Guidelines for Designing Data Collection and Sharing Systems for Co-Managed Fisheries:

PART I: PRACTICAL GUIDE

WorldFish
C E N T E R

FAO
FIAT PANIS

MRAG

DFID

MEKONG RIVER COMMISSION
MRC
FOR SUSTAINABLE DEVELOPMENT

FOURTH FISHERIES PROJECT

INTEGRATED LAKE MANAGEMENT

Guidelines for Designing Data Collection and Sharing Systems for Co-Managed Fisheries

PART I: PRACTICAL GUIDE

Halls, Ashley S.[1]
Arthur, Robert I.[2]
Bartley, Devin[3]
Felsing, Malene[4]
Grainger, Richard[5]
Hartmann, Wolf [6]
Lamberts, Dirk[2]
Purvis, John[7]
Sultana, Parvin [8]
Thompson, Paul [8]
Walmsley, Suzannah[2]

―――――――――――――

[1] Aquae Sulis Ltd (ASL), Midway House, Turleigh, Wiltshire, BA15 2LR, United Kingdom
[2] MRAG Ltd, 18 Queen Street, London, W1J 5PN, United Kingdom
[3]FIRI, Food and Agriculture Organisation of the United Nations (FAO), Viale delle Terme di Caracalla, 00100 Rome, Italy
[4]Environment Waikato, Box 4010 Hamilton East, New Zealand.
[5]FIDI, Food and Agriculture Organisation of the United Nations (FAO), Viale delle Terme di Caracalla,
[6] Mekong River Commission Secretariat, P.O. Box 6101,Unit 18 Ban Sithane Neua, Sikhottabong District,
Vientiane 01000, Lao PDR.
[7] Lake Victoria Fisheries Organisation (LVFO), P. O. Box 1625, Jinja, Uganda.
[8] Middlesex University, Queensway, Enfield, EN3 4SA.

Abstract

The increasing shift towards co-management has prompted managers to reflect upon their new roles and reconsider their information requirements. Whilst a vast pool of useful literature already exists that can help guide co-managers design and implement data collection programmes to support their evolving needs, much of it has been written in the context of other sectors or with little emphasis on designing systems specifically for co-managed fisheries.

This Technical Paper forms the first of a two-part set of guidelines that attempt to meet the growing need among co-managers for guidelines to help design and implement appropriate and cost-effective data collection programmes or systems.

This **Part I: A Practical Guide** has been written specifically for co-managers and facilitators working in the field and offers simple and practical advice on helping stakeholders identify their information needs in relation to their management objectives and responsibilities, and developing collaborative ways of collecting and sharing the information in the most effective way.

The accompanying **Part II: Technical Guidelines** provide more technical detail on each of the sections in the Practical Guide, including: examples of the types of data that might be of interest to different stakeholders; data collection methods and sources; the design of sampling programmes, and guidance on data analysis and interpretation. They are expected to appeal to Department of Fisheries and extension staff, research agencies and academic institutions, but they will also provide field practitioners with an additional resource that can be referenced when necessary.

Together, Parts I and II draw together relevant elements of the literature, the output of DFID-funded research, as well as the experiences and expressed needs of co-managers currently designing or preparing to design their own data collection systems. The guidelines are, however, intended to complement, rather than replace, existing relevant manuals and guides already published in this and other FAO publication series.

This **Practical Guide** begins by describing the scope and purpose of the Guide. Section 2 explains, in the context of the co-management process, who needs information, what types of information they need, and why they need it. The main Section 3 describes an eight-stage participatory process for designing and implementing data collection and sharing systems to meet these needs in a participatory manner with relevant stakeholders. Further sources of information and advice are also provided in the Annex. Frequent cross-referencing to relevant sections of Part II is made throughout the document to complement the material provided.

Preparation of this document

These guidelines (Parts 1 and 2) represent the main outputs of two collaborative research projects funded under the Department for International Development's (DFID) Fisheries Management Science Programme (FMSP): Fisheries Data Collection and Sharing Mechanisms for Co-Management (R8285) and Evaluation and Uptake Promotion of Data Collection Guidelines for Co-Management (R8462). Full details of both projects can be found at http://www.fmsp.org.uk/.

The goal of project R8285 was to provide co-managers with guidelines to develop appropriate cost-effective systems or guidelines mechanisms for the collection and sharing of data and information necessary to improve the sustainable management of their resources. The project involved a series of participatory research activities with the following collaborating institutions and projects (and their respective partners) representing a range of stakeholders operating at different levels in the management hierarchy (e.g. local, sub-national, national, and regional): MRAG Ltd, London; the Food and Agriculture Organization of the United Nations (FAO), Rome; WorldFish Center, Malaysia and Bangladesh [Community Based Fisheries Management (CBFM) Project and Fisheries Co-management Research Project (FCMRP)]; Mekong River Commission (MRC) [Mekong River and Reservoir Project]; the DFID-funded Sustainable Fisheries Livelihoods Project (SFLP); the DFID-funded Integrated Lake Management (ILM) Project, Uganda; and the DFID-funded Regional Fisheries Information System (RFIS) Project [including the Tanga Coastal Zone Conservation and Development Project]. All the research partners were actively engaged or interested in designing or improving data collection systems to support co-management either as part of their mandate or under their own projects and programmes in countries including the Lao People's Democratic Republic, Cambodia, Thailand, Viet Nam, Bangladesh, Uganda and the United Republic of Tanzania. Project collaborators prepared "System Requirement Reports" (SRR) using a pre-defined format to report details of existing data collection systems, stakeholder needs, capacity, available resources, and opportunities. A total of 18 reports, downloadable at http://www.fmsp.org.uk/r8285.htm were prepared on the basis of literature reviews, focus group discussion, consultation exercises and workshops involving staff from regional management bodies, departments of fisheries and associated research institutions, local management institutions, and resource users. This process not only helped build capacity but aimed to ensure that the project outputs, including these guidelines, were demand-driven, maximizing the likelihood of their uptake by target institutions. The content of the reports were presented, discussed and synthesized at the project's "Guidelines Development Workshop" held at the MRC headquarters in Phnom Penh, in April 2004, attended by more than 25 representatives of the collaborating institutions and their project/programme partners (see Guidelines Development Workshop Report at http://www.fmsp.org.uk/r8285. htm). The recommendations arising from this workshop, together with a synthesis of the relevant literature and outputs from earlier FMSP research, particularly projects R7042, R7335, R7834 and R8293 formed the basis of the first draft of these guidelines.

The utility of the guidelines was assessed at the Huay Luang Reservoir in Udon Thani Province, Thailand, under the "Management of Rivers and Reservoir Fisheries in the Mekong Basin Component (MRRF)" of the MRC Fisheries Programme in January 2005. Here, a two-stage workshop was implemented with 55 representatives of local resources users, the local management institution (Or Bor Tor) and administrative levels of government. The guidelines proved effective for identifying common data

and information needs among the stakeholder groups and helped them identify and agree upon a data and information collection and sharing strategy that was summarized graphically. This multistakeholder planning exercise also raised awareness among government bodies of the widespread interest of resource users to diversify their livelihoods to include tourism-related income generating activities. These field-testing activities also identified that a simplified version of the accompanying *Part 2: Technical guidelines* was required to provide all stakeholders, but particularly intermediaries working alongside resource users, with the opportunity to fully utilize the relevant and helpful tools contained in them. An earlier version of this *Part 1: Practical guide* was therefore written to address this need.

Project R8462 undertook further evaluations of both parts of the Guidelines involving stakeholder workshops and focus group discussions in Bangladesh under the Fourth Fisheries Project (FFP), and the Community Based Fisheries Management Project (CBFM); and during a second phase of testing in Thailand under the MRC's MRRF Project in the Lower Mekong Basin (see Guidelines Evaluation Reports available at http://www.fmsp.org.uk/r8462). Subsequent revisions and improvements were made to both Parts 1 and 2 of the Guidelines.

Abstract

The increasing shift towards co-management has prompted managers to reflect upon their new roles and reconsider their information requirements. While a vast pool of useful literature already exists that can help guide co-managers design and implement data collection programmes to support their evolving needs, much of it has been written in the context of other sectors or with little emphasis on designing systems specifically for co-managed fisheries.

This Technical Paper is the first of a two-part set of guidelines that attempt to meet the growing need among co-managers for guidelines to help design and implement appropriate and cost-effective data collection programmes or systems.

This *Part 1: Practical guide* has been written specifically for co-managers and facilitators working in the field and offers simple and practical advice on helping stakeholders identify their information needs in relation to their management objectives and responsibilities, and developing collaborative ways of collecting and sharing the information in the most effective way.

The accompanying *Part 2: Technical guidelines* provide more technical detail on each of the sections in the *Practical guide*, including: examples of the types of data that might be of interest to different stakeholders; data collection methods and sources; the design of sampling programmes; and guidance on data analysis and interpretation. They are expected to appeal to Department of Fisheries and extension staff, research agencies and academic institutions, but they will also provide field practitioners with an additional resource that can be referenced when necessary.

Together, Parts 1 and 2 draw together relevant elements of the literature, the output of DFID-funded research, as well as the experiences and expressed needs of co-managers currently designing or preparing to design their own data collection systems. The guidelines are, however, intended to complement, rather than replace, existing related manuals and guides already published in this and other FAO publication series.

This document begins with the scope and purpose of the Guide. Section 2 explains, in the context of the co-management process, who needs information, what types of information they need, and why they need it. The main Section 3 describes an eight-stage participatory process for designing and implementing data collection and sharing systems to meet these needs in a participatory manner with relevant stakeholders. Further sources of information and advice are also provided in the Annex. Frequent cross-referencing to relevant sections of Part 2 is made throughout the document to complement the material provided.

Acknowledgements

Contents

Definitions

Co-management is an approach to management in which the responsibility for management of resources is shared between the resource users and the government.

Co-managers are the people and organizations involved in and responsible for management of fisheries resources in a co-management system. This includes national government departments involved in fisheries and their staff, district or local government offices involved in fisheries, and resource users represented by a co-management body or local management institution (LMI, see below).

Data types
Groups of common data variables (see below).

Data variables are measurements or characteristics that can assume different values (e.g. catches, price, fish length, etc.). They are typically classified according to their scale of measurement e.g. scale vs. categorical, ratio and interval scale, ordinal and nominal scale, etc.

Explanatory variables
Variables selected to explain the response (change) of another (performance) variable through time or space.

Facilitators are people brought in to support the process of identifying information needs and developing data collection and sharing systems, by bringing together the various stakeholders and taking them through the process. They may or may not be fisheries specialists, although some knowledge and experience of the fisheries sector would be useful, to assist the identification of data needs and collection methods.

Hypothesis matrix
A table summarizing a selection of explanatory variables believed (hypothesized) to effect other performance) variables.

Indicator
A variable, pointer or index typically calculated from data variables (see above). Qualitative indicators may be assigned scores or values using subjective judgements.

Information
Information is the product of data that have been acquired, analysed, and interpreted for use.

Local management institution (LMI) is an organization or association that represents the interests of local stakeholders or resource users. They may be people's organizations, community-based organizations, fishers' associations that have no government representatives. They have the remit to manage the fisheries resources in partnership with government agencies.

Stakeholders are groups of people or organizations that have an interest or role in a process, in this case fisheries management.

1. Introduction

1.1 PURPOSE AND SCOPE OF THE GUIDELINES

This *Practical guide* forms the first of a two-part set of guidelines for designing and putting into practice data collection and sharing systems to support the co-management of fishery resources.

Part 1: Practical guide has been written specifically for co-managers and facilitators working in the field and offers simple and practical advice on helping stakeholders identify their information needs in relation to their management objectives and responsibilities, and develop collaborative ways of collecting and sharing the information in the most effective way.

Part 2: Technical guidelines provide more technical detail on each of the sections in the Practical Guide, including:
*   examples of the types of data that might be of interest to different stakeholders;
*   data collection methods and sources; and,
*   the design of sampling programmes and guidance on data analysis and interpretation.

They are expected to appeal to Department of Fisheries and extension staff, research agencies and academic institutions, but they will also provide field practitioners with an additional resource that can be referenced when necessary.

