manage successfully, e.g. to exclude poachers from outside the village. In other cases, villages may be receptive to the incorporation of new management tools (e.g. a harvest reserve) into their existing systems, particularly where this requires little extra effort.

- Co-management should only be introduced where its **legality** is recognised both by government and by local people. As described in Section 1.5, the recently increased autonomy of Indonesian local authorities has already created an enabling legislative environment under which co-management may be developed. In other countries, similar changes in national policies and legislation may be required.
- The **ownership rights** of villages over the water-bodies in their territory should also be recognised by local people. Villages with accepted local rights may already manage access to their water-bodies (e.g. by auctions or lotteries), and/or restrict the access of outsiders to their resources.

Illegal fishing by 'outsiders' in Seliban village

Seliban village in West Kalimantan is a temporary fishing community, in which up to 60 families live on their boats over the dry season. The community have developed their own fishing regulations including a harvest reserve, but report frequent illegal fishing by outsiders, both with electricity and other locally prohibited gears. The project's monitoring programme reported poaching on 78% of the nights fished at this site, and fish catches in the village were less than a tenth of those in the best reserves in West Kalimantan. This apparently destructive illegal fishing was believed to be carried out by rich outsiders from the nearby town of Suhaid, who were not dependent on the reserve and did not recognise the management rights of Seliban's temporary community.

- Co-management will be easiest to develop for floodplain water-bodies that are located completely **inside the administrative boundary** of a single village. In this situation, initial management discussions will only be required among the members of the one village. The benefits from management may also be more likely to be retained mainly within the village, increasing the incentives for its members to manage their resources.
- Co-management may also be developed in water-bodies that are **shared** between several villages, but greater efforts will be required for their management and simpler management strategies and tools should therefore be used. Such water-bodies include lakes surrounded by two or more villages, or large floodplain systems that flood around many villages. The dispersal of fish from reserves in these situations may be much less clear, and village members may thus have less incentive to participate.

Water-body ownership and co-management

At most of the sites studied in Jambi and West Kalimantan, the communities were permanently settled and had established accepted local rights to manage the fishing waters within their administrative village boundary. In some cases, their waters were fully inside the village territory, while in others they were shared with an adjacent village. Such villages offer good prospects for effective community-based management systems.

In contrast, access to fishing in the River Lempuing study sites in South Sumatra is managed by *regional* authorities using an annual auction system. The leaders of the Palembang kingdom originally set up this system in 1822 to prevent conflicts between fishers. It has since been adopted by the kabupaten-level government administration, and the auction fees now represent a significant portion of local government income. As a result of the system, water-body owners change frequently, there are no permanently settled communities among the floodplain lakes, and the temporary fishers have little incentive to conserve their fish stocks. Developing a co-management system for this resource would require major changes in the way access and 'ownership' are managed.

- Co-management should be introduced in places where local people agree that there are **problems** with their resources and where the community or user group is highly **dependent** on those resources. Where fisheries are still reasonably healthy, the potential **benefits** of management may not be large enough to justify the time and effort involved. To reinforce the co-management system, the actual benefits of management should be demonstrated as early as possible to be **greater than the costs** involved. In some places, local people may need **education** on the principles of conservation and

sustainability before they recognise local problems.

Seeing a need for change in Dano Lamo

In Jambi's Dano Lamo village, the poor state of the local fishery in the mid-90's prompted local people to seek the advice and financial support of government. Following discussions on a range of alternative options, the villagers accepted the idea of a new reserve in their local river. Recognising their need for a change, they have since complied closely with their new regulations and now report some improvement in catches.

- Co-management approaches are most likely to succeed in communities that have strong **organisations** (e.g. the village committee) or skillful and respected **leaders**. They may also have mechanisms (e.g. the *musyawarah desa*) for discussing issues and finding solutions to local problems, and for enforcing their own management rules and resolving conflicts. All of these factors may provide a strong basis for the introduction of new management regulations.

Effective community management?

As noted in Section 1.3, the most abundant fish stocks were found in the community managed fisheries in Meliau and Sekolat villages in West Kalimantan. These villages had well-designed harvest reserves and other conservation regulations, and very low rates of poaching (0% of nights in Meliau and 6% in Sekolat). The success of these villages in managing their fisheries may be due to a range of important factors. Both of the villages were fairly small (28 and 167 households respectively), and highly dependent on fishing. Though the villages had mixed cultures (Dayaks and Malays), they lived harmoniously and accepted the leadership of their village committee. Access to fishing positions for the effective *jermal* drift traps was decided by fortnightly lotteries in both villages. This was perceived as a 'fair' way of distributing the benefits from fishing, and may have reduced the incentives of village members to poach from their reserves. Meliau's fish stocks may also have been protected by its remote upstream position and by its extra 'reserve' water-bodies inhabited by crocodiles and 'evil spirits'!

- Finally, co-management practices are more likely to be successful in **smaller villages** than larger ones, and also where fishery stakeholders share the **same culture and ideals**. Co-management (or indeed *any* management) will be more difficult to develop in villages that have many existing conflicts and tensions between village members.

Conflicting cultures in Pulau Majang

Pulau Majang village in West Kalimantan is inhabited by around 170 households, most of whom are mainly dependent on fishing. These fishing families are mainly Malays who have settled in the region. The

village boundary, however, includes 22 indigenous families from a different tribe, living in a separate hamlet. Members of this other tribe traditionally fish using natural poisons in the dry season water bodies. Though such poison fishing is banned by government, its use is tolerated to some extent where it is a traditional practice. As noted earlier, fish stocks in Pulau Majang were found to be up to 22 times less abundant than in the other villages with well-managed reserves. The new Malay fishers would like to improve the management of their local fish stocks, but have so far been unable to control the poison fishing of the indigenous people due to their different cultures.

2.2 Institutional strategy (who should manage and how?)

The institutional strategy defines **who** should be involved in the management process, and how they should **interact** and **operate**. 'Institutions' in this sense may thus be understood as the 'rules of the game', 'standard operating practices', 'routines, conventions and customs', or simply 'the way things are done'.

The co-management process should include (in one way or another) **all** the **stakeholders** who either (1) depend on the resource or (2) may influence the success of the co-management initiative (some stakeholders may fall into *both* categories). The key stakeholders in co-management are likely to be those most directly involved in using the resource – fishers and their households. A 'stakeholder analysis', however, should also identify those with more indirect interests in the resource. In Indonesia, effective co-management may require the participation of representatives from some or all of the following major groups, either at provincial, kabupaten, kecamatan or the most local village levels:

- fishers and their households;
- fish processors and traders;
- boat operators;
- farmers and their employees who farm in the surrounding floodplain or use water for irrigation;
- Dinas Perikanan (Fisheries Service);
- fishery researchers and scientists;
- local government administrations;
- traditional village leadership organisations;
- non-governmental development organisations (NGOs);
- BAPPEDA (Regional Planning Board);
- Agricultural Extension Service, including BPTP, LPTP, IPPTP, BIP and BIPP; and
- enforcement agencies (e.g. local police)

Not all of these stakeholders have to be **fully** involved in the co-management process. The key partners, however, do need to know **who the other stakeholders are**, and **how they might be affected** by management measures,

so that possible future conflicts can be avoided.

