

**Analysis of Fisheries Co-Management Arrangements:
A Research Framework**

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1. INTRODUCTION

The Fisheries Co-management Research Project is a collaborative project between International Center for Living Aquatic Resources Management (ICLARM), Institute of Fisheries Management (IFM)-The North Sea Center and National Aquatic Resource Systems (NARS) partners in Asia and Africa. It is based on a mutual interest to gain practical experience in research on fisheries co-management. There are two components to the research:

- (1) Comparative case studies of fisheries co-management strategies on the basis of existing literature and country research.
- (2) Co-management models based on (1) and tested at pilot sites.

This paper describes a research framework which has been developed by the project to carry out the above research. The aim is to provide a common analytical framework which will enable comparison between case studies, country research and pilot-tested co-management models. This will allow data to be analysed in a systematic way and allow generalisations to be made about conditions which facilitate successful fisheries co-management. The framework is in draft form because it is anticipated that once it has been applied in the analysis of case studies and country research, there might be a need to modify and/or expand it.

This paper is divided into two main sections. The first section briefly describes the theoretical background to the research framework, exploring the concepts of common property, fisheries co-management, institutional analysis and rights and rules. For more detailed coverage of the theoretical background, readers are encouraged to consult the bibliography. The second half of the paper describes the framework itself.

2. THEORETICAL BACKGROUND

2.1 Common property resources

The “commons” include natural resources, such as fisheries, wildlife, forests, irrigation waters and pasture lands, which by their physical nature are now owned by individuals but are shared by a community or group of users, such as fishers. The “commons” has come to connote inevitable resource degradation. Many accepted that fishery resources which are held in common are subject to overexploitation and degradation. The main rationale for this was based on Hardin's theory on The Tragedy of the Commons (Hardin, 1968) which concluded that "freedom of the commons brings ruin to all". The assumption was that when resources are limited and publicly owned, it is rational for each individual to overexploit them, even though this behaviour ultimately results in tragedy for the group (Acheson, 1989). Hardin's solution was either to privatise the commons or keep them as public property, to which rights of entry and use could be allocated i.e. privatisation or government control.

In more recent years, social scientists have observed that not all common property resources are subject to such a 'tragedy' and are not overexploited. This has led to considerable discourse on the subject and consequent rejection of the notion that it is the common property nature of the resource which is the problem. What is important is not the type of resource i.e. common property, but the

property rights regime in combination with the resource it is subject to, namely open access, private property, communal property and state property. The following definitions are given by Feeny et al (1990) to describe these regimes:

Open access: the absence of well defined property rights. Access to the resource is unregulated and free and open to anyone.

Private property: the rights to exclude others from using the resource and to regulate the use of the resource are vested in an individual or group. They are usually recognised and enforced by the state and are usually exclusive and transferable.

Communal property: the resource is held by an identifiable community of interdependent users who exclude outsiders while regulating use amongst members. The rights are unlikely to be exclusive or transferable and are often rights of equal access and use. Some inshore fisheries and shellfish beds are managed as communal property. The rights of the group may be legally recognised or *de facto*.

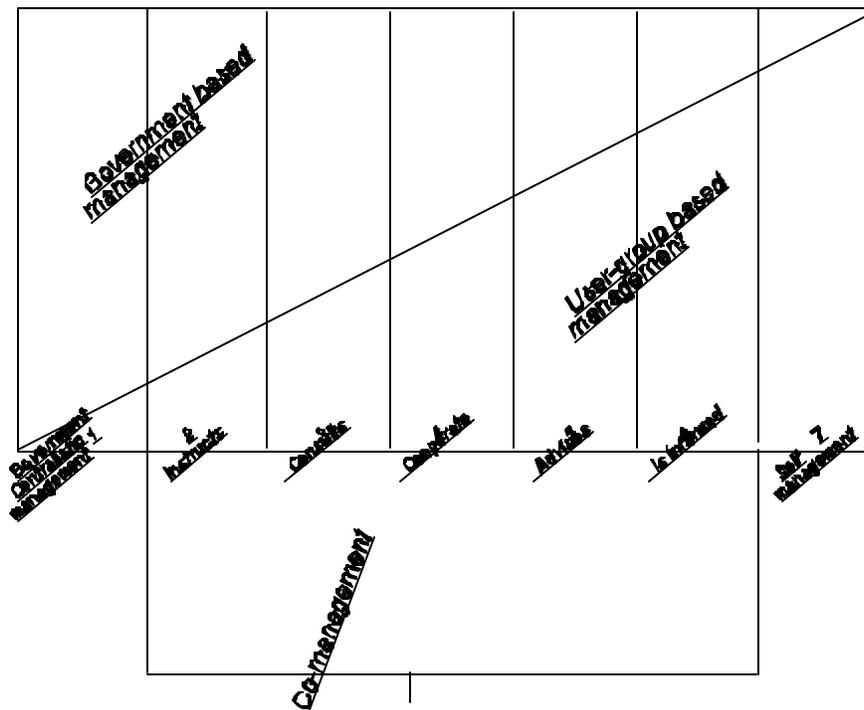
State property: rights to the resource are vested exclusively in the government which makes decisions concerning access to the resource and the level and nature of exploitation.

This separation between the nature of the resource and the property regime it falls under shows that Hardin's theory was correct inasmuch as it predicted a situation of a common property resource under an open access regime. However, other property regimes can and have also led to overexploitation, indicating that the provision of property rights alone is not enough. New methods of management are being investigated, in an attempt to take on the best aspects of state control, private and communal property. Largely from the management experiences gained in certain fisheries, and other common property resources such as forests and groundwater, it is recognised that what is needed is a more dynamic partnership using the capacities and interests of local fishers and communities, complemented by the ability of the state to provide enabling policies and legislation as well as enforcement and other assistance. This has been termed co-management.

2.2 Fisheries Co-Management

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. Lying between two management strategies - centralized control and self- or community management - co-management covers a broad spectrum of management arrangements (Figure 1). The amount of responsibility and/or authority that the government and local resource users have will differ and depend upon country- and site-specific conditions. For this reason, co-management covers a number of arrangements ranging from government (fisheries administration) instructing user groups to user groups informing government on management arrangements they have developed. Co-management should not be viewed as a single strategy to solve all problems of fisheries management. Instead, it should be seen as a set of alternative management strategies, appropriate for certain areas and situations (Pomeroy and Williams 1994).

Figure 1 Spectrum of co-management arrangements (adapted from McCay, 1993 and Berkes, 1994)



2.3 Institutional Analysis

In conducting research on fisheries co-management we are essentially interested in understanding how rules affect the behavior and outcomes achieved by fishers using fisheries resources. Institutional analysis, which focuses on the institutional arrangements, the set of rights and rules by which a group of fishers and government organizes resource governance, management and use in collective action situations, will provide the framework for the research. It should be noted that not every detail of institutional analysis will be discussed in this paper. The reader is encouraged to make use of the highlighted publications in the reference list for more specific discussion of several aspects of institutional analysis.

The purpose of institutional analysis is to separate the underlying rules (institutions) from the strategy of the players (organizations). Institutional analysis examines how institutional arrangements affect user behavior and incentives to coordinate, cooperate and contribute in the formulation, implementation and enforcement of management regimes. When carrying out institutional analysis, it is also important to examine some aspects of organizations because their strategies can influence, or lead to change in, institutions.