Together, Parts 1 and 2 draw together relevant material from previous guidelines, the outputs of previous DFID-funded research, as well as the experiences and expressed needs of co-managers currently designing or preparing to design their own data collection systems, particularly in South and Southeast Asia. These guidelines are intended to complement, rather than replace, existing relevant manuals and guides already published in this and other FAO publication series.

1.2 STRUCTURE OF THE *PRACTICAL GUIDE*

This *Practical guide* is arranged in three sections plus Annexes:

Section 1	Introduction and scope of the Guidelines
Section 2	The context of the co-management process
Section 3	An eight-stage participatory process for designing and implementing data collection and sharing systems
Annexes	Sources of further information and reference material

2. Information for co-management

Before thinking about what information is needed for co-management, it is worth considering the process of fisheries management and what co-management means in fisheries.

2.1 THE MANAGEMENT PROCESS

Management is a *process* to make fisheries policy and development plans work in real life. Fisheries policy describes the general goals on how resources should be used and managed including co-management arrangements. These goals are implemented through management plans for each fishery, resource or management unit. Management is a cyclical process involving **five main activities** (Figure 1):

1. Formulating (making) and reviewing fisheries policy and development plans.
2. Formulating and coordinating management plans, which includes setting objectives and management rules and regulations for each fishery, resource or management unit.
3. Implementing plans to meet the management objectives.
4. Evaluating the performance of management plans.
5. Evaluating fisheries policy and development plans and satisfying obligations.

FIGURE 1
The five main activities that form the management process
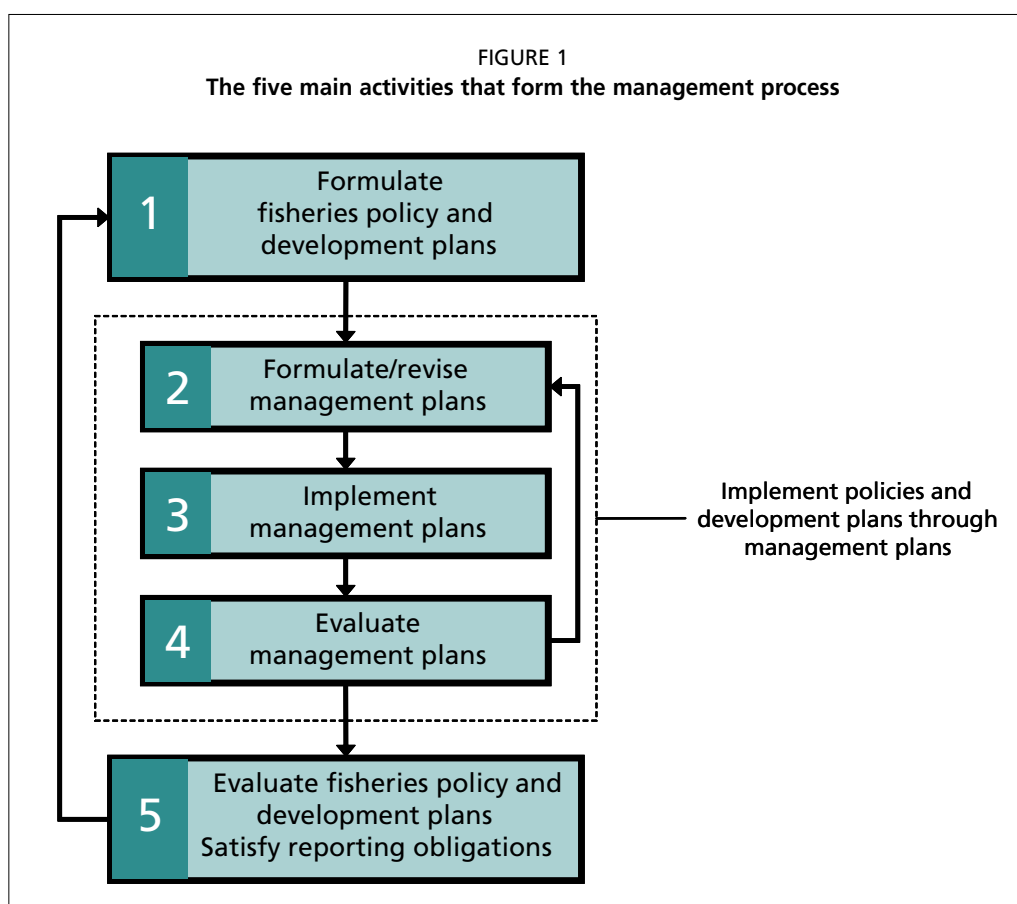
2.2 CO-MANAGEMENT: SHARING RESPONSIBILITY FOR MANAGEMENT ACTIVITIES

Co-management is defined as the sharing of responsibility and/or authority between the government and local resource users to manage a specified resource e.g. fishery, coral reef, waterbody (ICLARM and IFM, 1998). Co-management covers a broad spectrum of management arrangements with differing amounts of responsibility and authority of government and local resource users. It ranges from *consultative co-management* (where government consults user groups but decisions are taken by government), through *cooperative co-management* (where government and user groups cooperate as equal partners in decision-making) to *delegated co-management* (where user groups have management authority and inform government of their decisions) and an appropriate legal framework must support its implementation. Recent developments in the co-management literature argue that only cooperative co-management where genuine empowerment and user participation in setting management objectives on equal terms with government is "true" co-management (Jentoft, 2003). The usefulness of these Guidelines is not restricted to those situations of true collaborative co-management, but recognizes the wide array of possible co-management arrangements, and evolving arrangements, and aim to guide those involved to design appropriate and context-specific systems for information collection and sharing.

Under most co-management arrangements, government departments share responsibility for undertaking the five management activities shown in Figure 1 with local management institutions (LMIs). LMIs represent the interests of local stakeholders. The LMIs may be people's organizations, community-based organizations (CBOs), or fishers' associations that have no government representatives. Who takes responsibility for each of the five management activities will depend upon their resources, skills, rights and motivation. Intermediary organizations such as non-governmental organizations (NGOs) or foundations are often involved in supporting these five management activities. Examples of some of the most common roles for co-managers are described in Table 1; other roles may exist as well such as establishing infrastructure, capacity building and legislative frameworks.

A PRA exercise in Pabna, Northwest Bangladesh

SARDER SHAFIQUL

TABLE 1
Typical roles or responsibilities adopted by co-managers and intermediary organizations in relation to the five key management activities

Management activity	Examples of possible roles/responsibilities		
	LMI	Intermediaries	Government
1. Formulating and reviewing fisheries policy and development plans	• Help ensure the true value of fisheries to livelihoods is known so that fisheries are given fair consideration in multi-sector planning, funding and decision-making activities • Help steer co-management policy and development plans	• Help ensure fisheries are given fair consideration in multi-sector planning, funding and decision-making activities. • Help steer co-management policy and development plans.	• Make fisheries policy, co-management policy and development plans • Ensure fisheries are given fair consideration in multi-sector planning, funding and decision-making activities • Assign financial and human resources to support plans
2. Formulating and coordinating local management plans	• Set objectives and rules and regulations for the local management plan • Share local knowledge and advice	• Help set objectives and rules and regulations for the local management plan • Coordinate local plans • Provide technical advice and information	• Ensure local management objectives and rules and regulations are consistent with national policy and legislation • Coordinate local plans • Provide technical advice and information
3. Implement local management plans	• Enforce rules and regulations including access restrictions and licensing • Monitor implementation of the plan • Watch out for and help solve conflicts	• Encourage people to share local knowledge and experiences • Help monitor implementation of local management plans • Make sure participatory monitoring meets relevant standards • Monitor local management activities • Watch out for and help solve conflicts	• Enforce rules and regulations including access restrictions and licensing • Encourage people to share local knowledge and experiences • Make sure participatory monitoring meets relevant standards • Monitor local management activities • Watch out for and help solve conflicts
4. Evaluating local management plans	• Evaluate the performance of the local management plan to see if it is achieving its objectives • Share information and learn from other LMIs	• Evaluate the performance of local management plans to see if they are achieving their objectives • Encourage information sharing and learning	• Evaluate the performance of local management plans to see if they are achieving their objectives • Encourage information sharing and learning
5. Evaluate national fisheries policy and development plans		• Evaluate the performance of fisheries policy and development plans • Evaluate the performance of co-management policy	• Evaluate the performance of fisheries policy and development plans • Evaluate the performance of co-management policy

2.3 FOUR CATEGORIES OF INFORMATION TO SUPPORT MANAGEMENT ACTIVITIES

Information is required to support the five management activities described in Figure 1. Examples of the types of information that may be required to support each management activity are provided in Table 2. Here information for both formulating and evaluating fisheries policy and development plans (activity 1) and to meet reporting obligations (activity 5) have been combined into a single category (1) because of their similar nature, leaving *four categories of information*. Exactly what data are collected by

TABLE 2
The four categories of information required to support the management process

Information category	Examples of information types
1. Information to help formulate and evaluate national fisheries policy and development plans including information to evaluate the success of a co-management policy. Information to help meet reporting management and reporting obligations.	Gross value of production, fish landings, imports and exports, fish consumption, employment in fisheries sector, number of co-managed fisheries, catch per unit effort (CPUE), distribution of benefits.
2. Information to help formulate and coordinate local management plans.	Fish species, catch weight or value, fishing gears and seasons, socio-economic categories and numbers of fishers, fisheries legislation, management responsibilities. Management strategies and activities described in local management plans to coordinate actions.
3. Information to implement management plans typically for enforcing rules and regulations and resolving conflicts.	Registers of fishing units and licences, lists of licensed fishers.
4. Information to evaluate and improve local management plans.	Performance indicators such as abundance (CPUE) of different species, income, fish consumption, occurrence of conflicts. Explanatory variables including fishing effort, details of management strategies and environmental variables such primary production and flooded area.

whom to meet these information requirements will depend on who takes responsibility for each activity as well as the policy goals, management objectives and capacity of the main stakeholder groups.

2.4 MEETING INFORMATION REQUIREMENTS

A data collection and sharing system is the combination of data sources and collection methods, networks and activities that provides co-managers with the information from each category they need to undertake the management process.

Data are the numbers and variables recorded such as catch, price, fish length etc. from members of a "population" of sampling units (e.g. vessels, households, fishers etc.). **Information** is the product of these data after they have been collected, analysed and interpreted for use.

Co-managers will have overlapping information needs (Figure 2). The greater the overlap the more opportunities will exist to share data and information and the

FIGURE 2
The common data needs of co-managers

DATA NEEDS OF
GOVERNMENT

DATA NEEDS OF LOCAL
MANAGEMENT INSTITUTION

Common
data needs
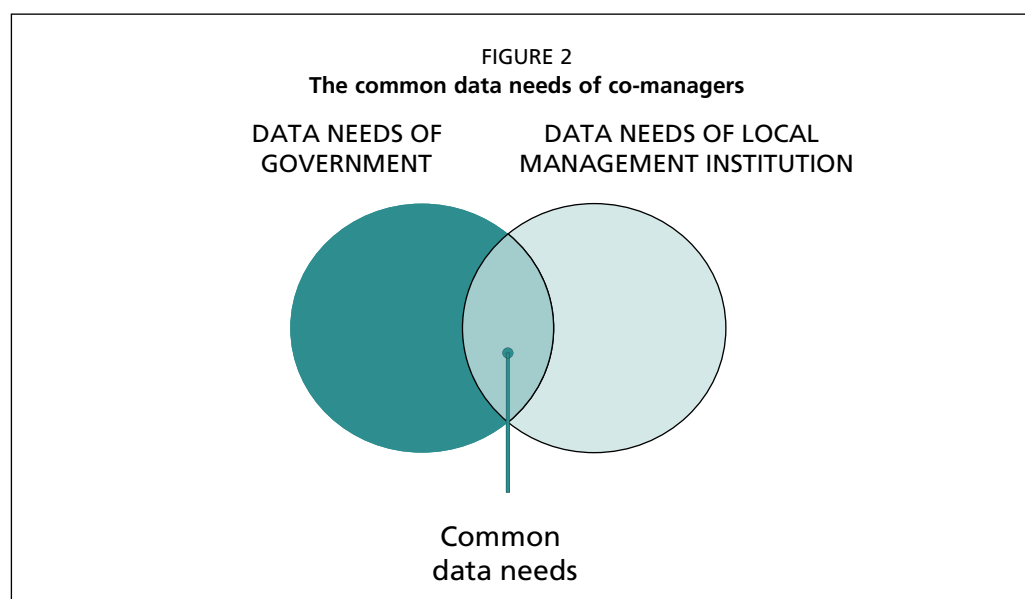
Stakeholders identifying their information needs and opportunities for information sharing in Bangladesh

PARVIN SULTANA

Villagers in the Songkhram River Basin in Northeast Thailand discuss what they know and what they need to know to improve the management of their fisheries

KANOKPORN DEEBUREE

responsibility for collecting it. Key stages in designing an effective and efficient data collection and sharing system are therefore identifying and maximizing this overlap, and reaching agreement on who should collect and share data to generate this information based upon their *capacity* and *motivation*.