Once potential stakeholders have been identified, their most appropriate levels of participation in co-management should be worked out. Four levels of potential involvement can be used:

- **Informed** – people who may not be directly affected by management measures but have some interest in the resource and may need to be kept informed of changes.
- **Consulted** – people who are liable to be affected by management but are not directly involved in use of the resource. These stakeholders should be consulted so that they are fully aware of what is going on and feel that their concerns have been taken into account.
- **Partners** – people whose co-operation is essential for the success of co-management, who take part in all consultations and work together with other stakeholders in implementing and monitoring the co-management process.
- **Owners** – people who “control” the co-management process; depending on the circumstances this might be the government agencies promoting co-management and/or the stakeholder groups who benefit directly from the management process.

As the process of co-management develops, the most appropriate level of participation of the different stakeholder groups may change. The stakeholder analysis therefore needs to be continually developed and adapted.

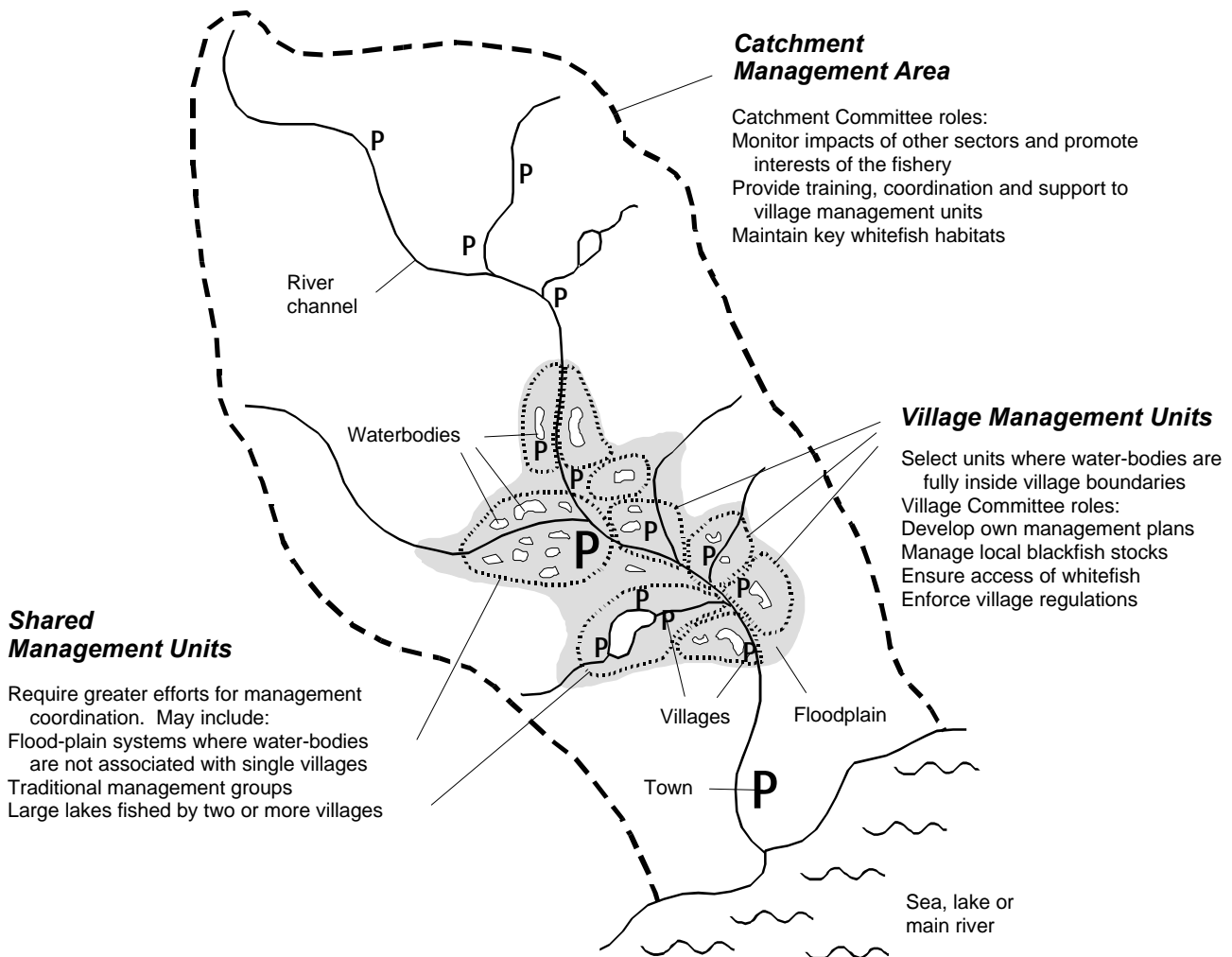
To enable the most effective contributions by each of the key stakeholders, a **hierarchical** and **spatial** institutional structure is proposed. A hierarchical structure enables community members to participate strongly at a **local** level, while government agents and other stakeholders play co-ordinating and supportive roles at intermediate **regional** levels and at the **national** policy level. Such a structure draws on the strengths of both bottom-up and top-down contributions. A spatial structure enables the floodplain fishery to be sub-divided into **management units**, each with its own fishing waters and associated community members.

The detailed **institutional structure** for each river system or reserve should be allowed to vary according to the wishes of the different local stakeholders and their relative capacities. *No attempt should be made to impose a single standard structure in all places.* As a basic pattern, however, there would be some form of management committee within each local management unit, and another committee at the regional coordination level. The following points guide the establishment of such dual committees and describe the potential roles of the different players.

- Firstly, the catchment should be sub-divided into a number of **management sub-units** (see figure). The

choice of such sub-units should be guided by the distribution of both floodplain water-bodies and communities to maximise the **overlap** between fish distributions and community authority. Co-management practices should initially be developed in sub-units having a single village, with a number of water-bodies (lakes, river channels etc) under its authority. Such villages should be selected by participatory techniques, and not picked ‘top-down’ by outside experts. Further details were given on the selection of potentially appropriate management units in Section 2.1.

- In each management sub-unit, a **stakeholder analysis** should be undertaken. This should determine the involvement of the different institutions, individuals and communities in the local fishery, and the costs and benefits each one incurs from their involvement. The analysis should identify both the ‘indirect’ stakeholders and the key stakeholders (the ‘owners’ and ‘partners’), who should be most directly involved in the management of the fishery.
- Problems with the resources, management issues and possible management solutions should be discussed by the key stakeholders, leading to the establishment of an effective **institutional structure** for the co-management of the fishery. The most appropriate structure will depend on the **capacity** of the different stakeholders. Capacity here includes the resources required for management (both people and money) and the skills and motivation necessary to perform the different roles. Where local communities lack the skills to contribute to decision-making and management, they should be provided with additional support and assistance until these skills have been acquired.
- Though local flexibility must be encouraged, the institutional structure may be expected to include both a **local or village co-management committee** and a **catchment co-management committee**. In the simplest terms, the Village Committees may be responsible for the active management of their local fisheries, while the Catchment Committee provides guidance and support, based on its broader, catchment-wide perspective.
- The **membership** of the committee(s) should be clearly specified but allowed to change over time, as new stakeholders are identified. The **roles** and **relationships** of the different committee members should be clearly defined and agreed.
- Committed and effective **leaders** should be identified to develop the co-management partnership. The best leaders will have strong personal skills in negotiation and conflict resolution and a good standing in the community. Leaders need to represent stakeholder interests and be accountable to the groups they represent. While some of the skills required can be developed through training, others will vary between individuals or need time and experience to develop.
- The committee(s) should be provided with recognised **legal powers** to (1) select the objectives of



management (within certain basic principles of sustainability), (2) limit access to the fishery (decide who may fish), and (3) manage the fishery (set local regulations) to achieve the chosen objectives. Such legal recognition may be achieved by district or provincial government regulations (depending on the size of the management sub-unit), and should be granted **permanently** (depending on effective performance) to maximise incentives for sustainable use. In some countries, **national legislation** may need to be modified to enable such decentralised co-management to be applied.