Institutions are the “rules of the game” in a society and are affected by economic, social and political factors. Institutions can be both formal and informal, created or evolved. Any human interaction is governed by both formal rules (i.e. those that are written down) and informal rules or codes (i.e. those which everyone knows about but are not formalised in any way). North (1990) uses the analogy of American football to describe institutions. In football there are formal rules and usually

unwritten codes of conduct which underlie and supplement formal rules such as not deliberately injuring a player from an opposing team. The effectiveness of the rules is determined by whether they are enforced, the cost of enforcement and the severity of punishment.

Organisations, on the other hand, are groups of individuals bound by some common factors to achieve particular objectives. The origin of organisations and how they evolve is influenced by the institutional framework and in turn organisations influence how the institutional framework evolves. Organisations can be political such as a local council, economic such as a cooperative, social such as a church, or educational such as a school.

In general, institutional arrangements are defined by authority relationships that specify who decides what in relation to whom. The institutional arrangements can be subdivided into several attributes: operational rules for governing resource use, collective choice rules for determining, enforcing and altering operational rules, and organizational authority relationships.

Ostrom (1994) states, "Action situations are perceived to be nested within at least three relevant tiers of action. Operational level actions are decisions which occur whenever individuals directly affect variables in the world by doing such things as harvesting products, worshipping at a forest shrine, planting seeds, building fences, patrolling the borders of a forest or feeding leaves to their animals. Collective choice actions constitute a group's decisions about operational activities, e.g., the actions taken at an annual meeting of a forest users' association to keep a forest closed for the harvest of a particular product except for a specified time. Constitutional choice actions are decisions about how collective choice actions will be made. An example is the resolution of a forest users' association to create an executive committee that will meet once a month to determine joint activities to be undertaken. Constitutional choices are frequently made without recognition that they are indeed creating a future structure to make rules about an operational action."

Institutional arrangements are sets of rights that fishers possess in relation to the fishery and the rules that define what actions they can take in utilizing the fishery. In order to organize their harvesting, for example, fishers must develop rules to establish how rights are to be exercised. Rules give substance to rights, structure a situation, define the behavior of the group members, and reduce conflict. Rules may create different incentive structures that affect cooperation or conflict among fishers. Rules structure human behavior into four categories: compulsory, permitted, authorized and non-authorized (Thomson 1992). The types of rules that are devised will depend upon the severity of the problem the fishers face, the level of information they possess, socio-cultural traditions, the extent of the bundle of rights they hold, the level of opportunistic behavior, and the ease with which actions can be monitored and enforced. Rules can provide stability of expectations, and efforts to change rules can rapidly reduce their stability (Ostrom 1990). It should be noted that the institutional arrangements fishers develop and use may not always be the same as formal laws and regulations. The fishers may develop institutional arrangements to meet their needs which are not recognized and legitimized by government. These informal or traditional rights and rules may be as or more important and credible to the local fishers than the formal fisheries laws and regulations.

The terms "rights" and "rules" are often used interchangeably in referring to the uses of natural resources. "Rights" refer to particular actions that are authorized (Ostrom 1990). A right is a claim to a benefit stream that is consciously protected, in most cases by the state. The possessor of the right has the expectation in both law and practice that their claims will be respected through the assignment of duty to others who may interfere with the benefit stream (Bromley 1991). To possess a right implies that someone else has a commensurate duty to observe this right (Commons 1968). Rights define the uses which are legitimately viewed as exclusive and the penalties for violating those rights. The specification of a right does not define how the right is to be exercised. How rights are exercised are defined by rules. Rules define specifically what acts are required, permitted, and

forbidden in exercising the authority provided by the right. For every right that an individual holds, rules exist that authorize particular actions in exercising the right. For example, a right provides the authority for a fisher to operate on a specific fishing ground. How the fisher exercises that right through the fishing activity is specified by rules which may dictate the type of fishing gear used or the time of year when the fishing gear can be used. Thus rules specify both rights and duties. The important aspect of rules in terms of institutional analysis is that they may create different incentives which affect cooperation among users. Schlager (1990) cited the example of two groups of fishers in an identical set of rights but with different rules determining how these rights can be exercised. These two groups may have different incentives to cooperate so that the result may be totally different outcomes. The more complete the set of rights, the less exposed the fishers are to the actions of others, and the less risk that the fishers face in organizing themselves in groups (Ostrom 1990).

For common-pool resources, the most relevant day-to-day or operational-level property rights are "access" and "withdrawal" rights. These are defined as:

Access: the right to enter a defined physical property.

Withdrawal: the right to obtain the "products" of a resource; e.g., catch fish.

Individuals who have access and withdrawal rights may or may not have a more extensive set of rights which authorize their participation in defining operational-level rights or what is referred to as collective-choice actions. In regard to common-pool resources, these additional rights include management, exclusion and transfer. These rights are defined as:

Management: the right to devise operational-level rights of withdrawal.

Exclusion: the right to devise operational-level rights of access.

Transfer: the right to sell or lease all or part of the above collective-choice rights (Schlager and Ostrom 1993).

The sources of the rights of access, withdrawal, management, exclusion and transfer are varied. These property rights may originate by government which explicitly grants rights to fishers. These de jure rights are given formal and legal recognition. Property rights may also originate from fishers. Such indigenous or de facto rights, devised and enforced by fishers, are not usually recognized by government. These two types of property rights may overlap, complement or conflict with each other. While de facto rights may eventually be given recognition by government, until they are formally legitimized, they are less secure than de jure rights (Schlager and Ostrom 1993). While most authorities tend to ignore de facto rights, many have proven to be efficient and equitable in fisheries management.

Ostrom (1991) identifies three levels of rules which are all closely linked. Operational rules govern and regulate resource use. Operational rules directly affect the day-to-day decisions made by the fisher concerning when, where and how to harvest fish; who should monitor the actions of others and how; what information must be exchanged or withheld, and what rewards or sanctions will be assigned to different combinations of actions and outcomes. Operational rules can be formal (written, legitimized) or informal (unwritten, customary/traditional). In both circumstances they are understood by those to whom they apply.

Several kinds of operational rules have been identified (Gardner and Ostrom 1991, Ostrom, Gardner and Walker 1994). Position rules specify what position a fisher may hold. Boundary rules specify who can enter the fishery. Allocation rules specify the procedures or actions for harvesting. Authority

rules specify the authorized actions fishers may take independently. Scope rules specify the characteristics of fish that can be harvested. Information rules specify the information that fishers must reveal to others. Aggregation rules specify the procedures that fishers must follow for making decisions which involve multiple individuals. Penalty rules specify punishment for non-compliance. Payoff rules specify the rewards or penalties that may be assigned to certain actions or outcomes. Input rules specify fishers requirements in terms of time, money and/or materials for management and participation.

Ostrom, Gardner and Walker (1994) state that in the IAD methodology, "... one has a conceptual tool for inquiry about how rules affect a given situation. For each variable identified in the action situation, the analyst interested in rules needs to ask what rules affect the variable as specified. For example, in regard to the number of participants, the analyst asks: Why are there N participants? How did they enter? Under what conditions can they leave? Are some participants forced into entry because of their residence or occupation?" "Answers to these sets of questions are formalized as a set of relations that, combined with the structure of a physical world and the type of community involved, produces the particular values of the variables of the situation." Ostrom, Gardner and Walker (1994) further state that "... a second advantage of examining the rules that directly affect ... an action situation is that doing so leads to a relatively natural classification system for sets of rules. Classifying rules by what they initially affect enables us to identify rules that all directly affect the same working part of the situation."