Responsibility for collecting the remaining data will also have to be reached. In some cases, the Government and LMI may be happy to collect these data independently of one another (often informally in the case of the LMI) but then later share them with one another. In other cases they may agree to collect data on behalf of one another provided they are sufficiently motivated to do so.

This document provides practical guidance on how to undertake these key and other important stages for designing data collection and sharing systems for co-managed fisheries.

3. A participatory design process

This section describes an eight-stage participatory process, involving the key stakeholders, for designing data collection and sharing systems (Figure 3). Designing participatory data collection systems should be part of the process of formulating or reviewing management plans.

The first step is to identify the main stakeholders involved in management of the resource, and their responsibilities and capacities (Stage 1) which will help define their potential roles in the system. Management plans (Stage 2) are key to successful and focused data collection and sharing systems, because the management objectives and strategies will be defined in the plan. Based on the objectives in the plan, the data that will need to be collected can be identified (Stage 3). Existing data that are already collected by different institutions are then reviewed (Stage 4) and gaps are identified, so that for

FIGURE 1
Administrative and technical linkages in aquaculture, China, 2002
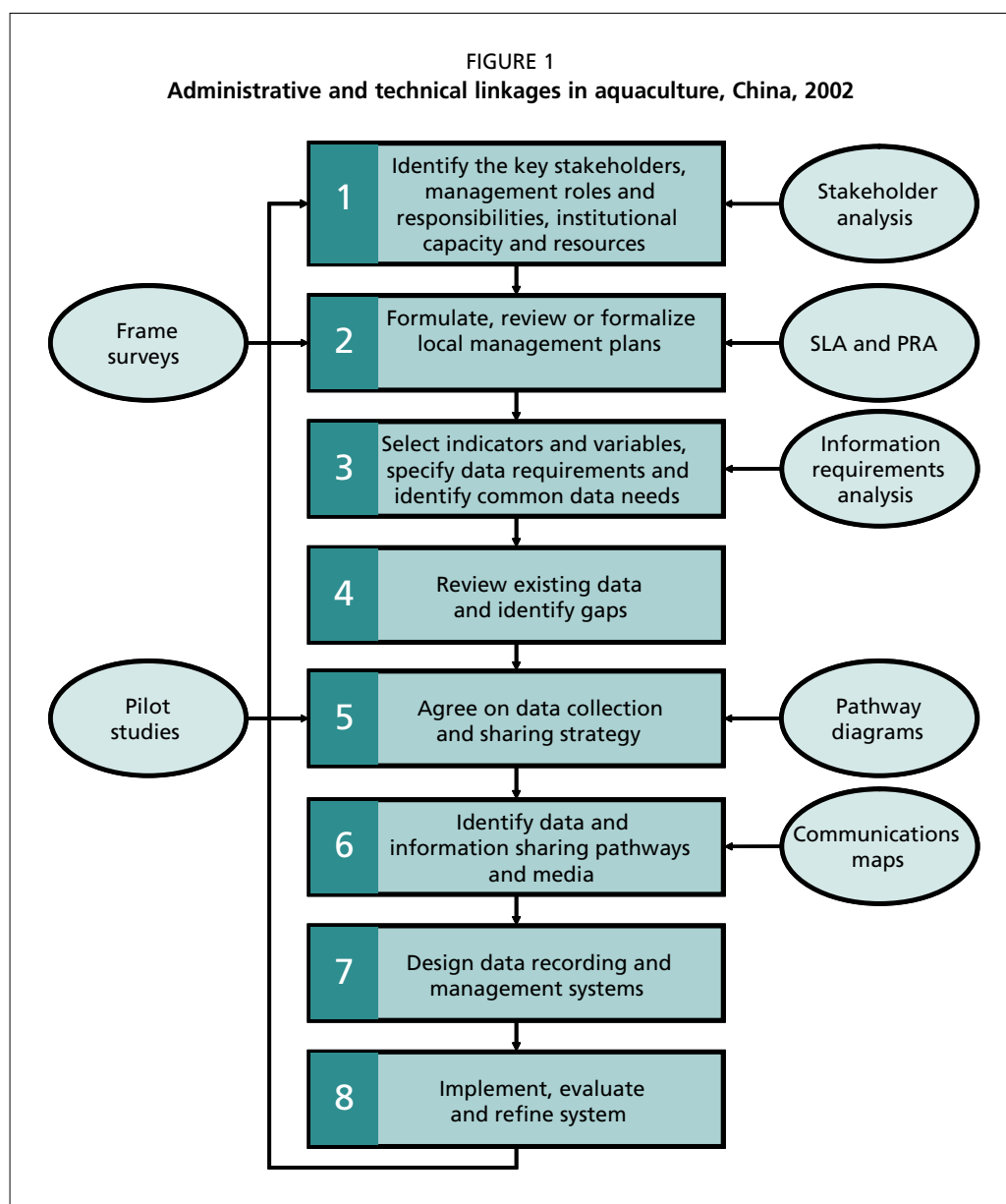
the remaining data that are required by the stakeholders, a strategy can be identified to collect those data (Stage 5). Pathways and methods to share those data between stakeholders are agreed in Stage 6, and ways of recording, storing and managing the data are identified in Stage 7. Finally in Stage 8, the system is implemented, evaluated and refined. A scaled-down pilot system could be implemented at first, involving a reduced number of data variables and stakeholders, so that all involved can get a feel for the system and which ideas will work well or not in practice. The orange ovals in the diagram represent possible tools that can help carry out the stages. These tools are described either in this *Practical guide*, or in *Part 2: Technical guidelines*.

Bringing stakeholders together

During the process of designing data collection systems, the overlapping data needs of different stakeholders will become clear.

In order to consider their data needs and identify areas of overlap, the main stakeholders may have to take part in a series of focus group discussions and planning workshops at different times and with different levels of government administrators, for example, district, regional and national. The location and timing of meetings, the facilities where the meetings are held, and facilitation should be arranged to make sure that all stakeholders are able to participate in the process in ways that are important to them (see Case Study 1).

Facilitators are people who help organize meetings or workshops, bring stakeholders together and help lead the discussions and drive the process forward. Facilitators may be external – either independent facilitators or from an outside organization not otherwise involved in the data collection and sharing system, or they may be from an organization involved in the process, for example, from the lead organization, such as the Fisheries Department, local government office or an NGO or project.

Each of stage in the process is described below, with tools and ideas for how to facilitate each part.

STAGE 1: IDENTIFY THE KEY STAKEHOLDERS, THEIR INTERESTS AND ABILITIES

Stakeholders are groups of people or organizations that have an interest or role in a process, in this case fisheries management. The main reasons for taking time to identify key stakeholders are to:

- Make sure there is participation by the key stakeholders in the management planning process and design of the data collection and sharing systems. If stakeholders understand why information is being collected they are more likely to participate. Participation in the design process will also make sure data collection systems are practical and easy to understand and will increase the sense of ownership of the data.
- Define the interests of different stakeholders in the resource and their capacity to monitor, evaluate and manage. Stakeholder capacity includes resources like money, equipment and facilities and people with knowledge and skills, legal rights and motivation.

Stakeholder analysis is a systematic way of identifying key stakeholders. It is the starting point of most participatory work. It can provide important information about who will be affected (positively and negatively) by management, who needs to be involved, how they should be involved and their capacity to monitor, evaluate and manage and who needs to learn more skills or gain more knowledge so they can participate.

Even if the co-management arrangements are already well established and management plans already made, stakeholder analysis is still a useful starting point for designing data collection systems by means of making issues clearer and updating understanding.

CASE STUDY 1

Bringing stakeholders together to discuss information needs

During testing of the Guidelines in Bangladesh with the Fourth Fisheries Project, we found that this eight-stage participatory process worked at the local level by bringing together the stakeholders involved in a local management plan, including fishers, fishers associations, local government, district fisheries officers, and a representative from the national Department of Fisheries. A separate workshop was held to identify data needs and systems at the national level.

Source: Sultana, P. (2005) Evaluation and Uptake Promotion of Data Collection Guidelines for Co-managed Fisheries (R8462). Draft Evaluation Report with Fourth Fisheries Project, Bangladesh

How to do a stakeholder analysis

To carry out a stakeholder analysis, begin by identifying or defining the resource or management boundary. Brainstorm all of the different people, groups and organizations that may have an interest in the defined area, and list their potential interest or management role in the process. Then, for each stakeholder group, identify what their capacities, skills or assets are that they could bring to the management process and information collection, and finally what the barriers to their involvement are, which may be a lack of financial, technical or human resources, cultural or perceptional barriers, amongst others. This information will be useful in the next Stage: "Formulate, formalize or review and revise local management plans", and will identify where extra resources or training may be required to facilitate participation in the data collection and sharing systems.

You can use a table such as the example in Figure 4 to record the results. Sources of further guidance on how to conduct a stakeholder analysis can be found at http://www.iied.org/forestry/tools/four.html or Annex D of IFAD (2002): http//www.ifad.org/evaluation/guide/index.htm.

STAGE 2: FORMULATE, FORMALIZE OR REVIEW AND REVISE LOCAL MANAGEMENT PLANS

Properly formulated and clearly recorded management plans will greatly aid the identification of suitable indicators and information types for monitoring as well as suitable sources and methods. Before common data needs can be established, each LMI or co-management unit should have a fully documented management plan. The information in the plan will also be needed to help coordinate local management units and minimize conflict among local managers. It may also be a good source of data for explaining the performance of local management activities and co-management policy.

Making or revising management plans involves **Category 2** information (information to help formulate and coordinate management plans). Making management plans is not the focus of these Guidelines, but a brief explanation of the process is provided below. Further information if needed can be found in Hindson *et al.* (2005). A checklist of the types of Category 2 Information that might be included in each local management plan is provided in Section 3.3 in Part 2 of these Guidelines and a summary in Annex 3 of these Guidelines.

Formulating management plans

Generally speaking, making the plan will involve the following steps that can also be used as the structure for recording the plan:

FIGURE 4
Example format to record the results of the stakeholder analysis

Stakeholder Analysis for   Tangaon River Fishery

Stakeholder	Potential Interest / Management Role	Capacity / Skills / Assets	Barriers to involvement
Net fishers	- Earnings, - Combat illegal fishing	- Presence at fishing ground - Already monitor own catches	- Perception that catch information will be used for taxing income - Lack of time to weigh catches for accurate data
LMI	- Sustain production - Involve fishers in management - Implement management plan	- Local knowledge of situation - Responsible for monitoring implementation of plan	- Lack of funds and equipment - Members need training in data collection techniques
Fishers Cooperative	- Increase financial security of fishers - Increase marketing opportunities	- Good links with fishers	- Focus on market opportunities
Local Government	- Poverty reduction - Food security	- Extension workers in District - Collect household data	- Lack of feedback to households of results of surveys has created distrust
Etc.			