- Representatives of key stakeholder groups, under the guidance of the Village Committee, should *jointly* select the **management objectives** for the fishery. This will usually involve *choices*, for example, between high employment with low profits or lower employment with a higher quality fish catch. Stakeholders should thus recognise the need to **compromise** between their personal objectives, and aim to achieve the maximum possible **consensus**. To encourage participation, the preferred objectives of the community members should be supported wherever possible.
- The Catchment Committee should participate in

catchment management planning activities, e.g. for the control of pollution, and the effective allocation of water resources between competing demands from fisheries, agriculture, industry and other sectors. With its broad regional focus, the Catchment Committee is well placed to (1) promote the interests of the fishery; (2) inform the Village Committees about the impacts of other sectors on the productivity of local fisheries; and (3) transfer lessons between the different local management units in their catchment. The Catchment Committee should also **extend** the co-management practices to new areas as appropriate, and provide **training, coordination** and **support** as required.

- The Village Committee should participate in **choosing local management tools, enforcing** those tools and **penalising** rule-breakers, **monitoring** the outcome of the management strategy and **guiding** adaptations (see Section 2.4).
- **Communication** between the different stakeholders should be a major priority. Stakeholders should be kept informed about any changes made to the management strategy, the anticipated impacts on community benefits, and (later on) the actual outcomes which result. Publicity materials may include posters, leaflets, newsletters and public

meetings, both within the village, and at government offices.

- Mechanisms for **rule enforcement** and **conflict resolution** should be established, to encourage the acceptance of management regulations proposed by the committee(s). The mechanisms should be primarily based on the **participation** of members of the fishing community (e.g. by discussions at village meetings), but should also be supported by existing **formal** (government) mechanisms and policies (including the 1985 Fisheries Act No. 9). The mechanisms should be low-cost and able to resolve conflicts as soon as they occur.

Problems with 'top-down' management

As described in a previous box, the South Sumatra government manages access to fishing in the River Lempuing by the annual auction of fishing rights in its floodplain water-bodies. Under the auction system, lease-holding fishers take responsibility for controlling who may fish in their water-bodies, and with which gear types. This 'self-policing' effectively prevents poaching within the lease units and allows lease-holders to use highly efficient barrier and seine gear types. Unfortunately, the resulting high levels of fishing have caused the virtual disappearance of several valuable fish species including *arowana*, *gourami* and *belida*, and the giant *udang* prawns.

Government attempts to manage a harvest reserve within this system have proven difficult. The Lempuing's Teluk Rasau water-body was withdrawn from the auction system many years ago by the government Fisheries Service and declared a fully closed reserve, with a permanent on-site guard. Local people were not consulted in the selection of the reserve. The project's sampling programme found that the reserve was fished illegally on 35% of the observed nights. Poachers included both professional fishermen from nearby auction units and farmers living near the reserve shores, who had lost their local source of income. Even the guard fished for subsistence.

With this ineffective reserve management, catch rates from the experimental gill nets in Teluk Rasau were found to be no better than in a nearby, fished water-body, Teluk Toman. In the 1998/99 wet season Teluk Rasau catch rates were also five times lower than those in the West Kalimantan reserves. In the 1999 dry season, Teluk Rasau catches were slightly below those in poison fished Pulau Majang, and 32 times less than those in Sekolat's reserve!

- **Penalties** for people breaking rules should vary in severity, depending on the seriousness of the offence, and the number of offences committed. Rules must be **enforced**, and penalties applied, so stakeholders can see that monitoring is effective and rule-breakers are penalised.
- Where management involves financial costs (e.g. for holding discussion meetings, or publicising regulations), a system should be established for providing **revenue** for self-funding of the co-

management system. Fund raising systems are most often based on revenues from licensing or leasing access to the fishery.

- A **management plan** should be prepared in consultation with the stakeholders and publicised widely. The plan should provide a clear statement on the selected objectives of management; the management tools to be used; the feedback mechanisms for monitoring the performance of the management strategy; and the responsibilities of each of the co-management partners (e.g. for co-ordination, communication, monitoring, analysis, enforcement etc).

2.3 Technical strategy (which management tools should be used?)

Harvest reserves are just one possible option from a wide range of **alternative technical tools** for the management of fisheries. Other management tools include closed seasons (covering *all* areas, not just inside a reserve); permanent bans on damaging gear types; and legal size limits on gear meshes or fish. Access rules (e.g. lease systems, lotteries or gear licensing) may further define *who* may fish in which water-bodies at particular times. Other tools or actions may be used to improve environmental conditions (e.g. by dredging silted channels) or to improve fish stocks (e.g. by stocking depleted fish species). These different rules each have their own advantages and disadvantages, and may be combined in many different ways to achieve good local outcomes. The **best combination** of rules for a given locality depends on its hydrological, physical and social characteristics. The ideal combination is difficult to predict in advance, but may be moved towards gradually over a period of time by adaptive management (see following Section 2.4).

The choice of initial management regulations to be used for a fishery should be based on a simple assessment of its local characteristics. Such assessment should combine the **local knowledge** of the fishing community and the **scientific knowledge** of government offices such as CRIFI and Dinas Perikanan. Assessments should provide enough understanding of the local floodplain river **environment, fish stocks** and **fishing practices** to guide which management tools (e.g. reserves, gear bans, fish stocking etc) may be useful in that locality. When choosing rules, consideration should also be given to the likely difficulties that the local community might have in enforcing them. Harvest reserves, for example, may be easier to implement in some places than fish size limits or annual fish stocking.

Holding discussions based on the following key questions may provide initial ideas on the suitability of alternative technical management tools:

- *Are fish stocks relatively stable or in decline (i.e. becoming smaller, or harder to catch, or extinct)?* Active management is only worthwhile if there is a clear problem to be solved.
- *Which stocks are declining – are they blackfish or whitefish? Where do such fish survive over the dry season? Where do they breed? Where are they badly affected by fishing practices or other activities? How could such negative impacts be reduced?*
- *How could the local blackfish species be protected over the dry season? Are there any permanent local water-bodies that blackfish could survive in, but which are heavily fished instead?* Such water-bodies may be useful as harvest reserves.
- *Can migrant whitefish species access local fishing grounds from the main rivers?* Dredging silted channels, banning barrier traps, or ensuring that sluice gates are open during fish migration seasons may increase the numbers of whitefish entering local fishing grounds.
- *How do the different fishing gears interact or compete with each other? Which gears catch the same fish, either at the same time or in different seasons?* A management tool designed to benefit one gear may have negative impacts on another one. Introducing a dry-season reserve may, for example, increase the catch of most flood season gears used in a village, but reduce the fishing opportunities of the dry season gears. Similarly, a ban on a barrier gear may be good for the community at large, but bad for those people previously using that gear type. Where such impacts may cause significant difficulties for some people, these problems may need to be allowed for in the management plan. Alternative opportunities may need to be created, for example, or some compensation paid.
- *Could a proposed management tool be effectively monitored and enforced, given the resources and skills available?* Local fishery managers should start with the simplest options for managing their fishery, and leave the more ambitious plans for later.

2.4 Adaptive strategy (monitoring and improving the fishery)

The management regulations for the reserve should be based **initially** on the basic technical strategy, arising from the stakeholder discussions and resource assessment described above. Adaptive management may then be used to check that the overall strategy (including its technical and institutional components) is actually achieving the intended benefits. For this approach, initial regulations

should be set **flexibly**, and adjusted over time, as required, depending on the outcomes achieved.