Operational rules are neither self-generating nor self-enforcing. Institutional arrangements are needed to adjudicate conflicts, enforce decisions, formulate and change operational rules, detect and sanction against rule violation, and hold officials accountable to users. These institutional arrangements are called collective-choice rules (Tang 1992). These are the rules used by fishers, their officials, or external authorities in making day-to-day decisions - the operational rules - about how the fishery should be managed. In a broad sense, collective-choice rules include qualifications for participation in the management organization and whether membership is compulsory. They state what proportion of the group of fishers must agree before a rule may be adopted. Of critical importance are the arrangements for monitoring and enforcing compliance with the operational rules and for settling disputes.

There may be multiple levels of collective-choice entities depending upon the situation. In some situations only one entity, such as a fisher's association, may be constituted to adopt and enforce their own collective-choice and operational rules. In another situation, multiple collective-choice entities, at national, regional and/or local levels, may subject fishers to multiple sets of operational rules. For example, national-level regulations may overlap with local-level regulations which may overlap with customary or traditional practices. Different levels of collective-choice entities may be constituted to deal with problems of different scopes. Issues of coordination and control must be addressed when multiple levels of collective-choice entities are in place (Tang 1992).

Finally, constitutional-choice rules affect operational rules by determining who is eligible to participate in the system and by establishing the process and rules by which collective-choice rules are created, enforced and modified. Constitutional-choice rules include, for example, the national fisheries policy and legislation which establishes a national fisheries agency and the fisheries administrative and management structure. This national institution has the mandate to empower lower level institutions to establish rules.

Ostrom, Gardner and Walker (1994) state, "Action situations are also linked across several levels of analysis. All rules are nested in another set of rules that, if enforced, defines how the first set of rules can be changed." "What can be done at a higher level will depend on the capabilities and limits of the rules at the level and at a deeper level. Changes in the rules used to order action at one level occur within a currently "fixed" set of rules at a deeper level. Changes in deeper-level rules usually are

more difficult and more costly to accomplish, thus increasing the stability of mutual expectations among individuals interacting according to a set of rules."

Operational or working rules are nested within collective choice rules which are in turn nested within constitutional rules. In other words, the rules affecting operational choice are made within a set of collective choice rules that are themselves made within a set of constitutional choice rules. To further complicate matters, all levels of rules operate at different levels: community, district, province, national, regional, and international. This means that the constitutional choice rules for a micro-setting are affected by the collective and constitutional choice rules for larger jurisdictions. A full understanding of behaviours and outcomes in managing a resource is only possible when information is analysed on how institutional arrangements at the operational level (resource use, monitoring and enforcement) relate to institutional arrangements in collective choice (policy, management and adjudication) and constitutional choice (governance, adjudication and modification).

Institutional arrangements are not organizations, and may not be associated with a formal organization. Examples of institutional arrangements operating independent of any formal organization do exist (Schlager 1990). Yet, organizations are important since they can serve to operationalize institutional arrangements.

A fishery management system may involve several discrete organizations, both formal, that is legitimately recognized, and informal, and the organizations may perform different management and service functions at different levels of management. There can be a variety of organizational forms for managing and governing the fishery which may range from fisher's organizations, to cooperatives, to nongovernmental organizations, to government sponsored organizations (Pollnac 1988). The organization will establish an agenda and goals which are to be achieved. This may include an identification of the problem or issue to be addressed and management and adjudication procedures. The authority system to ensure that fishers expectations are met is normally inherent in the organization. The analyst must recognize the mixture of organizations, both governmental and nongovernmental and internal and external to the community, and be able to identify the expansion and contraction of their roles under a co-management system.

A group of fishers can be regarded as organized to perform fishery management functions whenever it shares common understanding about:

- (a) who is and is not a member;
- (b) the rights of fishers to access and use the fishery as conveyed by membership;
- (c) how decisions are made concerning the development of coordinated strategies of managing the fishery;
- (d) leadership roles;
- (e) membership responsibilities to sustain the organization; and
- (f) how conflicts are to be resolved (Ostrom 1992).

3. INSTITUTIONAL ANALYSIS RESEARCH FRAMEWORK FOR FISHERIES CO-MANAGEMENT

Based on the theoretical and conceptual framework described above in Section 2, an analytical framework has been developed for use by project researchers on fisheries co-management. The purpose of the framework is to describe and characterise the key factors which influence the institutional and organisational aspects of fisheries co-management arrangements. Such an analysis

can then be used to make generalisations about the type of co-management arrangements appropriate for different situations. In particular, the analysis would enable:

- (1) The identification of the *existing property rights system* in order to determine who defines rights to exploit the resource, who has access to the resource and whether any of these rights are transferable.
- (2) The *scale and level of user group involvement* in order to determine the ways in which user groups do or can participate in co-management. Scale refers to the types of tasks which can be carried out by user groups, whilst level refers to the political level at which user groups are involved such as local, regional or national. Scale is related to level in the sense that different tasks can be carried out at different levels.
- (3) The *nature of the representation of user groups* in the decision-making process in order to determine the participants in the co-management arrangement, which user groups are legitimate participants in the decision-making process and who can claim rights to participate (eg. fishermen, fish processors, consumers, environmentalists).
- (4) The *type of management organisation* (existing or possible) in order to determine the type of co-management arrangement most appropriate for a particular fishery.

Ostrom, Gardner and Walker (1994) state, "At the conceptual level of a framework, theorists identify the broad working parts and their posited relationships that are used in an entire approach to a set of questions. Frameworks help to organize diagnostic and prescriptive inquiry." The institutional analysis research framework provides for a structured approach to document and evaluate the origin, current status, operation, impact and performance of fisheries co-management institutions and for designing modified or new co-management institutions. Oakerson (1992) has stated that, "Such a framework must be specific enough to offer guidance in the field, yet general enough to permit application to widely variable situations." The framework allows for the essential elements of the action situation to be identified and examined. The research framework is used to collect and organize information on key contextual variables which characterize collective action situations at multiple levels. The same set of contextual variables are used to describe and analyze all situations. These contextual variables will take on different values in different situations. By utilizing the same set of contextual variables, it is possible to conduct a systematic and comparative analysis of diverse situations and identify relationships among variables for evaluative, diagnostic and design purposes. As an evaluative tool, the framework can be used to describe a collective action situation. As a diagnostic tool the framework can be used to prescribe solutions to modify an action situation. As a design tool the framework can be used to develop and implement a new action situation (Oakerson 1992). It should be noted that the framework is not a causal model in which data is imputed and an output is generated. Rather, the framework is a method for logically arranging information, examining relationships among attributes and considering or describing outcomes. The framework can be used in different situations at varying levels of complexity and completeness as required.

The research framework is adapted from theoretical and empirical work on the Institutional Analysis and Development (IAD) framework developed by researchers at the Workshop in Political Theory and Policy Analysis at Indiana University, USA. The research framework uses concepts from economics, political science, anthropology, biology and law and relies on methods described by Kiser and Ostrom 1982, Ostrom 1986 and 1990, and Oakerson 1992. The theoretical foundations of institutional analysis are based on game theory, neoclassical microeconomic theory, institutional economics, political economy, transaction cost economics, and public choice.