- Describe the resource, environment, fishery, fishers and other stakeholders. If this information does not already exist, it will be necessary to carry out background studies before formulating the plan. The results of stakeholder and baseline data collection activities and analyses such as Sustainable Livelihoods Analysis (SLA), Participatory Rural Appraisal (PRA) and frame surveys (see Box 1) are useful information sources. Further guidance on these techniques and surveys is provided in Section 5.2.2 in Part 2 of the Guidelines.
- Select local management objectives that do not conflict with national policy. If these are not clearly stated then it will be impossible to identify suitable indicators to monitor management performance. Co-managers should be clear what they mean by objectives (see Box 2).
- Select management strategies to achieve the objectives that comply with national legislation. The results of the stakeholder analysis can be used to predict the effects management strategies will have on key stakeholders.
- As a group, agree on the roles and responsibilities of each stakeholder to help implement and evaluate the management plan. This should take account of the stakeholder capacities identified during the stakeholder analysis. When identifying roles it is important to describe exactly the area of competence, geographical area,

BOX 1
Frame surveys

Frame surveys are used to collect data on the infrastructure and characteristics of a fishery that can be used to guide the selection of data sources, statistical methods and sampling strata, and to be able to scale samples up to provide estimates for the whole fishery, for example of catch and effort data.

Frame surveys often use information from different sources such as directly from the LMI or resource users using RRA and PRA techniques, by direct observation, through a survey or census, and from other Government Departments or Ministries.

BOX 2
The difference between objectives and management strategies

It is important that the difference between management objectives and management strategies is clear.

- An **objective** in a management plan defines what we are aiming for or where we want to get to (e.g. increase income to fishers through increased production).
- **Strategies** detail how we will achieve that objective, or what we will do in order to get there (e.g. ban destructive fishing, establish sanctuary).

For example, banning destructive fishing practices is not an objective. It is a management strategy or intervention often used to achieve objectives such as improving yield or equity.

and fish resources each stakeholder is responsible for (see examples in Table 1). If policy and legislation allow, or if there are changes in stakeholder capacity, it may be possible to revise the roles, or share responsibility for them, to create or strengthen incentives for stakeholders to participate in monitoring and data sharing. Time and resources will need to be devoted to this critical and challenging activity.
- Agree together on surveillance and enforcement activities including the activities each stakeholder is responsible for.
- Develop a legal and policy framework for management if there is no framework already in place.

Supporting organizations may be able to facilitate the process of making the plan between the administrative levels of government and the LMI. Visualization techniques may help. For example, in Cambodia, SWOT (Strength, Weaknesses, Opportunities and Threats) analysis was used to review and adapt the management plans for the next year.

Recording the Management Plan
Local management plans should be written down and made available to all stakeholders. Agreeing on a common format among LMIs to record local management plans will make it easier to coordinate different management plans and activities and help make sure that the same *explanatory* variables (see later) are available from all LMIs so that among site or fishery comparisons can be made if required (see Section 3.5.4 of Part 2 of the Guidelines).

Maps are a useful way of recording and presenting information in the management plan such as the available resources, how they are used, who owns the resources, and

the problems and limits they face. They can also be used to monitor project activities and help solve problems. Such maps should be displayed in locations where they are easy for all members of the community to see.

STAGE 3: IDENTIFY COMMON DATA NEEDS AND DATA SPECIFICATION
In this Stage, each stakeholder group will identify their *own* information needs, which will later be compiled to identify *common* and *unique* data needs in Stage 5.

Once the stakeholders have a formulated or revised management plan that describes the environment, resources and fisheries, defines local management objectives, strategies and actions to take, and outlines roles and responsibilities for its implementation (i.e. **Category 2 information**), it should now be possible for each key stakeholder group to identify a provisional list of data needs or interests in relation to the remaining information **Categories 1, 3 and 4**. This part of the process is the **critical design stage** (see Box 3).

BOX 3
The critical design stage

Identifying *what* to monitor is the most critical stage in the process of designing and implementing participatory monitoring and evaluation activities and often requires a lengthy process of negotiation and collaborative decision-making among various stakeholders, particularly if the data and information generated are to be shared between stakeholders at different management levels.

Identify Category 1 and 4 information needs
Guided by written policies and management objectives from local and national management plans, government officers and representatives of each LMI should *select a list of indicators* (see Box 4) for:
- Policy and development planning and evaluation (Category 1 Information) which may also include indicators to meet reporting or recording obligations (see Section 3.2 of Part 2 of the Guidelines);
- Local management plan evaluation (Category 4 information) [see Section 3.5 of Part 2 of the Guidelines].

Identifying indicators for each information category can be done by fishers, LMI members, local government officers and national fisheries officers (for example) working in separate groups to identify their information needs, or they can work in mixed groups and identify the information needs for all groups. This may be done through a workshop and may need to cover basic concepts (see Case Study 2).

BOX 4
Indicators and explanatory variables

An indicator is a variable, pointer or index. Indicators are employed to evaluate the performance of management policies and plans implemented to meet various objectives or goals. Numerical (quantitative) indicators are typically calculated from *data variables*. Some data variables are vital to a wide variety of indicators. Other more qualitative indicators may be assigned scores or values using subjective judgements.

Explanatory variables are monitored to *explain* changes in performance indicators.

CASE STUDY 2

Explaining what "data" are to resource users

In Bangladesh, it was necessary to explain to resource users what is meant by "data" and "information" before they were able to identify what data they might need to collect in order to monitor the performance of the management plan. It was explained as follows:

"If you are ill with a fever and you go to the doctor, he will have to carry out lots of tests to find out what might be wrong with you. But if, before you go, you take your temperature regularly and keep a record of it for a day or so, and make a note of any other symptoms you are feeling, when you go to the doctor he will be able to make a diagnosis much more easily and maybe will not have to do a blood test. The information you provided your doctor with is data, and it is the same with fisheries. If we keep track of what is happening and how things are changing, we can understand the situation much better, and know what to do to improve it."

Identify several alternative indicators

To maximize data overlap, the stakeholder groups should be encouraged to *identify several alternative indicators* for each data need. Typical examples of indicators that might be selected are described in Section 3 of Part 2 of the Guidelines. Selected examples are also provided in Annexes 2 to 5 of this Guide to help illustrate the process described below.

If no suitable indicators are given, then the stakeholders will need to develop alternative indicators that meet their needs with the help of facilitators (see Box 5 and Section 5.2.3 of Part 2 of the Guidelines). Stakeholders should then indicate how important each indicator is to them by *ranking or scoring the indicators* according to their overall importance. Scoring can be done using a scale of 1 to 5.

Stakeholders do not need to think of all the information needs at this stage. As plans change and as stakeholders develop their ideas and their understanding of the plan, the data and information needs will change also and can be updated. Indeed, it is desirable to include summaries of this information in the management plan. This means that the data collection system and management plan should evolve and improve together through time as they are revised or reviewed.

These steps can be carried out and recorded using a table similar to the example in Figure 5, which gives examples of indicators ranked by importance for a LMI and

BOX 5
What makes a good indicator?

- Indicators should be "sensitive"; it should be possible to measure changes of a magnitude that you want to be able to detect.
- Indicators should be clearly and consistently defined.
- Indicators should have a scale from "undesirable" states to "desirable" states.
- Policy indicators should be clearly related to policy and give useful information about how policy has had an effect on life in the local community.
- Data for indicators should be easy to collect and help minimize the technical and collection costs.
- Preferred indicators are indicators from existing data collection systems or systems already in use that can be adapted to fulfil the purpose of collecting data.

FIGURE 5
Examples of identified information needs for different stakeholder groups

Stakeholder group: LMI and local resource users

Category	Objective	Information needed ('Indicator')	Importance (1 least important, 5 = most important)
4	Maintain fisheries production	Fish abundance measured as Catch per unit effort (CPUE)	4
4	Increase income	Income (profit)	2

Stakeholder group: Provincial Fisheries Management Institution

Category	Objective	Information needed ('Indicator')	Importance (1 least important, 5 = most important)
1	Reduce poverty in the Province	Poverty	4
	Increase employment in fisheries sector	Employment in fishing	4
	Sustain food security	Protein consumption	2

Stakeholder group: National Department of Fisheries

Category	Objective	Information needed ('Indicator')	Importance (1 least important, 5 = most important)
1	Reduce Poverty	Poverty	4
	Increase employment in fisheries sector	Employment in fishing	4
	Increase contribution of fisheries sector to national economy	Gross Value of Production	4

its local resource users, a Provincial Fisheries Management Institution and a national Department of Fisheries.

Facilitators should be aware that even within a stakeholder group there may be differences of opinion about suitable indicators (e.g. at the community level according to gender, age, occupation, wealth status) and the people involved may need to negotiate an agreement. In a situation like this, a trial or test could be run where several different indicators are monitored for a period of time to help people come to some agreement over which indicator is most suitable.

Identify explanatory indicators or variables

In addition to identifying indicators to monitor their *performance,* the groups should also identify what information they might need to be able to *explain* the performance

of their local management plan, and national policy and development plans. For example, to explain changes in catch, it will be necessary also to monitor fishing effort, details of the management strategy and interventions such as stocking hand habitat enhancement activities. Examples of these *explanatory variables* are provided in Annex 5b. Further guidance on selecting explanatory variables, including those for explaining policy performance can be found in Section 3.5.2 and 3.5.8 of Part 2 of the Guidelines. Facilitators may be able to help with this process using a *hypothesis matrix* that summarizes which variables or factors are most likely to explain differences in management performance and their associated indicators. An example of a hypothesis matrix is presented in Annex 6. Many of the explanatory variables should already be recorded in the management plan, so separate monitoring programmes may not be needed except for variables that change between or within years such as fishing effort, (and poaching) and environmental conditions such as the extent and duration of flooding and water quality parameters. It is likely that fishing effort will already have been selected for monitoring to estimate fish abundance (CPUE) – an important management performance indicator (see above).

Identify the data needed

The next step is for the stakeholders to identify, for each ***quantitative*** (numerical) indicator, what data they would actually need to collect to be able to calculate the indicator (see Box 4). To do this, firstly identify the ***types of data*** required for each indicator. For example, to calculate indicators of fish abundance such as catch per unit effort (CPUE), the ***data types*** required will be catch and effort.

Next, groups should identify several possible ***data variables*** that could be collected for each data type. For example, catch data can be collected in several ways: as the weight of the catch, the number of fish caught, or the number of baskets or boxes of fish.

To maximize the opportunity for sharing data and the responsibility for collecting it, each group should attempt to identify several alternative acceptable data variables for each quantitative indicator. For qualitative (non-numerical) indicators and explanatory variables, stakeholders should discuss and negotiate as many common indicators and explanatory variables as possible. To do this, the previously developed tables can be expanded by adding some extra columns (see Figure 6).

Agree on data specification

Members of each stakeholder group need to ***agree on the specification of each indicator or explanatory variable***. These specifications should describe the frequency, accuracy, and precision of the indicator and explanatory variable and any standards that must be met. This information is required to help design the data collection strategy in Stage 5 including the selection of appropriate, data sources, data collection tools, sampling units and sampling strata; and identification of the required sampling intensity (sample size and sampling frequency) and coverage (sample or complete enumeration).

The required minimum level of accuracy is typically 80-90 percent, but precision requirements will depend largely upon the how the indicators and variables are analysed and used. For example, catch data might need to be monitored with high precision to evaluate adequately the performance of different management strategies or stocking programmes (see Section 5.2.3 of Part 2). Required precision can be conveniently measured in terms of minimum detectable differences (MDD) in the indicator estimates (see Section 5.2.3.4 of Part 2), which may need to be as low as 10 percent depending upon the anticipated impact of the management strategy. For policy and development planning and evaluation purposes however, less precise and less frequent estimates may be acceptable thereby providing opportunities to collect the data using less costly indirect methods and sources such as infrequent national

FIGURE 6
**Example tables to summarize information requirements, alternative data variables
and required data specification. MDD- Minimum detectable difference.**

Stakeholder group: LMI and local resource users

	Objective	Indicator	Impor-tance	Frequency	Required Precision	Data types	Possible data variables
4	Maintain fisheries production	Catch per unit effort by species	4	Monthly	10% MDD	Catch (by species)	- Weight - Number - Number of baskets
						Effort	- Hours fishing - No. of traps set - No. of active full & part time fishers
	Increase income	Income (profit)	2	Monthly	10% MDD	Costs	- Fixed & variable costs
						Earnings	- Fixed & variable earnings

Stakeholder group: Provincial Fisheries Management Institution

	Objective	Indicator	Impor-tance	Frequency	Required Precision	Data types	Possible data variables
1	Reduce poverty in the Province	Poverty	4	Annually	10% MDD	Earnings	- Average fixed and variable earnings
						Living costs	- Basic daily living costs
	Increase employment in fisheries sector	Employ-ment	4	Annually	20%	Employment in fisheries sector	- Number of active fishers by category e.g. full / part time

Stakeholder group: National Department of Fisheries

	Objective	Indicator	Impor-tance	Frequency	Required Precision	Data types	Possible data variables
1	Reduce Poverty	Poverty	4	Annually	20%	Earnings	- Average fixed and variable earnings
						Living costs	- Basic daily living costs
1	Increase employment in fisheries sector	Employ-ment	4	Annually	20%	Employment in fisheries sector	- Number of active fishers by category e.g. full / part time - Number of licensed fishers
1	Increase contribution of fisheries sector to	Gross Value of Production	4	Annually	20%	Production (Catch)	- Landed weight of species
						Price	- Unit price of species

censuses. Further guidance on data specification is available in Sections 3.1.2, 4.5 and 5.2.3.4 of Part 2 of the Guidelines.