As described in Section 1.6, a **simple form of adaptive management** may be undertaken by keeping an open mind to new management ideas, and modifying rules based on observations and experiences in both the local fishery and in other villages nearby. In the longer term, and where capacity and resources permit, a more formal or analytical adaptive management strategy may be developed, as described in the following guidelines. Only practice will show whether this formal approach (and the extra effort required for data collection and analysis) will result in significantly better knowledge of the system and its management.

Adaptive learning can occur at two main levels. Firstly, the **village level** managers (e.g. the Village Committee) can learn purely from their own experiences, **over time**, by comparing their results this year with those they achieved in previous years. Traditional community-based managers have presumably mainly operated in this way in the past. Such year-to-year comparisons must, however, take into account the natural variability in fish productivity and catches that occur between years. This year's catch may, for example, be good because of a high flood rather than a newly introduced regulation. A **long-term view** should therefore always be taken before conclusions are drawn.

In support of the local *within-village* comparisons, **regional** managers (e.g. the Catchment Committee) may also learn by **comparing outcomes between villages**. If, for example, a village with a reserve including both river and lake habitats is getting much better results than another village with a reserve including only lake habitats, then the differences between the reserves *may* be partly responsible. Some uncertainty will still exist though, as the different results may also partly be due to differences between the habitats in the two villages (the two lakes may be very different depths for example). Regional managers should therefore always make **several comparisons** between different villages before drawing their conclusions.

The most effective adaptive management may be achieved by **collaboration** between *both* the local and catchment committees. In this partnership, the local community may be best able to understand the **local situation**, and to say *why* they are achieving a certain result in their waters this year (is the reserve being badly poached? are blocked water channels reducing productivity?). At a wider level, the regional partners may be best able to make comparisons between the different strategies being used in different villages. They may also be most able to understand the effects of **external impacts** on the catchment's resources (e.g. due to pollution from upstream areas, deforestation of uplands, or agricultural or urban development in nearby

parts of the catchment). Local people may simply not know about such impacts, and may identify them incorrectly as the effects of their own management activities.

A formal, analytical adaptive management strategy for floodplain river fisheries may therefore be undertaken as follows:

- Firstly, as noted before, key stakeholders in each local management sub-unit should *jointly* select the management **objectives** for the fishery (e.g. to prevent further declines in the catches of gabus, or to increase average daily incomes to Rp15,000 per fisherman). Adaptive management should have a clear target to work towards, and this target should be clearly *quantified* and stated in the Management Plan.

- The success of management must be measured in some way. A simple, cost-effective **monitoring system** should be set up to provide indicators of the current outcomes from the fishery (see below). The monitoring system provides the essential feed-back mechanism by which *adaptive* management approaches may learn about and improve the benefits from the fishery.

- The local fishing community members should be encouraged to **participate** in the monitoring system. When fishers are involved, they will be more likely to believe the data collected, and will be able to see directly, for themselves, the impacts of the management strategy. The fishing community may also supplement the limited capacity of the government management agencies for this role. Government agents should note, however, that communities will only participate effectively in this role if they are also actively involved in selecting the objectives for the fishery and the types of monitoring system to use.

- The **complexity** of the monitoring system should vary according to the situation. In some villages, adaptive management may be based on '**common knowledge**' simply collected at discussion meetings. In other situations, particularly where new approaches are being tested out or where between-village comparisons are being made, simple routine **surveys** may be used to collect basic **data** for comparisons. Managers, however, should *not* aim to collect data that are difficult or expensive to collect, or too complicated for village members to understand or make good use of.

- Both the **outputs** from the fishery and the **inputs** should be monitored. Outputs should be measured to determine the **success** (or **failure**) of management. Inputs should be measured to **explain** the outcomes that result.

- Which outputs should be monitored should be established by participatory methods, and should reflect the development goals of the local community. People are more likely to be motivated by the

achievement of their own livelihood goals than by those of an outsider. Outputs of interest to the community may include the sizes or total weights of fish caught, the overall **income** or **food** produced by the fishery, the **distribution** of income between different stakeholders and the **variability** of income over the fishing season.

- The inputs to be monitored should include the management **tools** in use (e.g. the area set aside as a reserve, the seasons closed etc); the amount of **fishing** (both legal fishing and illegal poaching); the existence of **environmental problems** (e.g. pollution, or fish kills due to very dry weather); and the effectiveness of the **management** institution (are rules being enforced or ignored?).

- The success of the management strategy should be **assessed** frequently, based on the level of the outputs, as determined by the monitoring system. Local fishery stakeholders should meet at least once a year to discuss the results obtained and decide on future actions. Where the desired outputs (the selected management objectives) are not being achieved with the current management tools, managers should attempt to determine why, and make appropriate **adjustments**. Clearly, the real cause of a particular outcome will often not be known. There may also be several factors that *jointly* determine the outcome. Alternative potential explanations should therefore be **tested** by the adaptive approach until success is achieved. Adjustments may be made to the *level* of regulations (e.g. the length of a closed season, or the number or size of reserves), or to the *combination* of tools in use (e.g. a new fish size limit may be introduced to complement an existing reserve). Adaptive modifications may also be made to the institutional strategy (e.g. a sub-committee may be introduced to improve the effectiveness of management for a particularly troublesome area).

Making management rules that work

Arang Arang village in Jambi has 173 households, most of whom mainly fish for a living. The village has been actively involved in managing its local fishery for many years, using a mixture of access controls and gear restrictions. Half of the village's main lake, Danau Arang Arang, is set aside as a 'reserve'. It was initially understood that the reserve was designed to conserve local fish stocks and only fished during a ceremonial village fishing day in those years when stocks were healthy. More probing investigations revealed that the 'reserve' regulations were neither very restrictive nor very well enforced. The ceremonial fishing 'day', for instance, could actually go on for three months until very few fish were left. Catch rates in the experimental gill nets at Arang Arang were similar to those taken at the poison-fished Pulau Majang in West Kalimantan, and far below those from the other well-managed reserves in Meliau and Sekolat. An adaptive approach at Arang Arang would question both the design and the enforcement of the current management rules.

- The adaptive management approach should initially be introduced in one or a few local fishery sub-units, to gain **experience** with participatory processes and co-management. Depending on the successful achievement of results, co-management should then be introduced into more fishery units around the catchment. Increasing the number of local fishery units co-managed by the Catchment Committee

should provide two benefits. Firstly, it should increase the opportunities for adaptive learning by comparisons between the different sites. Secondly, with successful management, it should improve the overall state of fish resources within the whole catchment, and lead to increased livelihood opportunities over the widest possible area.

3 Specific Management Guidelines for Harvest Reserves

3.1 Which water-bodies should be selected as reserves?

Reserve water-bodies should be carefully selected on the basis of a wide range of both *technical* and *social* criteria.

Reserves should not simply be selected by ‘experts’ brought in from outside. *Both* local people and external advisors may make valuable contributions. Reserves should also not be imposed on villages ‘top-down’ against the wishes of local people. The introduction of a reserve (or other management tool or strategy) may have very significant consequences for a nearby village, perhaps changing traditional access rights or fishing patterns. In places where such consequences are negative for many people, the reserve may prove very difficult to manage and so provide few of its intended benefits.