As specified for the fisheries co-management project, the institutional analysis research framework consists of three parts:

1. **Institutional Arrangements Analysis:** This component links contextual variables characterizing key attributes of the resource (biological, physical) and resource user (technology, market, social, cultural, economic, political) with the local fisheries management institutional arrangements (rights and rules). The contextual variables are referred to as a set since each is composed of a number of attributes. A causal relationship exists among and between the contextual variables, the local institutional arrangements (the focus of the analysis) and the resulting transactional (action) situations (Figure 2). The local institutional arrangements, structured by the contextual variables, affect the actions of the resource users by shaping the incentives and disincentives they face to coordinate and cooperate in resource governance, management and use; the incentives, in turn, shape the patterns of interaction that result when resource users select and implement fishing strategies; these interactions result in outcomes. These outcomes may, in turn, affect other outcomes. Time is a critical element. All the contextual variables can change through time. This causes change in institutional arrangements which, in turn, affects incentives, patterns of interaction and outcomes.

The six sets of contextual variables are:

- a. Fisher or community institutional and organizational arrangements;
 - b. Biological, physical and technological;
 - c. Market (supply and demand);
 - d. Fisher, stakeholder and community;
 - e. External institutional and organizational arrangements; and
 - f. Exogenous (macroeconomic, social, political, natural).
2. **Institutional and Organizational Performance:** The outcomes of co-management institutional arrangements can be evaluated in terms of performance, that is, the meeting of management objectives and the impact on the resource and its users. Performance can be evaluated in terms of different criteria such as sustainability, efficiency, equity, replicability, adaptability, and manageability.
 3. **Characteristics of Successful Fisheries Co-management Institutional Arrangements:** The most important aspect of this analysis is the specification of what conditions bring about successful long-enduring, locally-sustainable and self-governing fisheries co-management institutions. From the analysis we can identify a list of principles and propositions about conditions for the development and sustainability of effective fisheries co-management institutions.

The three parts of the research framework build on each other. The first part provides a framework for describing what is occurring in the collective action situation and specifying relationships between organizational and institutional arrangements. The second part is an assessment of how well the management institution is performing and what are its impacts. The third part is a determination of what characteristics or conditions of the management institution lead to successful co-management. For example, once described, a performance evaluation of a co-management institution may conclude that it is biologically sustainable but not equitable. As a result those attributes of the action situation which lead to sustainability can be identified and used to develop conditions for successful co-management institutions. Those conditions which lead to inequity can be identified and prescriptions made to improve the situation.

The analysis of an action situation focuses on how rules combine with various contextual variables to structure the action situation and to generate particular types of outcomes. Implicit and explicit assumptions about rules and the contextual variables all influence the way an action situation is analyzed (Ostrom, Gardner and Walker 1994). The institutional arrangements analysis begins with an identification of variables affecting the action situation; the institutional, biophysical, technological, market, socio-cultural, economic, and political attributes and conditions of the resource users and the resource. These variables form the context within which fishers and other resource stakeholders coordinate and cooperate to establish institutions and organizations to govern, manage and use the fishery; from which emerges some patterns of interaction. Patterns of interaction result directly from the mutual choice of strategies by members of the group. These patterns of interaction result in outcomes.

In analyzing institutional arrangements, the basic strategy is to separate and dissect the parts of the action situation - contextual variables, incentives, patterns of interactions and outcomes (Figure 2); identify and collect data on the attributes and conditions of each part; and examine the relationships between and among the attributes and conditions of each part. The purpose of dissecting the action situation is to examine relationships between and among the parts. Each part of the framework has a causal relationship with other parts, some stronger and some weaker depending upon the involvement of human choice in the relationship. Biophysical and technological attributes can have a direct affect on outcomes, for example, high levels of fishing effort can lead to overexploitation, regardless of whether or not institutional arrangements are in place. Institutional arrangements, on the other hand, have an indirect affect on outcomes as they lead to changes in human behavior and choice, which affect interactions and outcomes (Oakerson 1992). Different combinations of these parts can be examined depending upon the situation. These relationships can be analyzed forward or backward depending upon if one is using the framework as an evaluative, diagnostic or design tool. Explicit and implicit assumptions about the relationships help structure and guide the analysis.

The various biophysical, socioeconomic and institutional attributes of the contextual variables which may affect collective action situations are identified. These attributes include who is involved in a situation, what their stakes and resources are, the types of actions they can take, the costs of those actions, what information is available to them, how much control individuals can exercise, how individuals and actions are linked to one another and to outcomes, the outcomes that can be achieved through what actions, and how rewards and punishments are allocated to particular combinations of actions and outcomes. Similar to the various parts of the action situation described above, the attributes are interrelated, a change in one attribute may create a new structure of incentives, resulting in different outcomes. Based on the contextual variables, one tries to explain or predict the patterns of relationships and the interactions and outcomes that are most likely to occur for an action situation, given the incentive structure. These explanations and predictions for what is observed are then verified in an empirical setting. The performance of the outcomes are then evaluated using established criteria (Ostrom 1990, Tang 1992, Ostrom, Schroeder and Wynne 1993).

As mentioned earlier, the institutional arrangements analysis framework can be used as an evaluative and diagnostic tool by working backwards through the relationships (Oakerson 1992). Thus, the analysis focuses on outcomes. What is happening with the fish stocks? Are they increasing, stable or decreasing? Are returns from the fishery increasing, stable or decreasing? Are they being distributed equitably among the users? Is the quality of life of the fishers and their families improving, stable or worsening from previous years? The next question is why? Oakerson (1992) states, "A first order answer can be obtained by examining patterns of interaction among resource users. Are members of the community competing with one another to maximize their individual 'take' from the commons? The inquiry cannot stop, however, with patterns of interaction. The question of why recurs. Second-order answers depend on how ..." contextual variables, together with institutional arrangements, jointly affect patterns of interaction. Do fishers face a high level of uncertainty over

fish availability and are they highly dependent upon the resource with limited livelihood options which would provide an incentive for low compliance with rules and non-conforming behavior?

"Outcomes disclose the effect of a difficulty that is manifested behaviorally in patterns of interaction" (Oakerson 1992). The reason for the difficulty is that the institutional arrangements do not adequately address the problems generated by the contextual attribute, for example, the biophysical characteristics of the fishery. This "lack of a good fit" between the biophysical attributes of the resource and the institutional arrangements used to manage and govern its use leads to a non-optimal incentive structure resulting in counterproductive patterns of interaction and undesirable outcomes (Oakerson 1992).

The framework can also be used as a design tool to modify or develop collective action situations. Design requires the analyst to work forward through the framework. The analyst must identify key contextual attributes and what problems exist in the community. The analyst then evaluates what institutional arrangements are needed to address these issues. This is followed by a series of questions such as: What incentives for interaction will these institutional arrangements produce? What strategies will fishers select based on the incentives? How will this affect the resource and the fisher?

