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LOCAL ORGANIZATIONS FOR NATURAL RESOURCE MANAGEMENT: LESSONS FROM THEORETICAL AND EMPIRICAL LITERATURE *

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ABSTRACT

The sustainability of natural resource management depends not only on appropriate technology and prices, but also upon the institutions involved in resource management at the local level. Heavy state involvement in natural resource management has been justified based on the prevalence of market failures, notably the positive and negative externalities and the strategic importance of the resources. Policies of devolving management responsibility from the state to users have become increasingly widespread in response to the performance deficiencies of government agencies, the fiscal crisis of the state, and broader policies of decentralization. The success of these policies depends upon the local capacity for collective action, but the factors that encourage or inhibit the collective action are insufficiently understood.

This discussion paper aims to identify factors which condition local organization for resource management. It draws upon a review of two major bodies of literature: empirical analyses of forestry, fisheries, grazing, and irrigation management, and game theory literature. The empirical literature on resource management highlights the physical and technical characteristics of the resource, the characteristics of the group of users, and the attributes of institutional arrangements as key factors affecting the management capacity of local organizations. Simplistic game theory has often been used to predict a "tragedy of the commons" for natural resources, but more refined versions provide insights into the role of communication, group size, time horizons, trust, and social norms in supporting collective action.

The evidence on voluntary organization indicates that collective management is often a viable alternative to nationalization or privatization of natural resources. Although local organizations will not be able to solve every collective action problem, in many situations they could be at least as effective as other management agencies. Knowledge of the factors which condition local organization should be used to develop policies to support local organizations for natural resource management.

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Lise Nordvig Rasmussen** and Ruth Meinzen-Dick***

1. INTRODUCTION

Resource degradation problems in a number of sectors--including forestry, fisheries, grazing, and irrigation--have received increasing attention in recent years. Concepts of sustainable natural resource management (NRM) as only a technical-ecological matter on the one hand, or an economic issue, on the other, have been shown to be too simplistic. If either approach were sufficient, natural resource degradation problems would be relatively easy to solve. The persistence of these problems, and the failure of simple technological or economic "fixes" demonstrate the need to look at more complex aspects of resource management. There is thus growing recognition of the centrality of social actors, their institutions and organizations when exploring natural resource management issues. Voluntary organizations at the local level which provide a source of collective resource management are receiving particular attention, as an alternative to state management on one side, or private management on the other.

The primary aim of this discussion paper is to **identify factors which condition local organization for natural resource management**. The attention given to this issue is based on the premise that an understanding of the factors which affect local

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organization for natural resource management is essential for making improvements in the outcome of natural resource management practices.

The examination of this key issue in this paper is based on selected pieces from the enormous body of existing literature in this field. The empirical literature has seen a rapid growth in the number of case studies exploring management of various natural resources, from varying disciplinary perspectives, particularly in the past decade. For example, Martin's (1992) bibliography on common pool resources and collective action alone holds 7250 citations. The theoretical literature, particularly game theory, is also growing. In this paper, we focus on the literature that attempts to synthesize theoretical as well as empirical findings, rather than individual case studies. It draws from work relating to a range of natural resources, including water (especially irrigation), fisheries, forestry, and grazing land, with emphasis on the common lessons that apply across the different types of resources. Thus, a second purpose of this paper is to serve as an overview and guide to the literature in this field.

The paper is structured as follows: the second section examines the impetus for studying local organizations, particularly the through recent policy trends. The third section defines key terms related to local organizations for natural resource management. The fourth section focuses on the key factors which empirical studies have identified as influencing such organizations. The conclusions regarding determinants of local organization that can be reached on the base of the theoretical literature, and game theory in particular, are presented in the fifth section. The sixth section identifies the key gaps which remain to be addressed, particularly to improve the basis for policy change. The

final section points to the convergence between theoretical and empirical literature, as well as to limitations of each, and indicates areas for further research.

2. IMPETUS FOR EXAMINING LOCAL ORGANIZATIONS

Heavy state involvement in natural resource management has been justified based on the prevalence of market failures, notably the positive and negative externalities and the strategic importance of the resources. The current emphasis on user groups and local management as an alternative to state control over such resources has its roots in both academic studies and policy pressures. From the late 1970s on, there has been an increasing number of field studies of user-managed resource systems, which suggested that government management was not the only (nor even always the best) option. Since the mid-1980s there has been greater attention to management of common pool resources in the theoretical literature (e.g. Bromley 1992; National Academy of Sciences 1986; Ostrom 1990; Runge 1986). These studies have argued that local management by users does not necessarily lead to a "tragedy of commons", provided there are effective local organizations.

On the policy side there has been a growing awareness of the performance deficiencies of many government agencies in managing resources at the local level. The fiscal crisis of the state, combined with structural adjustment programs, have created pressures to reduce subsidies to agencies, and look for alternatives. Devolving management responsibility to local organizations has therefore been seen as increasingly attractive.