Depending on their location and on the seasons which are closed, harvest reserves may benefit fish stocks in a number of different ways, such as:

- ensuring that some blackfish species **survive the dry season** to spawn next year’s stock (blackfish are especially vulnerable to capture in the dry season);
- reducing disturbance of broodfish during **spawning** seasons (usually the early flood);
- restricting the capture of **juvenile** fish during the rising and high water seasons; and
- restricting the excessive capture of **migrating** fish during rising and falling water seasons.

These benefits to *fish stocks* will only be translated into **benefits to fishers** if, either (1) the reserve is located in a water-body from which fish can emigrate to fished areas, or (2) some fishing is allowed inside the reserve (e.g. in limited seasons, or with non-threatening gears).

The selection criteria for a harvest reserve thus depend on which of the above objectives the reserve is intended to achieve, and on how the benefits to fishers will be achieved. Clearly, reserves must be placed in a location that protects fish at one or more of their key life stages (e.g. spawning or migrating). Reserves intended to protect *all* vulnerable life stages would need to include a range of different habitats (pools, river channels, swamps etc) and may be so large that they were against the interests of local fishers. The following criteria indicate **which** water-bodies may make useful harvest reserves, and how they may be selected.

- Most importantly, local people should take the lead in the selection of reserves, using their **local experience** to identify the most suitable water-bodies. Villagers are more likely to know the hydrology of their local

area, and to support reserves if they consider that the best water-body has been selected. Real participation involves much more than just saying ‘yes’ to an outside expert’s choice.

Links between reserves and fished areas

For harvest reserves to increase fish *catches*, they must be connected in some way to accessible fishing grounds. In Dano Lamo for example, the new reserve was established in a section of river running through the village, and adjacent ‘economic zones’ were identified both upstream and downstream of this ‘core zone’. In West Kalimantan, open channels linked the floodplain lake reserves with other fishing grounds in each village, and some limited fishing was also allowed inside each reserve.

In contrast, several factors prevented the efficient operation of the fully-closed reserves, established by government in South Sumatra. Teluk Gelam reserve, for example, was found to be located in a remote area with only temporary channels linking it to the fishing grounds. Teluk Rasau reserve was close to the fishing grounds, but the connecting channel was blocked with silt and overgrown with weed. Another ‘reserve’, Lebung Karang was originally created as an irrigation reservoir and was still disconnected from surrounding floodplains by closed sluice gates. Such water-bodies may make attractive recreation sites but do not function well as *harvest* reserves.

- **Several small reserves** should be selected, scattered around a river catchment, rather than one large one. In river systems, several small harvest reserves may give more benefits to fishers, due to the limited dispersal patterns of blackfish. To spread out the management costs between the beneficiaries, one or more reserves may be established in each village where suitable social structures and reserve habitats exist.
- Reserves should be selected in several **different habitat types** to protect different fish species and their various life stages. Some reserves may, for example, be selected in river sections (especially including the deep scour pits or *lubuks*), and others in floodplain lakes. In larger lakes, important habitats may often be found where streams and rivers flow into and out of the lake. The largest reserves may include such habitats in both rivers and lakes.
- The best **size** for a harvest reserve will vary between locations due to the movement patterns of the local fish and the distribution and type of water-bodies. Where a village has many small water-bodies, connected by channels, one, two or more of the deepest water-bodies may be used as reserves. Where a village has only one large lake, a part of the lake may be set aside, perhaps in a bay near the village with habitats used by spawning and juvenile

fish. In any case, the reserve(s) should be large enough to protect fish from disturbance, while still allowing fishing to continue in the village, either in the non-closed seasons, or in areas outside the reserve.

- Local '**blackfish**' reserves should be selected in **deep, permanently flooded water-bodies** in floodplain areas. Such water-bodies are more likely to protect blackfish over the full dry season, while other shallower pools dry up and cause fish kills.
- For the more migratory '**whitefish**' species, reserves should be selected in their known **spawning grounds**, in upstream stretches of rivers. Additional restrictions on barrier traps may be needed to ensure that the whitefish can reach the protected spawning grounds.
- For both blackfish and whitefish reserves, only those water-bodies should be selected that have good **connections** to surrounding fished areas (e.g. through water channels or across flooded land). These connections ensure that the extra fish produced in the reserve may be caught. Where practical, such connecting channels should be included in the area defined as the reserve.
- Where possible, reserves should be located well away from potential **sources of pollution**. These may include industrial or agricultural areas where toxic chemicals or pesticides are in use, or transportation routes that may be polluted by fuel or oil.
- In water-bodies disconnected from the floodplain river system, such as **dams** or isolated **ox-bow lakes**, permanent closure of the whole water-body may mean that the extra fish produced are not available in any fishable waters. Only partial closures should be made in such water-bodies, either as one or more small partial reserves, or as a closed season. In large lakes, reserves may be introduced in the local waters of different fishing villages around the lake.
- Reserve water-bodies should be selected to leave enough alternative **fishing grounds** in the village to maintain fishing opportunities. A village's *only* water-body should not be set aside as a fully closed reserve, as it is likely to be badly poached.
- Where possible, a new reserve should be close to the village(s) involved in its management. Such closeness maximises the **visibility** of fishing activities and minimises opportunities for illegal fishing.

3.2 How should harvest reserves be managed?

Once a reserve waterbody has been selected, additional consideration must be given to exactly how it will be managed. As noted in Section 1.2, it may not always be most effective to permanently close the reserve.

- In blackfish reserves, the use of particularly **dangerous dry-season gears** should be restricted to ensure the survival of part of the spawning stock over the dry season (most floodplain fish spawn at the start of the flood). The most dangerous fishing gears include poison and electric fishing, which are already nationally prohibited by the Indonesian Government. De-watering and fish drives may also be dangerous in those places where they can be used (some water-bodies may be naturally protected from these gears due to their deep water or underwater snags).
- Either **permanent or seasonal closures** may be used to ensure protection of critical life cycle phases. Closed seasons may be set to prevent the capture of juvenile fish in the high water season, brood-fish during the early flood spawning season, or migrating fish during the rising/falling water seasons. The actual period for a closed season may need to change between years depending on the dates of flooding.
- The location of the reserve should be made as **clear** as possible, by defining **boundaries** at recognisable local features, such as bridges, well-known buildings (mosques, schools etc) and river confluences. Marker posts may also be used if these can be made clearly visible. Grid references, which are invisible on the ground, should be avoided, unless marker posts are also used. New reserves may also be usefully located in areas traditionally protected by religious or cultural sanctions.
- In reserves where the movement of fish into fished areas is via channels in the floodplain, such connections may need to be maintained by the **removal of silt or vegetation**. Similarly, when reserves are silting up and drying out in the dry season, they may be excavated to maintain a sufficient depth of water. Artificial reserves may even be excavated to enable more fish to survive the dry season.
- To increase the acceptability of a new reserve, additional measures may be used to **enhance its perceived benefit** to the village. Such measures may include the stocking of a depleted fish species into the reserve, the rehabilitation of nursery or spawning habitats (e.g. re-planting reed beds), or allowing the communal use of reserve waters for recreation or other non-destructive activities.

Establishing Dano Lamo's new reserve

When the Danau Mahligai reserve in Jambi's Dano Lamo village was first declared in 1997, it was stocked with 30,000 fingerlings, paid for by the Provincial Planning Service (BAPPEDA). Such stocking may not always be biologically necessary (stocking some fish species may even have negative impacts on natural fish stocks). However, such ceremonies usually increase the value of a new reserve as *perceived* by local people.

- Due to the uncertainty in the best size and numbers of reserves, and in the seasonality of closures, and the

use of other management tools, **adaptive management** practices should be used to determine the optimal combination of regulations for each locality. As described in Section 2.4, such adaptive

management may be either simple or analytical, depending on the level of data collection and analysis involved.