In a short-run analysis of an action situation, the contextual variables are assumed to be unchanging. Over a longer period, however, change will occur in them. Yields may increase, gear type may change or the day-to-day rules may be restructured. A dynamic element can be introduced into the framework. One approach treats institutional changes as exogenous; the aim is simply to understand how a series of changes in resource attributes or institutional arrangements affects patterns of interaction and outcomes. Another approach examines long-term relationships between attributes and institutional arrangements in an iterative and causal fashion. For example, outcomes can affect patterns of interactions resulting in a process of learning by the fishers; causing, in turn, individuals to modify their strategies. These relationships can be traced through the framework to identify factors which cause the strategies to change (Oakerson 1992).

4. THE RESEARCH FRAMEWORK

The following sections, describe each of the main framework components in more detail. These sections focus on what are considered to be the key attributes which affect incentives and patterns of interaction in a fisheries co-management situation. It should be emphasised that the attributes are not definitive and might vary according to situation. As research gets underway, other key attributes might be identified and existing ones rejected. However, the purpose is to focus research on critical attributes to ensure that considerable time is not spent collecting an exhaustive amount of information which ultimately turns out to be of little use for diagnostic or prescriptive purposes for fisheries co-management.

1. Institutional Arrangements Analysis

I. Contextual Variables

(1) Biological, physical and technological attributes.

Problems and constraints over resource use most often originate in the biological and physical attributes of the resource and in the harvesting technology used. The nature of interactions among fishers are commonly structured by the biophysical and technological environment of the fishery. Fishers vulnerability to scarcity and uncertainty in fish supply and its effects impact upon their

incentives to engage in collective action. Collective action situations have been shown to develop when a group of individuals are highly dependent on a resource and when availability of the resource is uncertain or limited. If the resource availability problem is repeatedly experienced, such as low or no catch, and if it exists within a single community of users, the fishers are likely to develop institutional arrangements to deal with the problem. To understand the actions fishers have taken and the institutions that they have developed requires an understanding of the fishing grounds, fish stocks, fishing activity, boundary conditions and fishing technology. Key questions to be considered are shown in Table 1.

Oakerson (1992) has identified three considerations for analyzing these attributes:

(a) The relative capacity of the fishery to support many fishers simultaneously without mutual interference and/or without diminishing the aggregate yield of the fishery for the group (subtractability). The harvesting activity of an individual fisher subtracts from the amount of fish available for other fishers to withdraw. The catch of one fisher affects the amount of fish that can be harvested by other fishers utilizing the same fishing ground. Oakerson (1992) states, "The analysis should specify as precisely as possible the 'limiting conditions' that pertain to natural replenishment or maintenance of the resource. Physical limits established by nature or technology provide critical information for devising rules to maintain jointly beneficial use."

(b) The degree to or relative ease with which access to the fishery is limited (exclusion). The physical nature of fishing grounds means that exclusion (or limiting access) of fishers is both difficult and costly. A single fisher would find it difficult to exclude other fishers, therefore, fishing grounds are subject to joint use. Oakerson (1992) states, "Two types of exclusion can be distinguished: (1) access may be fully regulated on an individual basis, or (2) it may be partially regulated and applied only to those outside the immediate community. This distinction is related to the potential exposure to increases in demand. Within a definite community of users, increases in aggregate demand derive mainly from expanded operations. If there is open access, however, increases in the number of users can also contribute to an increase in total demand on the resource."

Thus, a fishery is characterized by high levels of interdependence among fishers. The action of one fisher affect the actions and outcomes of other fishers. These interactions can lead to conflicts among fishers over space and amount of fish (Schlager 1990).

(c) The spatial boundaries of the fishery, which determine the minimal scale on which effective coordinated resource management can occur (indivisibility). Physical boundaries having to do with divisibility of the fishery derive from nature, human design and technology. Fishing gear type, terrestrial and oceanographic features, customs, culture, government, organizations and scale all dictate the division or partitioning of the fishery into smaller units for management purposes (Oakerson 1992).

The basic institutional forms for fisheries management are fundamentally shaped by these three characteristics of the resource. In addition to the above, two other concerns are important. Technological problems occur when fishers physically interfere with each other in the fishing activity. Gear conflicts may occur or the placement of gear may interfere with the flow of fish, often referred to as crowding. Assignment problems occur when fishers, desiring to fish the most productive spots, fail to allocate themselves efficiently across spots, leading to conflicts (Schlager and Ostrom 1993).

If the attributes of subtractability and exclusion are arranged in a simple matrix, four types of goods can be identified: (1) private goods, (2) public goods, (3) toll goods and (4) common pool goods (Savas 1987, Thomson 1992, Tang 1992).

(1) If a resource is consumed individually and it is possible to exclude some people from access to the resource, it is a private good. An example of this is a fish consumed by a fish farmer which has been produced in her fish pond on property that she owns.

(2) Public goods are those to which access cannot be easily controlled (exclusion is infeasible), especially free riders, and consumption is joint. An example of this is improved environmental quality in a region, such as air, resulting from maintaining the environmental health of the fishery.

(3) If a resource is consumed jointly but it is still possible to exclude access to it, such as for free riders, then it is called a toll good. An example of this is a water bottom area for clam harvest for a group of fishers who purchase use rights. The group harvests clams in the area together and exclude others from fishing in the area.

(4) Common pool goods are those to which access cannot be easily controlled and consumption is separable. An example of this is a small-scale fishery where there are a relatively large number of fishers using different fishing gear types in a situation where effective regulation is not feasible. Common pool goods can be subdivided into common property and open access goods. Common property goods are managed to some extent. Access to and exploitation rates of the common property fishery are controlled by an identified group of users. Open access goods are not managed. Neither access nor exploitation are controlled.

A fishery could be either a private, public, toll or common pool good or a combination of these goods, depending upon the local biophysical, technological, and social setting. A fishery may be a private good at one point (such as along a shoreline) and a common pool good at another point (such as the coastal waters). Which type of good a fishery resembles tends to determine (within broad parameters) how social or elaborate the fishery management institution will need to be, and to what extent the government is likely to be involved in management. Ostrom (1990) points out that changes in biological, physical and technological attributes can potentially transform a resource from one type of good to another, which in turn is likely to lead to pressures for other basic institutional changes. Diverse biophysical factors, gradual trial-and-error experiments and negotiating lead to the emergence of site specific institutional forms, which continue to evolve over time. Characteristics of excludibility and subtractability or jointness of consumption which characterize different types of goods strongly influence the incentives for fishers to use, manage and govern the goods.

Table 1 Biological, physical and technical attributes and indicators

Biological, physical and technical attributes	Key questions
Multi-species or single species fishery	What species are caught?
Migratory or sedentary fishery resources	Are the fish resources sedentary or migratory?
Level of stock exploitation	Have total catches been falling over time?
	C Is catch per unit effort increasing or decreasing?
	C What do stock assessments say?
Status of habitat	What is the % coverage of coral (where applicable)
	C Are the fish and plant resources healthy?
	C Is the water polluted?
Boundaries	Are there geographical boundaries for the fishery? How are they defined?
	C Are there restrictions on who can enter the fishery? How are these defined?
	C Are there any other boundaries relevant to the exploitation of the fishery? What are they?
Single or multiple gear fishery	What types of gears are being used?
Artisanal or industrial fishery	What gear and vessel types are there?
	C What is the range of fishing operations?
	C Can the fishery be divided into artisanal and industrial?
	C How are these terms defined?
Level and mix of technology	What are the gear and vessel types?
	C What are the technologies for preservation/processing of fish?
Dispersed or localised fishing patterns	Is fishing a seasonal activity?
	C Does fishing take place in a localised area?
	C Is fishing carried out offshore?