Stakeholders should clearly explain the reason for the data specification. This exercise can be educational and may encourage managers to review or reconsider their roles and responsibilities as the purpose of management, data and information becomes clear.

Identify Category 3 information needs

Data and information needed to implement local management plans (Category 3 information) might also be identified now, particularly if government agencies are expected to take full or partial responsibility for these roles and responsibilities. Data and information required to implement the plan will relate mainly to that required for enforcing local rules and regulations e.g. vessel or fisher access or licence registers and associated data. Examples of these types of data are provided in Annex 4 of this document (Also see Section 3.4 in Part 2).

Updating management plans

Whilst information for formulating the management plan may at first come from ad hoc surveys and assessments such as PRAs, frame surveys and SLAs during the development of the first plan, the plan should also aim to include summaries of Category 1, 3, and 4 information. The plan should therefore be updated after this information becomes available.

STAGE 4: REVIEW EXISTING DATA AND IDENTIFY GAPS

Gap analysis

Check whether any other institutions or organizations are already collecting the required data, as other government agencies, universities, research organizations, NGOs and others may already be routinely collecting the same data. Start by asking whether reporting mechanisms at the village, district or national levels already exist for the information you need, such as population, boat ownership and poverty indicators. These data may be generated by a range of methods such as national census or specific research methods.

You may find it helpful to make a table (see example in Figure 7) showing:
- what information is already being collected;
- who collects it;
- how they collect it (including how often and to what accuracy);
- why they collect it; and,

FIGURE 7

Example table to record information already collected by different organizations

Organization	What data is collected	How they collect it	Why they collect it	Where information is kept
Village chief / administration	Number of people in village	Village census, once per year	To provide information to District Government	Village chief & District Government records
LMI	Number of fishers	Registration	Membership purposes	LMI records/registers
University	Fish species and catch data; Plankton biomass data	One-off sampling, not continuous	Research projects	University, academic papers
Dept of Fisheries	Number of licensed fishers;	Licences awarded	To keep track of and control no. of fishers	Head office
Local NGO	Household socio-economic survey on poverty indicators	Household interview, sampling at village level	Socio-economic studies for poverty alleviation projects	NGO office, published in reports

  • where the information is kept.

Also determine whether the information is reliable for the needs of each stakeholder. It may be possible to persuade other agencies to adapt or add to their data collection methods in ways that will support the needs of your stakeholders.

STAGE 5: AGREE DATA COLLECTION AND SHARING STRATEGY
Identify data collection strategy

Co-managers should now be ready to begin designing the collection and sharing strategy to meet their data needs. This will involve identifying possible sources and methods for each data variable, identifying an appropriate sampling strategy and agreeing who will take responsibility for collecting the data and sharing it with whom.

To facilitate this process, ***combine the tables developed above for each stakeholder (Figure 6) into a single table (Figure 8)*** by adding an extra column "stakeholder" on the left. Some column headings e.g. "objective" can be dropped at this point if space is lacking. Additional columns can then be added to the table to summarize:

  • The population of interest, for example, fishers in a village, households in a Province, the entire fisheries sector, etc.
  • A list of potential sources of data (see Section 4.1 of Part 2 of the Guidelines).
  • A list of potential data collection methods for data that are not currently collected (see Section 4.2 of Part 2 of the Guidelines). The identification of potential sources and methods should consider the available local capacity and resources and needed accuracy, but should also:
    o be regarded by local participants as a way to help them answer questions and solve problems;
    o not affect a participant's day-to-day activities and normal responsibilities;
    o provide timely and necessary information for decision-making;
    o produce reliable and believable results;
    o reinforce community solidarity, cooperation and involvement;
    o be gender sensitive.
  • Required survey coverage (samples or everyone in the population). Consideration should be given to the indicator or variable specification (i.e. the required accuracy, precision, frequency), available resources, management roles and responsibilities and potentially acceptable data collection methods and sources identified below.

Identify common data needs

Next, ***identify and highlight common data types or variables*** in the "Acceptable data variables" column of the table. In the example table below (Figure 8) this has been done by highlighting common data variables with circles of the same colour.

Assign responsibility for collecting data

For these common data needs, stakeholders should then discuss and ***agree who will collect that data***, how and from where, and with whom they can share the data. In the table (Figure 8), open circles have been used to indicate who will collect the data, how and from where. The arrows connecting the coloured circles show how the data will be shared. **NB:** For the purposes of illustrating this process, not all of the indicators and data variables identified by the three stakeholder groups in the previous Stage 3 (Figure 6) have been included in the table.

Having agreed a provisional data collection and sharing strategy, estimate the sample size and sampling frequency needed to meet the specified levels of accuracy and precision corresponding to each data variable (see Section 5.2.3.4 in Part 2 of the Guidelines). Another column should be added to the table to record this information. This may require pilot sampling programmes to find out the sample variance and if there is any sampling bias.

If stakeholders are unable to sample the population at the required intensity (sample size and frequency) to meet the common needs of the stakeholders then alternative sources and data collection methods may need to be selected. Sampling strata (Section 4.41 of Part 2 of the Guidelines) may be used to improve the precision of estimates, and may also be required for reporting or administrative purposes. A further column may be added to the table to record any strata selected or required.

If proposing to use data that other institutions are already collecting, it will be necessary to negotiate the use of their data with them and agree how the stakeholders involved will access it. This will be particularly important if the data will be needed either more frequently or in a different format from that usually made available to the public.

Data processing

Stakeholders will need to agree on the form in which the data or information will be shared. How will the collected data be compiled or analysed, and who will do what? For example, will the raw data collected by the LMI be passed on to the PFMI, or will the LMI first summaries it before passing it on? This will depend on the level of detail required by each stakeholder and the capacity of each stakeholder to analyse and compile the data. Stakeholders should refer to the data specification for details of what is required by each group.

Overcoming potential problems

If necessary, in order to come to agreement on the data collection and sharing strategy, *re-negotiate* indicators, identify alternative data variables and sampling units, and adjust sample sizes until as many stakeholder needs are met as possible. You can improve accuracy by selecting alternative data variables, sources and methods. Where stakeholder needs in terms of accuracy and frequency do not coincide, each group will have to carry out their own data collection to satisfy their requirements. A minimum "need-to-know" approach may help make sure that the most important information is collected with enough accuracy and at the lowest possible cost. Once it is set up, the system can be expanded to include more detail on species, value, products and other factors.

If a mutually agreeable strategy cannot be identified, it may be necessary to create further incentives or re-negotiate the respective roles and responsibilities of each stakeholder (see below). When considering alternative strategies, always keep in mind the operational limitations such as the cost of salaries, training, costs for transport, computers, office equipment, and setting up and maintaining information sharing networks and any regular costs that have to paid weekly or monthly. Especially for catch data, the selection of tools and sources may be guided by the use of fish disposition pathway diagrams (see Section 4.6.2 in Part 2 of the Guidelines).

Uncommon (unique) data needs

Once stakeholders have agreed how to collect and share their *common* data needs, they should consider who might collect the remaining data needs. It may be that the government and LMI are happy to collect their own remaining data needs and can select appropriate sources and tools accordingly using the approaches described above. Alternatively, incentives may be offered to stakeholders, particularly the LMI or resource users, in exchange for the task of collecting data. Examples of incentives that governments are likely to be able to offer LMIs in return for collecting and sharing data and guidance on encouraging participation and data sharing are described below.

Incentives for participation and sharing

Some groups may need to be encouraged to share data or information with other groups or organizations, and to participate in data collection programmes, particularly,

CASE STUDY 3

Identifying common data needs and sharing strategy: a hypothetical example

In the example illustrated in Figure 8, stakeholders in the LMIs identified an interest in monitoring both CPUE and income, and identified levels of precision for each indicator. They also identified data variables that would be acceptable or collectable, and possible data collection sources and methods.

The Provisional Fisheries Management Institution (PFMI) and the Department of Fisheries (DoF) identified poverty, employment and GVP as important indicators for policy and development planning and evaluation purposes. They also specified their own needed levels of precision for these indicators, short-listed possible data variables, and identified possible data sources and methods.

During a process of consultation and negotiation, the LMIs agreed to monitor catch weights and numbers of active fishers in each month by direct observation and agreed to share these data with both the PFMI and the DoF who can use these data variables to help determine levels of employment and calculate GVP.

Sample sizes that can be collected by LMIs were found to be suitable for the needs of all stakeholders. If this had not been the case, then it may have been necessary to negotiate larger sample sizes with the LMIs or encourage the LMIs to collect more precise measures of effort such as total fishing hours. In return, the PFMI agreed to share income data with the LMIs. They plan to collect income data on monthly basis using interview methods from households including those belonging to members of the LMI. The DoF offered incentives including helping the LMIs evaluate and adapt their management plans based on comparing fisheries and facilitating information sharing and learning among members of the LMIs (see below). The other data needs were available from other government agencies. These data were needed to estimate the poverty and GVP indicators needed by the PFMI and the DoF, for example, living costs and price data.

if the data appear at first to be irrelevant to them. For example, fishers may not want to collect or record data if it is time-consuming or if they consider their own informal monitoring sufficient for their needs.

One important means to encourage participation is to communicate clearly the benefits of doing so. For example, data generated by monitoring programmes are used to shape policy and development plans that will directly or indirectly influence fishers' livelihoods. It is therefore in the interests of fishers and other dependent resource users to ensure that policy makers have reliable and timely information concerning the value of their fisheries and their socio-economic dependence upon them. Effectively communicating this is therefore fundamental to encouraging participation (see Box 6).

Government agencies can also offer a range of incentives to local managers or resource users in exchange for their participation in local monitoring programmes or to maximize data need overlap, which may also help government agencies formulate and evaluate co-management policy and development plans. These are described in detail in Section 5.2.5.5 in Part 2 of the Guidelines and include:

- **Helping local managers make their management plans**
  – Doing baseline studies, frame surveys and livelihood appraisals to help local managers think of suitable management strategies or alternative livelihoods such as tourism, and designing data collection strategies;
  – Giving technical advice or information, for example, teaching people about best practices for stocking programmes, management strategies, preventing or treating fish diseases, fisheries law (including citizen's rights), credit policies and alternative markets for fish or sources of raw materials.

FIGURE 8

Example of tabular summary of stakeholder information requirements, and agreed data collection and sharing strategy. S – Sample; CE – Complete enumeration.