4 Summary of Key Steps for Co-Management of River Fisheries

The following summary provides step-by-step guidelines for the implementation of co-management institutions in river fisheries. The guidelines are divided into four discrete stages to emphasise that the process of implementation can be undertaken gradually, learning lessons and building skills and capacity along the way. It is more important to make a start on the co-management pathway, than to achieve the most comprehensive arrangement straight away.

Section 4.1 provides guidance on how to select locations that have good prospects for co-management. Section 4.2 then indicates the skills that will be required for co-management, both for village members and government staff. Section 4.3 illustrates the types of management activities that may be undertaken in selected village co-management units to develop effective management systems. The final Section 4.4 illustrates how regional stakeholders (catchment managers) may assist the local managers by providing advice and coordination to the local units.

To minimise the initial implementation requirements, it is recommended that only a small number of village co-management units should be selected in the first place (perhaps only two or three). More can be selected later. Some villages with good local capacity may go straight on to develop management systems as described in Section 4.3 or to modify their existing systems. Other villages will require much greater training and capacity building as described in Section 4.2. The final regional coordination activities in Section 4.4 are likely to be the most challenging to achieve, since they involve the greatest numbers of people and the most complex issues. These should be left until good skills have been developed at the village level.

4.1 Choosing village co-management units

A Village Co-Management Unit should include (1) a clearly defined part of the floodplain river system and (2) a group of local community members and other stakeholders who are able and willing to participate in its management. The selection of good village units is absolutely critical to the successful outcome of their subsequent management activities.

The process of selecting suitable village units should be initiated by catchment-level stakeholders (e.g. Dinas Perikanan, BAPPEDA and development NGOs), and proceed to involve villages in their own **self-selection**. The selection process may be carried out using the

following steps:

- Identify those parts of the river system where improved fishery management may provide the greatest benefits. Such areas are likely to include significant fishery resources (e.g. in lakes, channels, floodplains etc), that are thought to have declined, due to too much fishing or bad fishing practices.
- With reference to maps and/or by talking to villagers, identify villages that have their own fishing grounds wholly within their administrative boundaries. Management will be easier where agreements only need to be reached between members of the same village (large water-bodies exploited by two or more villages should be left until later).
- Hold discussions with the members of villages identified above to determine which of the villages have the following features (these features may make them particularly able and/or willing to manage their resources).

*Do villagers believe that there are **internal problems** in the fishery that may be solved by improved local management? Villagers are only likely to invest their time and energy in management if they believe that their contribution will give them a significant benefit. External problems affecting the fishery, such as pollution from an upstream factory, may be difficult for the village to solve on its own.*

*Does the village already actively **manage** its fishery resources? If so, how? Where management is perceived as already successful, there may be no need for large changes or new co-management systems. Such villages may however be helped by the legal recognition of government (e.g. to help them enforce their own rules), or may provide useful lessons for other villages.*

*Is the village highly **dependent** on the fishery for livelihoods (income, employment)? How many of the village members are employed by the fishery, either directly, or as traders, processors etc? Those villages that are highly dependent on a fishery stand to gain more from improved management and hence have a greater incentive to participate.*

*Does the village have a strong **leadership** and respect for authority? Does it have existing management organisations or skilful leaders who could take on the roles required for co-management?*

*Is the village large or **small** (how many households are there)? Smaller villages may be able to manage their resources more easily, as there are fewer people to argue about management options.*

*Do village members all share the same **cultures** and*

ideals? Villages with existing conflicts between different groups may find it hard to agree on new management measures.

- Where managers particularly wish to develop more harvest reserves, ask villagers if their village area includes any water-bodies that may be suitable for this purpose (see the criteria in Section 3.1). Do not select villages that already have their own harvest reserves unless these do not appear to be working well.
- Find out if there are any development-oriented NGOs working in the locality of the village. Such organisations may be able to help with chairing meetings, building consensus or resolving conflicts in the fishery?
- Ask village members if they would be willing to collaborate in the co-management of their fishery? Explain the types of activities and contributions which may be required, and the training which may be available.

4.2 Building the skills required for co-management

Enabling local institutions to take the initiative in the management of the fisheries in their local waters is not easy, quick or to be achieved without cost in time, effort or resources. However, it is critical that this stage is not ignored or cut short, as such institutions are the essential foundation of an effective co-management structure.

While there are villages with a tradition of managing their own fisheries through a process of consultation and consensus building and which achieve fisheries outcomes that are both sustainable and equitable, these are the exception rather than the norm. Replicating such institutions is not simply a matter of requesting the Kepala Desa to hold a meeting at which a series of institutional rules and regulations are announced – **there is no predefined package that can be disseminated.**

Though there are similarities to the process of forming a group to receive or adapt a technical extension message, group formation in a fisheries context is much more demanding. This is because the resource is shared, so success depends on a very high proportion of local fishers becoming **committed to the process.** The first step is therefore to ensure that they are informed and consulted at all key stages and that all stakeholder groups are fully represented in discussions. Initial commitment, once gained, must be maintained by ensuring that management decision-making remains open and **transparent.**

Within the wider user community, institutional rules must be agreed on: the size and composition of the management committee; the means by which members of

the committee might be appointed or removed; and the procedures through which different types of decision (operational fishing rules, penalties etc.) can be determined. Unless this process is transparent and seen to be fair, the operational rules that result will lack legitimacy among stakeholders, decreasing the chance of rule adherence and of rule breaking being reported.

Setting up a group in this way is complex, time-consuming and demands specialist skills that are likely to be beyond the experience of most Dinas Perikanan staff. Assistance may be sought from other government agencies, such as Dinas Kooperasi or Dinas Perindustrian, who may have experience in developing such management skills. Linkages may also be developed with NGOs, universities or other training institutions with appropriate capacity to provide support.

The actual training required for successful co-management will vary between locations, depending on the existing skills and capacity of the various stakeholders. The ‘curriculum’ of required knowledge and skills will, however, include the following subjects:

Training curriculum for co-management

- What is co-management? Why use it and where?
- Understanding the co-management *process.*
- Legal basis for co-management in Indonesia (implications of 1999 Regional Autonomy Act etc).
- Types of stakeholders and their interests in the fishery. How to identify stakeholders?
- Who to involve in the co-management partnership?
- Identification of stakeholder skills and capacity.
- Roles of local and catchment-level collaborators.
- Setting objectives and building consensus between stakeholders.
- Development of management plans (including technical and institutional components).
- Establishing legitimacy of the plan (including both formal legality and local acceptance).
- Implementation of management plans.
- Enforcement and conflict resolution.
- Communication strategies for different stakeholders.

In addition to these social and institutional development skills, effective management of floodplain river fisheries will also require a range of technical knowledge, e.g. about the following subjects:

Sustainability – its meaning and importance

- Environmental, economic, social and institutional sustainability.

Ecology of floodplain rivers

- Sources of productivity in floodplain rivers.
- Annual variations in flooding and productivity.
- Interactions between sectors (e.g. fishing and agriculture), and the need for integrated and locally appropriate solutions.

Ecology of floodplain river fisheries

- Seasonality – when are fish caught?
- Spatial aspects – where are fish caught?
- Behaviour of blackfish and whitefish.
- Response to fishing of different types of fish, and the effect of overexploitation.

Technical management tools for river fisheries

- Harvest reserves, gear bans, habitat improvements, stocking, licensing, leasing etc.
- Implications of different tools on sustainability and productivity of fish stocks (blackfish and whitefish).
- Implications of different tools on distribution of benefits between different fishing gears and different stakeholders.
- Investigation and analysis of the fishery – choosing technical strategies and rules.