(2) Market (supply and demand) attributes

Resource problems are often market-based. Market attributes (price, structure, stability) can effect the incentives for resource use activities, effort levels and compliance with rules. These attributes include those related to the operation and function of the market and those related to fisher and fish trader relationships. Some of these market attributes include:

- (a) stability of supply and demand in terms of price and quantity. Are there periods of scarcity of supply and/or high market demand? What effect does this have on price?
- (b) market availability and location. Are there ready and consistent markets for product. Is the fishing community isolated? Do fishers sell primarily to local markets or are there regional, national and international markets?
- (c) market structure. How competitive is the market at different levels within the market channel? How free is the flow of market information?
- (d) credit/market relationships. Are there strong credit and marketing linkages between fishers and fish traders and between fish traders and other business people?
- (e) changes in market. Have there been recent changes or "shocks" to the market in terms of structure, price or stability?

(f) market operation. Are there rules in terms of who can participate in the market and formal or informal operating procedures?

Key questions to be considered are shown in Table 2.

Table 2 Market Attributes and Indicators

Market Attributes	Key questions
Subsistence or market oriented fishery	C What proportion of the catch sold/consumed?
Market structure	C Are there many buyers?
	C Are there many sellers?
	C What are the power relations between buyers and sellers?
	C Do women service other market segments than men? What are these?
	C Are the fish/fish products sold in local, domestic or international markets?
Market orientation	C Are the fish/fish products sold in local, domestic or international markets?
Value of products	C _____ Is the value of fish/fish products high or low?

(3) Fisher, stakeholder and community attributes

Fisher, stakeholder and community attributes can all affect incentives to cooperate. These attributes include religious beliefs and practices, traditions and customs, sources of livelihood, the degree of social, cultural, economic and locational heterogeneity or homogeneity, asset ownership, community mores, level of community integration into the economy and polity, and others. Whether individual attributes or in combination with others, each of these attributes potentially affects collective action and outcomes. General assumptions about fishers and stakeholders are related to how they behave both individually and in groups. Stakeholders, those individuals indirectly dependent upon the fishery for their livelihood, such as fish traders, processors and transporters, are also included since their relationship with fishers can provide incentives or disincentives for the fishers to cooperate (Table 3).

Institutional analysis involves attempting to understand the behavior a representative individual will adopt in a certain situation in light of their interests. Fishers and stakeholders "are assumed to be self-interested, rational individuals who operate within a context of rules which specify lawful and unlawful behavior. Individuals are also assumed to make decisions under conditions of uncertain information and to adopt maximizing strategies." (Thomson 1992).

Some literature suggest two key attributes which lead to incentives to cooperate (Ostrom 1990, 1992, Runge 1992): (1) if a community of fishers exhibits a high degree of social, cultural and economic homogeneity in terms of kinship, ethnicity, religion, interests, beliefs, customs, livelihood strategies, etc.; and (2) if there is a high dependence or reliance of fishers on the fishery for their livelihood and the number of alternative livelihoods available to fishers in the community is low. If the fishers are highly dependent upon the fishery and if the availability of the resource is uncertain or limited, fishers are more likely to facilitate collective action to deal with the problem.

Table 3 Socio-economic Attributes and Indicators

Socio-economic attributes	Key questions	
Homogeneity/heterogeneity of users	C	How many ethnic groups are there among users? Are there differences in wealth, religion, gear types, residency amongst users? What are the vessel/gear/technology ownership structure?
Dependence on the fishery for livelihood	C	Who are the users/stakeholders (female/male)?
	C	What proportion of household/family income comes from fisheries?
Motivation of users	C	Are users exploiting the fishery for subsistence or commercial reasons?
Attitudes towards: risk, innovation, collective action	C	Are these attitudes: Strong/weak/indifferent?
	C	Is their heterogeneity in these attitudes?
	C	Is there any social/political mechanism, that prevent risk taking, innovation and collective action?
Level of information and knowledge on the fishery and management	C	What kind of knowledge (indigenous or scientific)?

(4) Fisher and Community Institutional and Decision-making Arrangements

Decision-making arrangements are concerned with how institutional arrangements, rights and rules, are made. There are three important aspects of decision-making: representation, relevance and enforceability.

- (a) Representation is the extent to which users and stakeholders participate in rule making.
- (b) Relevance is the extent to which the rules are considered relevant to the management problem.
- (c) Enforceability is the extent to which the rules are enforced.

The key questions which are considered critical are given in Table 4.

Table 4 Decision-making arrangements and indicators

Decision-making Arrangements	Key questions
Leadership/power structure of user groups	<ul style="list-style-type: none"> C What are the main characteristics of the leadership? C Are the leaders considered legitimate? C How are decisions taken eg. consensus, majority?
Main types of rules (operational, collective choice, constitutional choice) and at what level of applicability (local, regional, national).	<ul style="list-style-type: none"> C What are the formal and informal rules on access rights to the fishery? C What are the rules on harvesting rights? C What boundary conditions (social, economic, physical, legal) apply to the regulation of the fishery?
Decision-making process for operational and collective choice rules	<ul style="list-style-type: none"> C What are the main factors determining the way in which decisions are made for (one or two examples of) operational and collective choice rules? C How are decisions made (consensus/majority/autocratic)? C Which types of decisions are made through consensus/majority/autocratically
Level of representation in the decision-making processes at different levels (local, regional, national)	<ul style="list-style-type: none"> C Who are the users/stakeholders? C Are they represented in the decision-making process and how? C What is the level of participation of user groups/stakeholders in the decision-making process? C Are women represented and how?
Relevance of rules	<ul style="list-style-type: none"> C What are user and stakeholder attitudes/values towards decision-making processes? C What are user and stakeholder attitudes/values towards rule-breaking? C How much legitimacy do the rules have with users?
Enforcement of rules and regulations/sanctions	<ul style="list-style-type: none"> C How are formal and informal rules enforced? C What sanctions are used? C How do users perceive the utility of the rules? C What is the level of compliance/non-compliance e.g. number of convictions, user attitudes; obedience/obstruction? C What resources are available for monitoring and enforcement?

(5) External institutional and organizational arrangements attributes

Institutional and organizational arrangements external (international, national, regional, district or municipal levels) to the fisher or community level are relevant and can affect fisher or community institutional arrangements. However, the connection can vary widely. Some community-level arrangements may be subject to constitutional approval (constitutional-choice rules) to engage in collective choice. A community-level arrangement may be dependent on government for enabling legislation or enforcement of operational rules. An outside party may be needed to settle disputes between fishers. Fishers or communities may require outside assistance to facilitate and strengthen organizational capacity or to strengthen market forces. In some instances, fishers or community may need outside intervention to address problems outside its institutional mandate which impact upon local institutional arrangements and conditions (Oakerson 1992). There may be nested multiple layers of external institutional arrangements, with and without formal linkages, at both governmental and nongovernmental levels.

(6) Exogenous (macroeconomic, social, political, natural) attributes

A variety of factors exogenous to the fishery resource, fisher and community may have an impact on fisher or community institutional arrangements. These are factors which are beyond the control of the fishers and community, and at times higher level entities. These are surprises or shocks to the community or management system, brought about by macroeconomic, social, political or natural occurrences or interventions which affect the survival of the institutional arrangements. They may include typhoons, civil unrest, elections and inflation. They should be viewed in an historical and dynamic perspective.