Stake-holder	Indicator	Indicator Frequency	Prec-ision	Data types	Acceptable data variables	Population	Cover-age	Data sources	Methods/Tools	Sample size	Strata
LMI and local resource users	Catch per unit effort by species	Monthly	10%	Catch (by species)	- Weight - Number - Number of baskets	Fishers belonging to management unit	S	- Harvest - Post harvest	- Questionnaire - Interview - Direct Obs (DoF) - Direct Obs (LMI) - Reporting (LMI)	500/month	Gear type
				Effort	- Hours fishing - No. of traps set			- Harvest			
	Income (profit)	Monthly	10%	Costs & Earnings	-Nos. active full/part time fishers	Villages belonging to management unit	CE	- Harvest	- Questionnaire - Interview - Direct Obs (DoF) - Direct Obs (LMI) - Reporting (LMI)	1/ month	
				Costs & Earnings	- Fixed & variable costs & earnings	HH belonging to management unit	S	- Harvest - Post harvest	- Questionnaire - Interview	100/month	Demographic sub-groups
	Poverty	Annually	10%	Costs & Earnings	- Fixed & variable costs & earnings		S	- Harvest - Post harvest	- Questionnaire - Interview	1000/month	District Demographic sub-groups
				Living costs	- Basic daily living costs	HH in Province		- Harvest - Markets -Gov.Depts	- Questionnaire - Interview	1000/year	District
PFMI	Employ-ment	Annually	20%	Employment in fisheries sector	- No. active fishers by category e.g. full / part time	Fishers in Province	CE	- Harvest - Post harvest -Gov.Depts	- Questionnaire - Interview - Direct Obs (LMI)	NA	Management sector (co- and non-co-managed)
DoF	Gross Value of Production	Annually	20%	Production (Catch)	- Landed weight of species	Fisheries Sector	S	- Harvest -Gov.Depts	- Questionnaire - Interview - Direct Obs (DoF) - Direct Obs (LMI)		
				Price	- Unit price of species		S	- Harvest - Post harvest -Gov.Depts	- Questionnaire - Interview		

BOX 6
Explaining the benefits of collecting and sharing data to resource users

Emphasizing that policy and development planning decisions will ultimately shape their livelihoods may provide local managers or resource users with a strong incentive to participate in local monitoring programmes, thereby ensuring that policy decisions take full account of the value of their fisheries resources. Communicating these benefits will be key during the participatory design process. Local management institutions in Tanga, Tanzania, participate in local monitoring programmes largely for the purposes of lobbying local government and policy-makers (Purvis, 2004)

BOX 7
The importance of feedback

Where data collection is carried out locally but the data are analysed elsewhere, it is important to give regular feedback about the results of the monitoring. Data collectors need to see the results of their hard work to understand how the data they collect contributes to the larger scheme of things. Providing regular feedback helps maintain motivation and ensure the data continue to be collected well.

- **Helping local managers put their management plans into action**
  - Helping local managers enforce local rules and regulations;
  - Suggesting conflict resolution mechanisms;
  - Coordinating local management plans to minimize conflicts and encourage integrated approaches to management.
- **Helping local managers evaluate and improve their management plans**
  - Facilitating communication and learning among the members of LMIs to support adaptive approaches to evaluating management plans (see Section 3.5.4 of Part 2 of the Guidelines);
  - Organizing training programmes to help local managers evaluate for themselves the impact or performance of their management activities.

Other examples of incentives that may be offered either to LMIs or to fishers to encourage them to participate in data collection or monitoring programmes and to maximize data overlap include:
- Making participation in local monitoring programmes a condition of access to the fishery.
- Providing financial support for data collection activities, generated by payments for access to the fishery (e.g. licence fees).
- Providing credit in return for catch records.
- Paying for meals, accommodation and transport cost of data collectors.
- For local stakeholders the strongest incentive to participate may be to see that their actions or ideas have had an effect on policy and high-level government officers. This is one reason why it is important to give regular feedback about the results of the monitoring (see Box 7).

Minimizing barriers to participation
Government agencies should also try to minimize any disincentives (barriers) to participate in data collection and sharing programmes. Some points to consider are listed below:

- The benefits of collecting data must be greater than the cost of participating.
- Local participation will only be sustainable if it contributes to local understanding and empowerment.
- Feedback about findings must be reported regularly.
- The Participatory Monitoring and Evaluation (PM&E) process has to be flexible to deal with diverse and changing information needs.
- Expectations that come from participatory monitoring and evaluation, for example, acting on recommendations made by stakeholders, will need to be met, otherwise resource users will lose interest in the system.
- Trust should be built up between the stakeholders.

STAGE 6: IDENTIFY OR DEVELOP DATA AND INFORMATION SHARING SYSTEM

Once stakeholders have identified their common and unique data needs to evaluate the performance of their policies and local management plans and agreed who will collect these data, how, from where, and share with whom, they will now need to design systems or networks for sharing these common data needs. Depending upon the agreed roles and responsibilities of the stakeholders, these information sharing pathways or networks might also be required to:

- Share information contained within local management plans (Category 2 information) with relevant administrative levels of government to help them coordinate local management plans and resolve conflicts with local managers (see Section 3.3.10 and 5.2.3.5 of Part 2);
- Share (Category 3) information with relevant administrative levels of government if they are expected to take full or partial responsibility for enforcing local rules and regulations described in the management plan (see Stage 3 above, and Sections 3.4.1 and 5.2.3.5 of Part 2);
- Share Category 4 information with relevant administrative levels of government, intermediaries and research institutions if they are expected to help local managers evaluate the performance of their management plans (see Sections 2.3.1 and 3.5.4 of Part 2).
- Facilitate communication and learning among LMIs (or management units) to help local managers evaluate and refine their management strategies and institutional arrangements described in their management plans (see Case Study 4 and Section 3.5.4 of Part 2).
- Feedback the following information to relevant administrative levels of government and LMIs:
  – details of policy and development plans and the results of policy and development plan performance evaluations;
  – information about the actions needed to coordinate and enforce local management plans;
  – technical and socio-economic advice about effective management strategies, interventions and institutional arrangements possibly generated by research including comparisons of management performance indicators and explanatory variables among LMIs or management units (Section 3.5.4 of Part 2).

Remember, many of these information sharing and feedback requirements of the system may be incentives offered in return for participation in data collection (and other co-management) activities (see Stage 5 above). An effective data sharing system may therefore be key to sustaining the data collection system.

There are no ready-made solutions or generally applicable networks for data or information sharing. The design of the information-sharing network will be dependent on the institutional arrangements and administrative structures defining the co-management arrangements, and the roles, responsibilities and capacity of each key stakeholder group.

CASE STUDY 4

Increased learning through information sharing

In the Lao People's Democratic Republic it was found that allowing people to have access to information about other people's experiences was a key role of information networks. Similarly, giving district level staff opportunities to discuss ideas and experiences with each other and with state level staff and external researchers provided more opportunities for learning and information sharing at that level.

FIGURE 9
Illustration of potential information flows
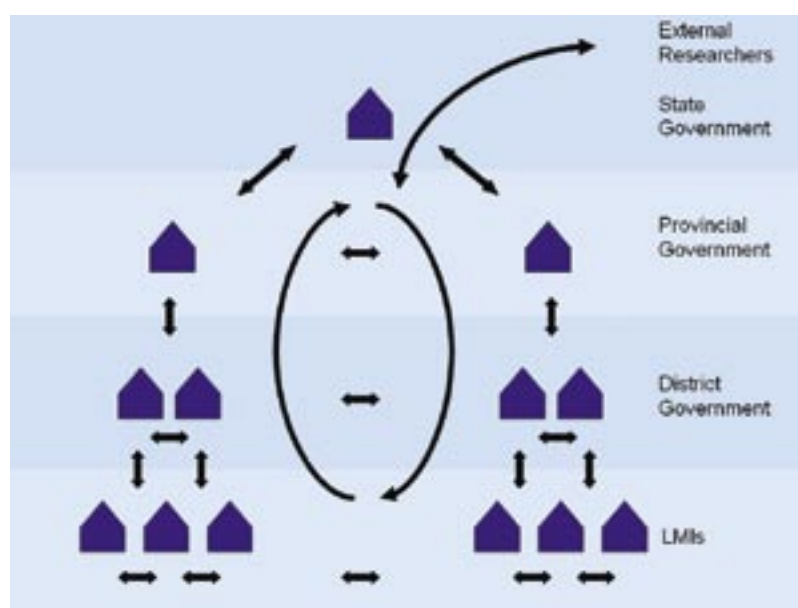
Modified from Garaway & Arthur, 2004

Garaway and Arthur (2004) suggest that stakeholders should start by studying communication networks already in place and the opportunities and limits of those systems. A diagram illustrating potential information flows is shown in Figure 9.

Communications mapping
One way of identifying possible information sharing networks is to draw a communications map showing existing and required information flows among stakeholder groups. Start by writing each stakeholder group on a piece of paper or card and positioning them on a larger sheet of paper. Then draw arrows that link different stakeholders to represent current and required information flows (see Figure 10).

These diagrams can be drawn by stakeholders and used as the basis for discussions to identify their opportunities and constraints, and develop networks for the data collection and sharing system. Trust among stakeholders is the most important thing to be able to develop effective systems.

Develop information sharing systems
To design and agree on a data and information sharing system, stakeholders will need to discuss and agree on the following points:
   • Who will share what data and information (and in what format) with whom;

FIGURE 10
Example of a communications map
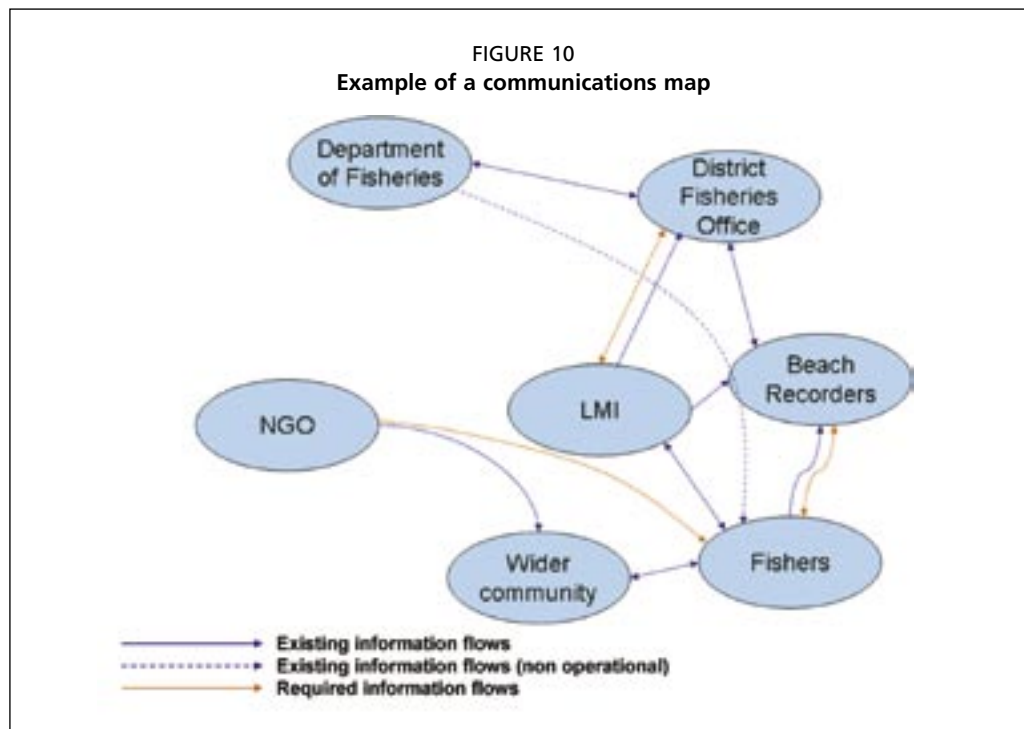
CASE STUDY 5

Finding appropriate data delivery systems in Mozambique

In Mozambique, the postal system was not reliable enough to deliver important data by post. Relationships were built up with certain drivers of local transport minibuses who deliver envelopes from the villages to the provincial government, and vice-versa. Another system that was used was to provide data collectors with a phone card so they could call the provincial fisheries office on a weekly basis to deliver information on fish prices at the market.

- How it will be shared, distributed or delivered to the relevant people and organizations (e.g. on what media – printed matter, on CD, by radio, by post, delivered by bicycle, called through on mobile phone etc.);
- How frequently it will be shared e.g. daily, weekly, monthly, annually. For example, if you are holding meetings, choose a time and frequency when people will be able to come.

It is important that these systems are realistic and sustainable. For example, if information is to be passed on through a phone call, there must be resources available to pay for the cost of the calls; if the postal system is unreliable, other methods will have to be found to deliver data on printed material, diskette or CD (see Case Study 5).

Media for information distribution

A variety of media and methods might be used to deliver, distribute and facilitate information sharing. Each media and method has advantages and disadvantages. Printed material can reach the largest number of people, but does not provide any opportunity for feedback. Radio provides for speedy communication to a wide audience and often encourages feedback, but is not suitable for communicating detailed or complex information. Face-to-face contact can lead to greater understanding and more frank discussion and feedback, but can only be used to reach a relatively small number of

people. A matrix-based approach involving discussions with the key stakeholders may provide a useful way of agreeing on which approach might be most suitable.