Adaptive management

- What is adaptive management? (learning from experience)
- Why use it? How to use it?
- Monitoring and feedback - simple or analytical?

These guidelines include material on many of the above topics, but they clearly can not provide all of the necessary knowledge. More detailed information is provided in FAO Fisheries Technical Paper 384/1 (see 'Preparation of this document', page i). Other location-specific information and training will also be required.

4.3 Activities in each village co-management unit

Having considered the necessary skills and capacity, the following lists describe the types of management activities that may be undertaken in the village co-management units. Many of these activities will benefit from the involvement of **both** the village members and the catchment-level stakeholders (government officers, NGOs etc).

It is important to note that the activities required may differ significantly between villages and may be more or less detailed than the outline given below, depending on local capacity and the wishes of village members. To encourage effective local participation, **government managers should not force village collaborators to accept any rigid or pre-planned structure**. They should instead encourage all of the stakeholders to work together to create management systems which they all believe will work for their local circumstances. The following guidelines are thus presented as a **menu of possible components**, or starting points for local discussions on how management might proceed.

These 'village' guidelines are divided into five basic steps: (1) the identification of stakeholders, their perceived problems, and their management objectives for

the fishery; (2) the assessment of the local fishery; (3) the design of a management plan; (4) implementation of the plan; and (5) the monitoring of outcomes and adaptation of the plan. Any effective long-term management system may be expected to include at least these basic steps, in one form or another.

Identification of stakeholders, and their problems and objectives

- Hold individual meetings with villagers, local government agencies and NGOs etc to identify all of the 'stakeholders' of the fishery unit. Stakeholders include all those people, groups or organisations that are likely to be *affected* (either negatively or positively) by the management of the fishery, and also those that *could influence* its outcome (again either negatively or positively). Identify the key stakeholders who may become the 'owners' and 'partners' for each unit.

- Hold a group meeting of all of the local and catchment stakeholders, to discuss local fishery resources and identify problems. Note that different community members (e.g. water-body leaseholders, subsistence fishers and traders) may have very different views on the fishery. The poorer or less powerful community members may need support or encouragement to participate effectively in the meeting. Some stakeholders may need educating about concepts of conservation and sustainability.

- At the group meeting, also discuss possible objectives for the management of the local fishery unit (e.g. to increase the numbers of a valuable fish species, or improve the distribution of benefits between village members). Again, note that different people will have different objectives and work towards developing a consensus based on a proper understanding of alternative perspectives.

- Write a clear statement declaring the management objective(s) for the fishery. Be specific and explain any trade-offs made between competing objectives. As far as possible, ensure that the statement represents the interests of all of the stakeholders. Choose compatible objectives, remembering that it may not be possible to achieve all of the desired objectives at the same time. Ensure that the statement allows for the needs of the poor (government regulations promote benefits to incomes and job opportunities for small-scale fishers, and maintenance of fish supply for domestic consumption).

Assessment of the fishery

- Encourage local fishers and other stakeholders to identify the key factors that maintain the local productivity of the fishery. These discussions should provide an understanding of the natural resources available to the village, i.e. the local fish stocks and the water-bodies and swamps etc that they live in. Discuss what management actions could be used to sustain these resources (e.g. harvest reserves for

blackfish).

- To help the discussions, it may be useful to draw maps of the village fishing grounds, showing which water-bodies fish are thought to survive in over the dry season, which channels they use to move between the different fishing areas of the village, and where they are caught. Such maps should be drawn by the village members, and do not need to be highly accurate or detailed.
- Discuss which fish species are thought to survive the dry season in local water-bodies (i.e. blackfish) and which migrate in every year from the main river (i.e. whitefish). If the blackfish species are declining, then local restrictions on the *fishery* may be useful (e.g. reserves, gear bans, less fishers etc). If whitefish species are declining, then it may be more useful to improve their *access* to local waters (e.g. by banning barrier traps or removing other blockages in channels). Reference to the maps may show where such management restrictions may be most usefully applied.
- Hold further discussions on which fishing gears may be most responsible for causing any declines in the local fishery. The effects of different gears will depend on where and when they are used – dry season fishing gears will be most damaging for blackfish, while barrier gears may be worst for whitefish. Consider what management tools could be used to reduce the negative effects of these gears (e.g. total bans of certain gear types, or general limits on fishing during migration seasons).
- Consider also the possible effects of other environmental factors on the fishery (e.g. the drainage of swamps for agriculture, declines in water levels or blockages in connecting channels). Some of these negative impacts may be difficult to resolve at local level (e.g. pollution from upstream), while others may be more controllable (e.g. by dredging silted channels). For some villages, scientific information may also be available on these issues, e.g. from Dinas Perikanan or BAPPEDA.
- Discuss which fishing gears compete with each other - such gears catch the same fish species, either at the same time or in different seasons. A management tool designed to benefit one gear may have negative impacts on another. Where such impacts may cause significant difficulties for the owners of the gears, these problems may need to be allowed for in the management plan.

Design of the management plan

- Hold meeting(s) with both local and catchment-level stakeholders to discuss the results of the fishery assessments, and design an appropriate management plan to achieve the selected local objectives.
- The management plan should include an integrated 'technical strategy' (a combination of different

management tools), to achieve (1) conservation of fish, and (2) the fair distribution of social benefits from the fishery. The conservation of fish may be achieved by the use of harvest reserves or other tools as described in Section 2.3 and Chapter 3. The distribution of social benefits will be affected by the use of different access control measures (auctions, lotteries, free fishing areas etc).

- The plan should also include a complementary 'institutional strategy', indicating *who will be responsible for each part of the management plan and how it will be implemented*. Who will set rules? Who will monitor the fishery and ensure that rules are enforced? Who will resolve conflicts between village members or with outsiders? How will revenue be raised to pay for any costs of management? When will future assessments be done and by whom?
- Create a 'village co-management committee' or other simple structure responsible for implementing the plan. Discuss the membership of the committee, representation of different stakeholder groups and the roles and relationships of the different members.
- Ensure that the plan has the greatest possible local benefits, and the minimum possible negative impacts (ensuring its support by local people, and reducing the requirements for strong enforcement). Discuss giving compensation or alternative opportunities to any badly affected fishers.
- Ensure that the plan is compatible with the capacity of the managing partners. People, technical skills, money and motivation may all be required in varying amounts. If either the selected objectives or the management plan now seem too difficult to achieve, discuss how they can be simplified.
- Write up the management plan as an official village document. The management plan document may include the following sections:

the area to be managed;
the stakeholders of the local fishery;
the requested rights of the stakeholders (to be confirmed by local legislation);
the assessment of the fishery, and the problems being addressed by the plan;
the management objectives selected by the stakeholders;
the roles of the managing stakeholders and their capacities for these roles;
the initial technical management tools to be used;
the mechanisms for the monitoring and enforcement of these tools;
and the process for the future modification of the management rules, as required.

Implementation of the management plan

- Establish the **legal basis** for the management plan. Submit the plan to the *Bupati* or to *Pemda Tk II* for its approval either as a Decision Letter or as a *perda* regulation.