These factors can provide an indication of how well the institutional arrangements are functioning and surviving through its capacity or resiliency to accommodate sudden change. Bromley (1992) states that all large changes in exogenous factors threaten the capacity of individuals to learn about change fast enough to make adaptive responses. The faster and greater the change, the higher the probability that the institutional arrangements will not be able to respond rapidly enough.

II. Incentives to Cooperate and Coordinate

The contextual variables, and specifically the institutional and decision-making arrangements, shape the incentives for individuals to take certain actions (cooperate, engage in collective action, coordinate activities) to achieve desired outcomes. The focus of the analysis is on how rules are devised, what the rules contain, whether the users consider them legitimate, and whether they are enforced.

An individual member of a group relies on reciprocal behavior from other members of the group regarding their adherence to the agreed-upon rules for management. An individual's choice of behavior in a collective action situation will depend upon how he or she weighs the benefits and costs of various alternatives and their likely outcomes. An individual's choices are often affected by limited information and trust in the actions of others which leads to uncertainty and by the level of opportunistic behavior or self-interest that individual fishers can expect from other fishers. Uncertainty often creates obstacles for exchange and cooperation among fishers (Ostrom 1991, Ostrom, Gardner and Walker 1994). Individual's also have differing discount rates; many poor fishers, for example, attributing less value to benefits that they expect in the future, and more value to those expected in the present.

In some situations, individuals may have incentives or opportunities, resulting from unevenly distributed information and power among the group involved in an action situation, to adopt opportunistic strategies to circumvent the rules and to obtain disproportionate benefits at the cost of others (Runge 1992). Three types of opportunistic behavior may occur: free riding, corruption and rent seeking. Free riders respond to incentives to engage in other activities while other members of the group work. Corruption can occur when incentives exist for rules to be changed for an individual through, for example, the provision of illegal payments. Rent seeking, the gaining of excess profits, can occur when an individual's assets, for example, property rights, increase in value through special advantages (Ostrom 1992, Tang 1992). The imperative of the group is to develop institutional arrangements which reduce or minimize transaction costs, reduce uncertainty and counteract opportunistic behavior.

For institutional arrangements to be maintained over time, it is important to develop workable procedures for monitoring the behavior of fishers, enforcing against non-conforming behavior with sanctions, and settling conflicts. The ease and costliness of monitoring rules devised to organize the fishing activity depend upon the physical nature of the resource, the rules-in-use, and the level of conformance to the rules (Ostrom 1990). The number of times that non-conformance must be measured affects the cost of monitoring. The ease and cost of monitoring will also depend upon whether the fishers can monitor compliance themselves, as they fish or through self-monitoring

incentives, or if they must establish more elaborate arrangements, such as external authorities.

Tang (1992) states, "Both transaction cost economics and institutional analysis are concerned with identifying appropriate institutional arrangements that can counteract perverse incentives inherent in various transaction situations. Whereas transaction cost economics approaches the problem by examining the characteristics of different transaction situations, institutional analysis explicitly identifies a higher level of analysis by delineating the contextual attributes that shape various action situations. At the contextual level of analysis, one examines how rules, physical attributes, and attributes of the community shape various action situations."

III. Patterns of interactions among resource users

While incentives to cooperate might exist, this does not guarantee that stakeholders and users will cooperate. Much will depend on the way resource users interact with each other and their behaviour both as individuals and as a group. (Oakerson, 1992). There is some overlap between incentives and patterns of interaction but the purpose in separating them is to assist the analyst in determine the likely reasons for a lack of cooperation when the incentives are thought to be in place.

To understand how fishers react according to incentives in the action situation, the analyst must systematically analyze the contextual attributes which combine to shape the incentive and constraint structure faced by the fishers. Given these contextual attributes and the incentives and constraints they generate for collective action, individuals make choices and develop strategies of action, from which emerges some patterns of interaction. Institutional arrangements do not generate patterns of interaction, but they shape and generate the choices and strategies individuals make in relation to others members of a group (Oakerson 1992).

Individual fishers will develop strategies to maximize their own self-interest within the bounds set by the institutional arrangements. Individual fishers will take advantage of the opportunities available to them and will comply with the rules to the extent required by those who enforce the rules (Thomson 1992). Individuals will adopt strategies which change with the level of information available to them and the level of reciprocal interaction from others. An individual's strategy to cooperate will depend upon assurance that others will do likewise. Patterns of mutual action will emerge. Thus, in the first period an individual will monitor the behavior of others. If he observes successful collective action, he will revise his strategy in the next period to increase the level of cooperation and compliance. He will continue to revise his strategy over time based on new information about the resource and its users (contextual attributes), the degree of reciprocity, and the effectiveness of monitoring and enforcement.

IV. Outcomes

Outcomes are produced as a result of patterns of interaction which are, in turn, the result of the strategies adopted by the fishers. The consequences of the patterns of interaction affect both those involved directly in the action situation and those indirectly involved. Various contextual variables can be associated with different outcomes. They may affect outcomes either positively or negatively depending upon the association. Patterns of interaction can produce biophysical, technical, social, economic, institutional and managerial outcomes. These include, for example, current resource yield, distribution of benefits and costs, livelihood and quality of life of fishers, knowledge of the fishery and its users, and degree of rule compliance. The specific outcomes may vary among fishers and communities and through time. Outcomes can be evaluated using different criteria. Of particular interest in evaluating outcomes in the question: How do predicted outcomes conform to evaluative criteria (Ostrom, Gardner and Walker 1994).

2. Institutional and Organizational Performance

The outcomes of co-management institutional arrangements can be evaluated in terms of performance, that is, the meeting of management objectives and the impact on the resource and its users. It is expected that in certain situations co-management institutional arrangements will perform better than other types of fisheries management institutional arrangements, such as centralized management. It is also expected that co-management will lead to more sustainable, efficient and equitable fisheries management.

The performance of co-management institutional arrangements can be evaluated at two levels. The first level of evaluation relates to overall institutional performance of co-management in meeting its stated advantages versus other types of management arrangements. These advantages include equity, more economical in terms of administration and enforcement, increased sense of ownership of the resource by users, self-management, higher degree of acceptability and rule compliance, improved information about the resource, improved social cohesion in the community, and more participatory (Pomeroy and Williams 1994). A comparative assessment of the performance of different co-management institutional arrangements can be conducted at this level of evaluation.

The second level of evaluation relates to performance in meeting specific management objectives and impacts at the operational level. Each individual co-management system has objectives established by the participants, both resource users and government, that are to be achieved. Performance of these systems is conducted to determine how well they achieved the objectives and what the impacts of the management activity are on both the human and biophysical environment.

The most common evaluative criteria are efficiency, equity and sustainability. Other criteria can also be used. These abstract evaluative criteria must be converted into operational measures of value for use in appraising specific outcomes (Oakerson 1992). Feeny (1992) has identified four methodological standards that operational measures of performance should meet. Reproducibility and reliability measures mean that the criteria should, for example, be able to be used by different observers to evaluate the same situation and get answers in close agreement. In addition, the measure should be applicable in different settings. "Validation may be demonstrated by showing that the operational measure that has been obtained inexpensively is highly correlated with an accepted and previously validated measure - the 'gold standard'". Lastly, a measure should be responsive and "... able to capture change, if in fact it has occurred, while providing stable scores for situations in which there has been no change."