Practical considerations when distributing information
- Make sure messages are clear, understandable and relevant to the target audience.
- The interests and concerns of different stakeholders are not the same.
- The format should be simple and easy to understand.
- Each group needs suitable media, language and content. An appropriate format locally will differ from the format needed by the government.
- Make sure information is presented in time for its intended purpose.
- Visually presented information (e.g. graphs, diagrams, maps) is often easier to understand than complex statistics. Photographs or videos may be effective but can be more costly when distributing information about the outcome of evaluations.
- Costs should be low and should never exceed the benefit gained from using the information.

Where relevant, it may be useful to give out prepared sets of data which people can analyse themselves and present findings to each other, instead of just presenting results. Involving the data collectors directly in analysing data, and presenting information back to collectors as soon as possible helps to create a sense of ownership in the data, builds capacity and gives people a stake in the process.

Record the plan
The operational details of the data collection and sharing strategy should be summarized and supported by a workplan or schedule for data collection, with maps or diagrams showing the position of data collection locations (see Section 5.2.6.5 of Part 2). Providing a list of data collectors and a roster may also be needed.

STAGE 7: DESIGN DATA RECORDING AND MANAGEMENT SYSTEMS
Data recording systems
Data can be recorded in many ways, depending on the data collection method. Some methods, particularly interviews and direct observation, may require the interviewer or observer to fill in logbooks, ledgers, forms or tables. Other methods might use a video camera or detailed notes. For each data variable selected, it will be necessary to agree on how it will be recorded. A consistent method will help to make sure that data can be compared.

For data collected routinely, recording forms should include basic information that helps data checking and makes sure that data can be referenced, sorted, collated and manipulated.

Users of data recording systems should be involved in their design to make sure that the forms are easy to understand and suitable for the purpose. It is not possible to develop generic data collection forms, but Halls et al. (2000) identified fields of information that are usually included in recording forms used for frame surveys, catch assessment surveys, biological and socio-economic monitoring programmes, and for vessel monitoring and licensing. These lists of fields may be a useful resource when designing data collection forms.

Data management systems
A data management system is a way of storing and retrieving data and information. Stakeholders will need to agree on data management systems for the data that will be collected. They will need to consider:
- What should be stored (e.g. what data needs to be kept for future reference and what does not)?

In the past, few women at Nam Houm Reservoir in the Lao People's Democratic Republic were asked their concerns about fishing which was deemed an activity for men. Women now contribute valuable information for management planning, implementation and evaluation purposes

- Who should store it (and at what level should it be stored e.g. local, district, national)?
- How should it be stored (e.g. on paper, in a database etc.)?

IFAD (2002) recommends that stakeholders keep in mind the following points when thinking about how to store data and information:

- What data and information to store. Everything that co-managers decide to monitor and evaluate will need to be stored in some way, either as reference, for tracking change through time, or for making comparisons among different locations or sites. However, some raw material generated by PRAs for example may not need to be stored if the information generated from it has been processed and stored elsewhere. For example, diagrams may not need to be copied, distributed and stored at all levels. Originals can be left with the stakeholders who produced them.
- The needs of different stakeholders. How the data is stored will depend a lot on who needs to have access to it and how often. Consider their capacities and the types of communication methods they are most comfortable with.
- The format for storage. Should the data be kept as hard copies or electronic data? Generally speaking, electronic files make it possible for more people to see and use the data. However, not all data or information gathered at the local level can be easily converted to computer files. Local level stakeholders might not have the ability to access computers or electronic networks. Information presented as diagrams or generated through discussion may be summarized in short reports for storage and distribution.
- The need to review the content of the system regularly. The content of the data storage system should be reviewed regularly so it does not become too big or too untidy. Computerized data should be regularly archived, yet still be fairly easy to access. Documents may need to be stored for legal reasons or for accounting purposes. Copies or material needed for making comparisons among places or comparisons over time must also be kept, including baseline data, copies of management plans, and summaries of progress.

Electronic databases

Electronic databases are a way of storing raw data in a secure and standard format and help make possible its rapid processing for decision-making. Databases also help to

make sure data are valid, reliable and consistent, and may allow different sets of data to be integrated, which increases their overall usefulness. FAO (1999) and Sparre (2000) offer useful guidelines on database design including advice on software development, interfaces, documentation, data processing, reporting, access and distribution (see Section 5.2.7.3 of Part 2 of the Guidelines).

STAGE 8: IMPLEMENT, EVALUATE AND REFINE THE SYSTEM

The final stage in the process is to put the system into action, monitor its implementation and subsequently revise or refine the system as needed. For the system to be effective, all stakeholders must fulfil their responsibilities and comply with the commitments they made to each other in the design process for the collection and sharing system.

Try implementing a pilot system

Before committing to full implementation, it may be useful to pilot a smaller part of the system to that stakeholders can get a realistic idea of what is possible, and then increase the range of data collected and shared or scale up as needed.

Training and capacity building

Training and capacity building is an important part of successful system implementation, and those involved in collecting and sharing data, including government staff as well as LMI members and fishers, should receive appropriate training if necessary so that they can successfully carry out their new responsibilities. Training and capacity building needs should be assessed against each indicator and corresponding set of data sources and methods. The gaps identified should form the basis of a training plan.

Continuous evaluation and revision

Once in place, the system should be evaluated regularly to see if it is answering the questions in the management plans and in policy, that it set out to answer. Is it providing the information needed and at the appropriate level of accuracy? What is working well, what is not working, have the needs of stakeholders changed and would it be helpful to make any changes or adjustments to the system?

Other points to consider for implementing the system are:
- Make sure that all stakeholders understand their roles and responsibilities. This could be supported by memoranda of understanding or contracts.
- Support activities. Make sure there are enough resources available (money, equipment and materials) to conduct data collection and sharing activities such as transport, accommodation, species identification manuals, raincoats, weighing scales, maps and rosters.
- Give regular feedback. All the people involved in the data collection and sharing system need to be motivated to participate actively, regular feedback of information to those that collected it can help show how the data are useful and increase motivation.
- Evaluate the system with all involved. Feedback from people implementing the system should be encouraged to help evaluate the system to identify weaknesses in the data collection and sharing system. These weaknesses should be fixed immediately and monitored.
- Technical Committees and Legal Frameworks. FAO (1999) recommends that technical committees be set up to guide the development of the information system. If giving data is going to be a condition of using a fishery resource or getting a licensing agreement then policy and rules need to be in place before the data collection system can be put into action.
- Data Verification. Fisheries data are prone to error and therefore it is necessary to make sure that data are both accurate and complete. FAO (1999) describe methods

that can be used to verify different types of data. One common approach used to check the accuracy of data or information generated by RRA and PRA methods is "triangulation" (Pido *et al.* 1996). Triangulation is a method that uses at least three sources or techniques to investigate the same topic. IFAD (2002) give useful guidelines in Section 6.3 on how to improve the reliability of data and information, including tips to avoid non-sampling errors and methods to verify data.

- System Documentation. Documenting the system means writing a description of the system and how it works. This is usually done in the form of a manual or handbook. Documentation is important to keep existing and future stakeholders informed about the activities and status of the data collection and sharing system, to justify further investment of money and other resources in the system, and to help make comparisons with other systems. Documentation should at least include the following headings: Objectives; Indicators; Sources of information; Baseline data needed; Who is involved?; Tools and methods; How often is data collection needed?; How often will the data be used?; Who will analyse the data?; Who receives the information?

References and recommended reading

A full list of references is included in *Part 2: Technical guidelines*.

Allison, E.H. & Ellis, F. (2001). The livelihoods approach and management of small-scale fisheries. *Marine Policy*, **25**: 377-388. http://www.sciencedirect.com/science/journal/0308597X.

Bazigos, G.P. (1983). Design of fisheries statistical surveys. *FAO Fisheries Technical Paper* **133**. FAO, Rome. 122 p. http://www.fao.org/fi/eims_search/publications_form.asp?lang=en

Berkes, F., Mahon, R., McConney, P., Pollnac, R. & Pomeroy, R. (2001). *Managing small-scale fisheries: Alternative directions and methods*, IDRC 2001, 320 p. http://web.idrc.ca/en/ev-28061-201-1-DO_TOPIC.html.

Caddy, J.F. & Bazigos, G.P. (1985). Practical guidelines for statistical monitoring of fisheries in manpower limited situations. *FAO Fisheries Technical Paper* **257**: 86p. http://www.fao.org/fi/eims_search/publications_form.asp?lang=en

Cochrane, K.L. (2002). A fishery manager's guidebook. Management measures and their application. *FAO Fisheries Technical Paper* **424**. Rome, FAO. 2002. 231p.http://www.fao.org/fi/eims_search/publications_form.asp?lang=en

FAO. (1999). Guidelines for the routine collection of capture fishery data. *FAO Fisheries Technical Paper* **382**, Rome, FAO 1999. 113p. http://www.fao.org/fi/eims_search/publications_form.asp?lang=en.

Garaway, C. & Arthur, R. (2002). *Adaptive Learning. Lessons from South Lao PDR*. 32p. http://www.fmsp.org.uk/r7335.htm.

Garaway, C.J. & Arthur, R.I. (2004) Adaptive Learning: A practical framework for the implementation of adaptive co-management. Lessons from selected experiences in South and Southeast Asia. MRAG Ltd. 44pp. http://www.fmsp.org.uk /r7335.htm.

Halls, A.S., Lewins, R. & Jones, C. (2000). Information systems for the Co-Management of Artisanal Fisheries. Final Technical Report to the Department for International Development, London, MRAG Ltd, 230pp. http://www.fmsp.org.uk /r7042.htm.

Hindson, J., Hoggarth, D., Krishna, M., Mees, C. & O'Neill, C. (2005) How to Manage a Fishery – A simple guide to writing a fishery management plan. London, MRAG Ltd.

Hoggarth, D.D., Cowan, V., Halls, A.S., Aeron-Thomas, M., McGregor, J.A., Garaway, C.J., Payne, I. & Welcomme, R. (1999). Management guidelines for Asian floodplain river fisheries, Part 1: A spatial, hierarchical, integrated strategy for adaptive co-management. Rome, *FAO Fisheries Technical Paper*: **384** 1&2. http://www.fao.org/fi/eims_search/publications_form.asp?lang=en.

IFAD. (2002). Managing for Impact and Rural Development: A Guide for Project M&E. Rome, IFAD. http://www.ifad.org/evaluation/guide/index.htm

ICLARM & IFM. (1998). *Analysis of Co-management Arrangements in Fisheries and related Coastal Resources: A Research Framework*. 21pp. ICLARM.

Jentoft, S. (2003) Co-management – the way forward. *In* Wilson, D.C., Nielsen, J.R. & Dengbol, P. (eds) *The fisheries co-management experience: Accomplishments, challenges and prospects.* Fish and Fisheries Series Vol 26. Kluwer Academic Publishers, Dordrecht, Netherlands.

Pido, M.D., Pomeroy, R.S. *et al.* (1996). A Handbook for Rapid Appraisal of Fisheries Management Systems (Version 1). ICLARM Education Series 16: 85p. http://worldfish. catalog.cgiar.org/pubsof.htm

Poate, C.D. & Daplyn, P.F. (1990). *Data for Agrarian Development*. Wye Studies in Agriculture and Development. University of London: London, UK.

Purvis, J. (2004). *Identification of System Requirements*. Report in preparation for the Guidelines Development Workshop: Levels 1 and 2: Fisher communities and district level managers within the national framework: Tanga Region, Tanzania. Report prepared as a contribution to DFID-FMSP project R8285: Data Collection and Sharing Mechanisms for Co-Management. April 2004, 59pp. http://www.fmsp.org.uk/r8285.htm

Sparre, P.J. (2000). Manual on Sample-based data collection for fisheries assessment. Examples from Vietnam. *FAO Fisheries Technical Paper* **398**, Rome, FAO. 171pp. http:// www.fao.org/fi/eims_search/publications_form.asp?lang=en

Stamatopolous, C. (2002). Sample-based fishery surveys. A technical handbook. FAO *Fisheries Technical Paper* **425**. Rome, FAO. 2002. 132p.http://www.fao.org/fi/eims_ search/publications_form.asp?lang=en

Sultana, P. (2005). *Evaluation and Uptake Promotion of Data Collection Guidelines for Co-managed Fisheries* (R8462). Draft Evaluation Report with Fourth Fisheries Project, Bangladesh. http://www.fmsp.org.uk /r8462.htm.