- When the plan is approved, publicise its key points to all of the stakeholders, e.g. at village meetings or by distributing a summary leaflet. State any new rules clearly and precisely: where do the new rules apply?; what are they intended to achieve?; when will they start?; what are the penalties for offenders?.
- Where necessary, develop people's awareness of the conservation principles underlying the management plan. Effective education may be achieved by publishing simple folklore stories for use in schools, or posters for display in public places. Conservation NGOs may be able to help with the development of suitable materials.
- **Enforce the rules, and penalise offenders as required.** Use graduated penalties, e.g. a formal warning for a first offence, a moderate fine for a second offence and a large fine or a ban for any further offences.
- **Resolve conflicts** between fishers within the unit, and with outsiders. The catchment stakeholders may also support this process (see Section 4.4).

Monitoring of the fishery and adaptation of the management plan

- **Monitor** the inputs to the fishery (the new rules and other influencing factors) and the resulting outputs, and learn from the results observed over time. Monitoring may either be based on simple or detailed surveys, or even just on discussions of fishers' latest catches and observations on the fishery at annual meetings.
- **Monitor the outputs** of the fishery to show whether or not the selected management objectives are being achieved. Which outputs should be monitored will depend on which objectives were selected for the fishery. They may include the revenue raised by licensing the fishery, the catch rate per standard unit of gear fished (which should be proportional to the abundance of fish in the water), the average incomes or profits of the fishers, or the distribution of benefits between village members.
- **Monitor the amount and type of fishing** (numbers of fishers, use of different fishing gears, introduction of new gears) and the levels of illegal fishing etc. This should show whether or not the selected management tools are limiting fishing as intended in the plan.
- **Monitor environmental conditions** to determine their likely impact on the productivity of the fishery. Important factors may include water levels during the flood or the dry seasons, changes in local land use practices, or pollution from upstream (see also Section 4.4).
- Each year, compare the current outputs from the fishery, with those in previous years, particularly looking for trends in the outputs. Jointly examine the current fishing practices, local environment conditions, and wider catchment influences to determine what may be responsible for current output levels.

Changes in outputs may be due to any one of these factors (a reduction in catch rate may, for example, be due to low water levels and not to a new management rule).

- If the fishery outputs are not meeting the unit objectives due to continued high levels of fishing, or to changes in fishing practices, adjust the technical management strategy as appropriate. Either the level of regulations may be adjusted (e.g. the length of the closed season may be increased), or new management tools may be added.
- If the fishery outputs are not meeting the unit objectives because the rules are not being followed (e.g. the reserve is being fished illegally), adjust the institutional management strategy as appropriate. Particular consideration should be given to *which* stakeholders are ignoring the plan, and *why?*
- If the fishery outputs appear to be declining due to the impacts of other sectors, ask catchment-level managers to lobby for the fishery, or request mitigation (see Section 4.4. below).

4.4 Catchment management and coordination

Though village fishery units can do much to manage their own resources, they are not independent of the wider river system. Whitefish stocks can be depleted by over-fishing in other parts of the river system. Water quality and quantity can also be badly affected by activities outside the village, reducing the productive potential of local blackfish stocks. Regional stakeholders may provide advice, assistance and coordination on these wider issues arising outside the village boundary. These activities should be undertaken within distinct river **catchments** (or sub-divisions of them).

A catchment is defined as the land area from which water drains into a river system. The catchment provides a natural boundary for the river system and its fish stocks, and limits the area from which the fishery may be affected. A village's fish catches may thus be affected by pollution from an upstream source in the same catchment, but not by pollution in an adjacent catchment. Catchments vary enormously in size, however, and whether a committee is formed to discuss fisheries issues over an entire catchment or just some part of it will depend on the scale of both the important problems and the administrative challenge of forming an effective co-ordinating body.

Since a catchment area may not overlap with existing **administrative boundaries**, catchment-level management may need to involve discussions on the shared use of river resources with agencies from adjacent kabupaten or provinces. In these cases, a full 'catchment committee' would clearly need to involve members from

the different administrations. In other places, a provincial or kabupaten boundary may overlap sufficiently with the catchment area for it to be able to manage the catchment resources independently from other administrations. Catchment management should initially begin in these simpler cases to deal with problems that arise at a sub-catchment level, and then proceed to the more complicated ones.

The following points then, discuss the potential **regional** activities that may be undertaken by the catchment-level managers, over and above their assistance to the village units described in the previous sections. The activities fall into three general categories: (1) promoting and coordinating the village units; (2) representing the fishery in its interaction with other sectors; and (3) contributing to the adaptive learning process.

Promotion and coordination of village units

- **Promote the development of more village co-management units to increase the numbers of local units contributing to sustainable management of resources within the catchment.** River fish stocks are likely to be much healthier if they are sustainably managed in the majority of fishing villages, than in just one or two. Select villages according to the criteria in Section 4.1, and provide training as described in Section 4.2.
- **Promote collaboration in the management activities of adjacent units, particularly to enable migration of whitefish stocks.** Discuss the implications of barrier traps and river channel blockages in one village on the migrations of fish into adjacent villages.
- **As requested by the village committees, assist with the resolution of conflicts between units.** Catchment-level collaborators may either play the role of a neutral mediator for discussions between the villages, or that of an arbitrator when the villages request an external decision to be made.

Representation of fishery interests at catchment planning level

- **Investigate the potential impacts of other sectors on the catchment's fisheries, and promote the consideration of fishery requirements in development planning decisions.** Floodplain river fisheries may be negatively affected by a wide range of different forces, including agriculture, irrigation systems, transport networks, forestry, deforestation, water abstraction, urban growth, industry, hydro-electric power and flood control schemes. The catchment committee may provide a much more powerful voice than the members of single villages working on their own, especially if it is able to demonstrate the benefits being produced by an otherwise well-managed fishery.

Contribution to the adaptive learning process

- **Inform village-level managers about the anticipated or estimated impacts on their fisheries of new developments in the catchment.** Such information may assist local managers to interpret their monitoring data. If a new upstream dam destroys the spawning grounds of whitefish for example, villagers should be warned to expect declines in whitefish stocks (and not to attribute such declines solely to the effects of their own management activities).
- **Facilitate committee members from different villages in the collaborative interpretation of their fishery outcomes, enabling them to learn directly from the experiences of others.** This process may be achieved by holding annual discussions attended by the catchment stakeholders and representatives of all the active village units in the catchment. An annual statement may be written on the achievements of the different villages, and distributed to all of the stakeholders to reinforce the learning process and provide new ideas for local use.
- **In addition to monitoring the simple inputs and outputs, monitor the successes and/or failures of the different village units in designing and implementing their management plans.** Such 'process monitoring' may reinforce the village selection guidelines given in Section 2.1 and 2.2 and provide other useful lessons. Skills will be required in social and institutional areas, which may be contributed by NGOs or government departments responsible for rural development.
- **Where appropriate, develop a formal, analytical, empirical system of adaptive management, capable of learning lessons by making comparisons between the village units.** Monitor the management activities undertaken in the village units, and the outcomes that they achieve. Take account of the wide range of external and internal factors that may affect outcomes. A reserve in one village may, for example, be working better than one in another village because it is in a deeper or less polluted water-body, or because its regulations are better enforced. The most useful lessons may be learnt by monitoring how a new management tool changes a village's outputs, compared to another nearby village without the new tool. For these comparisons, both 'before' and 'after' data are required for both the 'with' and the 'without' villages. Such lessons will only be learned when there are sufficient local management units participating over long enough time periods.
- **To improve the comparability of data from different sites, supplement the village's own monitoring data with additional records on both inputs and outputs in a standard format.** Such data may be based on simple surveys of catch rates of different gear types or fish species. The catchment committee should fund the collection of such data rather than the villages. This formal, analytical adaptive management style should be seen as a long-term goal, to be worked towards only gradually.