Efficiency

There are various measures of efficiency. The first aspect of efficiency is whether fishers have achieved an optimal rate of use of the fishery (Oakerson 1992). A less rigorous criterion is that fishers are not exceeding the sustainable yield of the fishery. A second measure of efficiency has to do with the flow of benefits resulting from the co-management institutional arrangements and the costs (such as transaction costs) of establishing and maintaining such arrangements. Ostrom, Schroeder and Wynne (1993) state, "Economic efficiency is determined by the magnitude of the change in the flow of net benefits with an allocation or reallocation of resources." A minimal efficiency criterion is that the benefits of operating and maintaining such arrangements exceed the full set of direct and indirect costs. A comparative efficiency criterion is that the difference between the benefits and the costs of co-management institutional arrangements in one setting is the same as or greater than those of similar arrangements in a similar setting elsewhere (Ostrom 1992).

As management processes are established to achieve particular objectives, the cost-effectiveness of the process compared to others has to be evaluated. One of the purported advantages of co-

management compared to centralised management is that it will reduce transaction costs - the costs of information-gathering and processing, coordination of decision-makers/ user groups and regulation enforcement. Some of these costs remain fixed regardless of the management regime, such as information which is required by law. Other transaction costs vary with the quality of data and the process used to make decisions. Hanna (1994) points out that a centralised approach is often associated with low programme design costs but high implementation, monitoring and enforcement costs as the management regime may have little legitimacy with user groups. A co-management approach, on the other hand, is associated with high programme design costs as effective participation is time-consuming and therefore costly. However, co-management is likely to lead lower implementation, monitoring and enforcement costs as legitimacy of the regime is greater (Hanna 1995).

Equity

Equity (fair treatment for all people involved in managing, governing and using the resource) has four main components (Hanna 1995):

- (a) *Representation*: a more equitable management regime should represent the range of interests in the fishery and accommodate the full diversity of those interests.
- (b) *Process clarity*: the management process should have a clear purpose and a transparent operation.
- (c) *Homogenous expectations*: the extent to which participants have similar expectations concerning the management process and its objectives
- (d) *Distributive effects*: the management process should address the distributional changes embedded in the options under consideration

Equity can be measured in several ways. First, is the distribution of an individual's return on contributions to the management and governance effort roughly similar to the benefits they receive? Oakerson (1992) states, "The presence of inequities may lead to the collapse of reciprocity, resulting in less efficient use. Equity problems are apt to be aggravated by asymmetries (unequal proportions) among users, which create opportunities for some benefit at others' expense. This, in turn, can lead to costly conflict where all parties lose." Corruption and abuse of authority may contribute to inequities. A second measure is to determine if there are patterns of redistribution that fishers wish to achieve at this level of institutional arrangements. Questions to be asked include: (a) whether most fishers in the community are relatively satisfied with the institutional arrangements; (b) whether any fishers have been consistently disadvantaged as a result of the institutional arrangements; (c) whether the distribution of resources and wealth in the community has changed; (d) whether allocation of membership and rights in the organization is fair; and (e) whether individual's are receiving benefits based on differential abilities to pay.

Sustainability

Sustainability can be divided into stewardship and resilience. Stewardship, the tendency for resource users to maintain productivity and ecological characteristics of the resource, is divided into three components: time horizons, monitoring and enforcement. To promote resources stewardship, the management process should expand time horizons beyond the short term. A sense of stewardship will be more likely if the effects of the management regime can be monitored and where necessary,

enforcement measures taken.

The other aspect of sustainability is resilience. This is the ability of the system to absorb and deal with changes and shocks. The three components of resilience are rule flexibility, structural adaptation and market adaptation. Rules should be flexible enough to respond quickly to changing conditions. The management regime should be able to adapt to both changes in the structure of the industry as well as changes in the market (Hanna 1995).

Ostrom (1992) identifies several other criteria by which performance can be measured. One is concerned with the "match" of the membership of the management and governance organization and the fishers. Ostrom (1992) states, "A key factor that affects the long-run performance of an organizational arrangement is whether organizations can be established and maintained whose boundaries are roughly coterminous with those of the..." resource and its users. Mismatches can take two forms. One is a case where an organization is considerably larger than the fishery or the number of fishers. This might result in a total indifference to the problems of regulating the fishery. A second would arise where the organization is substantially smaller than either the territory of the fishery or number of fishers. If only a small number of the total fishers are involved in the organization then the gains from the arrangements would be minimized. Operational patterns of the organizational and institutional arrangements must be examined before concluding a mismatch exists.

A second measure involves the knowledge generated by fishers about the resource and about user preferences, benefits and costs. It is highly improbable that an organization could survive in the long-run and perform efficiently and equitably without detailed information about the characteristics of the fishery and use patterns. Without this information, rules to structure resource allocation would not achieve desired results. Thus, performance can be measured by the increase in information about the resource and the exchange of information among resource users.

A third measure is the level of rule compliance. The willingness of fishers to regularly follow operational-level rules reflects the viability of the rules as coordinating devices. This measure may be included with other measures in a group of performance criteria called "governance". In addition to the level of rule compliance other measures of governance performance may include overall reduction in conflict, existence of an effective conflict resolution mechanism, and existence of practical and implementable enforcement procedures.

3. Characteristics of Successful Fisheries Co-management Institutional Arrangements

The most important research task for an institutional analysis of fisheries co-management is to specify conditions and propositions for successful development of co-management institutions and which arrangements are most favorable for maintaining it. A number of questions need to be answered: Why are some co-management arrangements successful, while others fail? Why do some co-management arrangements endure for long periods of time? How can we improve the success rate for implementation of co-management arrangements?

The success of co-management institutional arrangements may be related to specific contextual variables or attributes, and these may affect the development and maintenance of the arrangements. The research framework provides a means to identify attributes which lead to successful co-management from those which lead to failure. For example, specific biophysical or fisher attributes, such as boundary definitions or fish stock characteristics or social homogeneity of the community, may be critical factors for success of co-management. They may be more critical than the institutional arrangements themselves. By identifying these attributes and then examining their relationship with patterns of interaction and outcomes, it is possible to specify conditions and propositions which can lead to successful development and maintenance of fisheries co-management institutional arrangements.

Over the last decade, research done at different locations around the world has documented many cases of co-management and community-based management in fisheries and other natural resource systems. From the results, certain conditions are emerging which appear to be central to the chances of developing and sustaining successful co-management institutional arrangements. Ostrom (1990, 1992) and Pinkerton (1989) have made useful contributions to our existing knowledge about key conditions for successful fisheries co-management. These key conditions are discussed in Pomeroy and Williams (1994). These conditions should not be taken as complete as continued research is needed to reveal more about co-management arrangements and the factors leading to successful performance.

5. CONCLUSIONS

There are a number of research frameworks and alternative theories available for the study of fisheries co-management institutions. The institutional analysis research framework has been selected for use in this project because it is both specific enough in character for organizing inquiry but general enough to be useful in a wide variety of situations. The institutional analysis research framework has been used for analysis of diverse situations and no problems have yet been encountered. It is hoped that its use in this project will lead to further methodological strengthening of the research framework.

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