Guidance on carrying out a stakeholder analysis:

http://www.iied.org/forestry/tools/four.html or Annex D of IFAD (2002) http://www. ifad.org/evaluation/guide/index.htm

Annex 1

Checklist for the system

Use the checklist below to help confirm if you have the right system:

- **Is it feasible?** Do you have the capacity, motivation, skills and equipment? Can you cover the geographic area properly? Can enough technical support and training be provided?
- **Is it suitable?** Do stakeholders agree that the strategy is suitable and do they understand it? Can it be supported by existing institutions?
- **Is it valid?** Do the people who are going to use the information believe that the methods are valid and generate accurate information?
- **Is it relevant?** Does the system generate the needed information? Are all the data relevant and needed? Is there a pilot phase to test and refine the system (see below)?
- **Is it sensitive?** Will it be possible to detect small enough changes in indicators or variable estimates for management purposes? Can it be adapted to changing conditions without losing a lot of reliability?
- **Is it cost-effective?** Are there enough resources to support the system? Will the system produce the needed information at relatively low cost or do cheaper alternatives exist?
- **Is it timely?** Will the system generate data in time for its intended purpose or use?
- **Is it sustainable?** Will the system be sustainable without continuous support? Is the system documented so that everyone knows what it produces and what information is distributed?

Category 1 Information: Examples of indicators, data types and variables for formulating and evaluating policy and development plans

Category	Example indicators	Data types	Example data variables
Economic value of the fishery	Gross Value of Production (GVP)	• Production • Unit Prices	• Landed weight of species from co- and non-co-managed sectors • Unit prices of species
Food supply and fish consumption	Average fish consumption per capita	• Production • Fishery imports and exports • Conversion factors • National population	• Landed weight of species from co- and non-co-managed sectors • Quantity of fish products imported and exported • Ratio of weight of product by species • Number of people
Employment in fisheries sector	Employment in sector	• Number of persons employed in sector • Employment in non-fisheries sector • Unemployment • Conversion factors	• Employees by primary, secondary and tertiary sectors and by category e.g. full-time, part-time, and occasional in both co- and non-co-managed sectors • Employees • Unemployment nationally, by region, district • Numbers of employees in secondary and tertiary sectors per fisher.
Progress towards establishing co-managed fisheries	Progress indicators	• Number of co-managed fisheries • Number of fishers participating in co-managed fisheries • Landings	• Co-managed fisheries by region, province, marine/inland • Numbers of fishers by income grou. • Quantity by sector (co- and non-co-managed sectors
Conservation and resource sustainability	Catch per unit effort (CPUE)	• Total catch • Conversion factors • Gear • Gear size • Effort	• Weight; number; number of baskets by species • Weight of fish per basket by species • Gear type • Length, number of hooks, net area • Hours fishing, numbers of traps set, numbers of fishers
Income	Income	• Fixed costs • Variable costs (owner operating) • Variable costs (common operating • costs) • Earnings	• Gear, vessel investment; insurance; depreciation • Repair and maintenance of craft; repair and maintenance of gear; food; materials; stocking cost • Food; traditional taxes and offerings; materials; commission; repair of craft and gear; remuneration to other owners; repayment of loans; stocking costs • Fresh fish sales; processed fish sales; sales of fishing inputs; rental of gear; sale of fishing rights; investment

Category	Example indicators	Data types	Example data variables
Compliance with rules and regulations	Non-compliance incidents	• Identifiers • Non-compliance incidents • Sanctions for non-compliance • Other explanatory variables	• Co-managed fishery name; management area name, LMI identifiers, region, strata, etc. • Number and type • Warning, confiscation of gear/vessel/catch; revocation of licence, fine • Number of guards per unit area; clearly defined boundaries; representation in rule making, legitimacy of decision-making body; local support of co-management arrangements; knowledge of rules and regulations; expenditure on enforcement by local district officers
Co-management costs	Cost per fisher	• Costs to government • Costs to the LMI and its associated stakeholders • Number of fishers	• Surveillance costs, monitoring costs, enforcement costs, training costs, administration costs, research costs • Opportunity costs associated with participation in co-management activities (monitoring and enforcement activities, participating in meetings and workshops, and participatory monitoring programmes)

Note: Details of other indicators belonging to this category of information including poverty, equity and conflict, together with information needed for development and poverty reduction evaluation and to meet management and reporting obligations can be found in Section 3.2 of Part 2 of the Guidelines.

Category 2 Information: Examples of information that might be included in local management plans

Category	Examples
Resource and Environment	• The stocks or fishery being considered and the area under the jurisdiction of the LMI • Information on environments, habitats or locations critical to the life history of the stock or species • Potential catchment influences on the fishery or stock
Fishery	• Number of fishing units • Gear types and technology employed • Selectivity of gears • Seasonality of fishing • Location of fishing • Landing locations
Fishers and Other Stakeholders	• Socio-economic categories of fishers (professional, subsistence etc), their sub-categories (e.g. women, children) and other stakeholders (fish traders, leaseholders, etc.)
Management Roles and Responsibilities	• Details of all stakeholders involved in the management of the resources, including their roles and responsibilities and planned activities
The Management Plan Objectives and Current Status	• Agreed biological, social and economic objectives for the fishery • Current performance of the management plan and the impact on the resource and its users (biological, economic and social impact) • Data and information concerning non-compliance
The Management Strategy	• Details of management control measures (e.g. closed seasons, mesh size regulations, effort restrictions etc) and interventions such as stocking or habitat enhancement/rehabilitation programmes • Access rights, existing legislation and sanctions for non-compliance • Details of exiting monitoring (data collection), control and surveillance programmes and activities including who is responsible, what information is collected, how, when and where and associated costs. Known strengths and weaknesses of the existing systems
Performance Evaluation Criteria and Decision-Making Arrangements	• Details of the indicators and criteria used to evaluate the performance of the management plan in relation to the specified management objectives, and to adjust or refine the management strategy as necessary • Details of any models or analytical approaches (including explanatory variables) used to guide decision-making • Results of previous evaluations of the management plan
External Arrangements, Markets And Vulnerability Context	• Details of relevant legislation, cultural factors, markets, (seasonal) prices, trade arrangements, donor assistance, population, economic and technological trends, and the frequency and predictability of natural disasters
Other Information	• Costs: administration, staff and capital equipment for monitoring, evaluation, control and surveillance

Annex 4

Category 3 Information: Examples of data and information to implement local management plans

Data type	Variable
Identifiers	Name and address of each fisher or vessel owner and FEU identification number
Type	Vessel type (e.g. skiff, canoe, boat), and material of construction (wood, fibreglass, steel, etc.)
Power	Sail; engine hp
Size	Length, breadth, gross tonnage
Crew	Number by job description
Gear	Details of the gear type, size, number, mesh size, etc.
Licence or access details	Licence number, period of validity, fee (if applicable); details of gear, landing and access restrictions (e.g. closed areas, seasons, etc.)

Annex 5

(A) Category 4 Information: Examples of data, indicators and variables to monitor and evaluate management plan performance

Management objective theme	Example indicators	Data types	Example data variables
Yield	Multispecies Annual yield (MAY)	• Total catch aggregated across all species • Conversation factors	• Weight • Number • Number of baskets of fish • Weight of fish per basket
	Annual Yield of species, s (AY$_s$)	• Total catch of species, s • Conversation factors	• Weight of species, s • Number of species, s • Number of baskets of fish of species, s • Weight of fish of species s per basket
Resource sustainability	Catch per unit effort of species, s (CPUE$_s$)	• Total catch of species, s • Conversation factors • Fishing effort	• Weight of species, s • Number of species, s • Number of baskets of fish of species s • Weight of fish of species s per basket • Hours fishing • Number of traps set • Number of active full and part time fishers
Biodiversity	Species presence and richness (S)	• Catches by species	• Presence/absence of species • Number of species landed
Well-being (Fishers/households)	Household income from fishing	• Fixed costs • Variable costs • Earnings	• Gear costs • Insurance • Depreciation • Repair and maintenance costs • Stocking costs • Earnings from fish sales • Earnings from rental of gears • Earnings from sale of fishing rights
	Household assets	• Types of assets	• Number of TVs • Number of Bikes • Presence/absence of tin roofing
	Household fish consumption	• Landings • Sales and purchases • Demographic variables	• Quantity of fish landed • Quantity of fish bought and sold • Number of household members • Age, gender
Institutional performance	Compliance with rules and regulations	• Identifiers • Non Compliance events	• LMI identifiers, region, location etc • Number and type of non-compliance events
	Conflicts	• Identifiers • Incidence of conflicts	• LMI identifiers, region, location etc • Number of conflicts or conflict events by type e.g. verbal confrontation, injuries or deaths, incidents of gear damage etc.

Note: These are only examples of the kinds of variables and indicators that may be appropriate. Examples of other variables together with guidance on how to build empirical models of management performance based upon comparisons of performance and explanatory variables through time and/or among sites are described in Section 3.5 of Part 2 of the Guidelines.

(B) Category 4 Information: Examples of explanatory variables and indicators to *explain* management plan performance

Category	Explanatory variable	Example data types	Example data variables
Inputs	Exploitation rate	• Fishing effort • Mortality rate • Extent of poaching	• Gear type and size • Hours fishing; number of traps set; number of fishing days; total number of fisherman; number of gears operated during season x • Mean size of species s caught in month x, with gear x • Number of incidents of poaching during period x
	Stocking density	• Quantity of fish stocked • Stocking area	• Weight or number of fish stocked • Area of stocked waterbody
	Stocking size	• Size of fish stocked	• Mean length of fish stocked
	Habitat alteration activities	• Habitat enhancement measures	• Cumulative weight of brushpile added to water body • Cumulative length of canal dredged • Quantity of fertilizer added to waterbody • Reserve area
Environment	Production potential	• Water transparency • Carbon fixation	• Secchi depth • $g\ C\ m^{-2}$
	Floodplain hydrology	• Maximum flooded area • Minimum water area	• Maximum area of floodplain inundated • Water area at end of dry season
	Lake hydrology	• Lake level	• Water level during month x
	Pollution	• Pollutant levels	• Concentration of pollutant x
Management strategy and decision-making arrangements (described in management plan)	Control measures	• Gear bans • Landing size restrictions • Reserves	• Gear ban implemented (Y/N) • Landing size restrictions implemented (Y/N) • Reserves implemented (Y/N)
	Representation	• Fisher representation in rule making	• Low; medium; high
	Sanctions	• Sanctions for non-compliance	• Yes; No
	Legitimacy	• Legitimacy of local decision-making body	• Low; medium; high

Note: Examples of variables and indicators to explain *policy* performance are given in Section 3.5.8 of Part 2 of these guidelines.

Annex 6

Example of an hypothesis matrix for aiding the selection of sets of explanatory variables to explain differences in management performance

Category	Explanatory variables	Multispecies annual yield	Annual yield of species, s	Catch per unit effort species, s	Species presence and richness	Household income from fishing	Household assets	Household fish consumption	Compliance with rules	Conflicts
Inputs	Exploitation rate	√	√	√	√	√	√	√		√
	Stocking density	√	√	√	√	√	√	√		
	Stocking size	√	√	√	√	√	√	√		
	Habitat alteration activities	√	√	√	√	√	√	√		√
Environment	Production potential	√	√	√	√	√		√		
	Floodplain hydrology	√	√	√	√	√		√		
	Lake hydrology	√	√	√	√	√		√		
	Pollution	√	√	√	√	√		√		
Management strategy & decision-making arrangements	Legitimacy / widely accepted								√	√
	Management measures	√	√	√	√	√			√	√
	Representation in rule making								√	√
	Sanctions for non-compliance								√	√

(header: Management performance indicators)