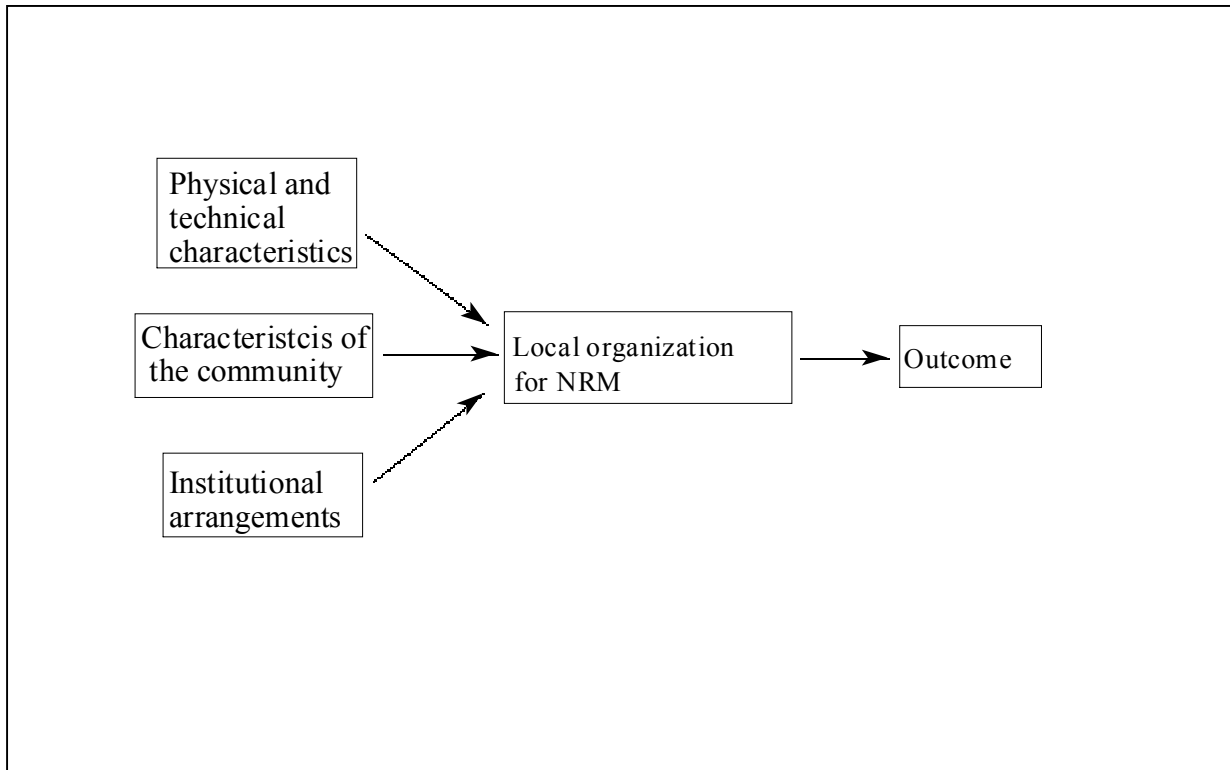
Initiatives such as turnover of irrigation systems from state agencies to water user associations, or joint forest management to involve local communities along with state agencies, are being implemented on a broad scale in many countries. These are based upon the assumptions that local organizations will exist or emerge to take on management functions. But for these efforts to succeed, a better understanding of the factors affecting LOs, and of the types of policy changes which facilitate their development, is required.

Several current development themes intersect and contribute to the growing interest in LOs on the part of donor agencies and national governments. One of the clearest themes is **improving natural resource management**. But a broader theme is **decentralization**, or "rolling back the boundaries of the state" to improve the management of natural and fiscal resources. This applies to both administrative decentralization which attempts to move decision-making authority down to the local level, and to financial decentralization which aims to shift responsibility for payment down to local entities, particularly users. LOs can facilitate both types of decentralization by providing a local entity for decision-making and resource mobilization. Interest in **privatization** to improve financial performance and cost recovery likewise leads to dealing with LOs because, in the majority of situations in developing countries, it is administratively unfeasible for each individual to operate independently in natural resource management. Finally, the themes of **participation** and **democratization** stress the involvement of citizens affected by programs, for social goals of empowering local people as well as goals of improving program performance. For these, LOs offer an organized forum for communication and local input.

3. DEFINING LOCAL ORGANIZATIONS FOR NATURAL RESOURCE MANAGEMENT

Managing the natural resources is increasingly viewed as a process in which the organization forms the central unit of interaction (Coward 1980). Figure 1 presents a simple, short-run conceptual framework for examining the processes and relationships between local organizations and the environment. The mode of organization varies as a result of the condition of external factors (independent variables). The mode of organization and the pattern of interaction within the organization, in turn, affect the resource management outcome. Identification of factors which condition the local organization, and of the types of organizations which facilitate sustainable natural resource management, are important for policies to assist local organizations. However, confusion between the organizations and the outcome in terms of resource management should be avoided. Organizations are not, in general, an end in themselves, but a means of improving the management of the resource.

Figure 1 Conceptual framework for examining local organization in natural resource management



Levels of action (decision making and activity) can be conceived as a continuum ranging from the international level in the one end to individual level in the other. **Local** organizations are those which operate somewhere in between, above the household and below the regional and national levels (Uphoff 608-609).

It is possible to distinguish between three sectors where natural resource management can take place:

- the private sector;
- the collective action sector; and
- the public sector.

These three sectors differ, among other things, by the assignment of property rights and the incentives of compliance which make people cooperate. Property rights in the private sector are assigned to individuals, in the collective action to groups, and in the public sector to the state. In the private sector utility is the primary incentive for cooperation; in the collective action sector cooperation is based on normative-voluntary incentives, and in the public sector the cooperation is enforced, with sanctions and penalties as the primary incentives. The different management sectors can also be perceived as a continuum, with the private sector on one end and the public sector on the other. In between these two poles we find the collective action sector, in which local organizations provide resource management (Esman & Uphoff 1980: 20-21; Uphoff 1993: 612-614).

If property rights are completely absent, there will be open access to the use of resource (Bromley 1992). Under open access, no one has responsibility for resource management, and there is little to prevent "free riders" from exploiting the resource without contributing to its maintenance (though some individuals or "privileged groups" may provide maintenance services, if the benefits are great enough). The difference between an open access situation and the three management systems mentioned above is essential for correct interpretation of situations and policies. Failure to distinguish between common property and open access situations has led to more than intellectual confusion: it has also contributed to mistaken policies of privatization of resources, on the one hand, or state take-over of resources on the other.

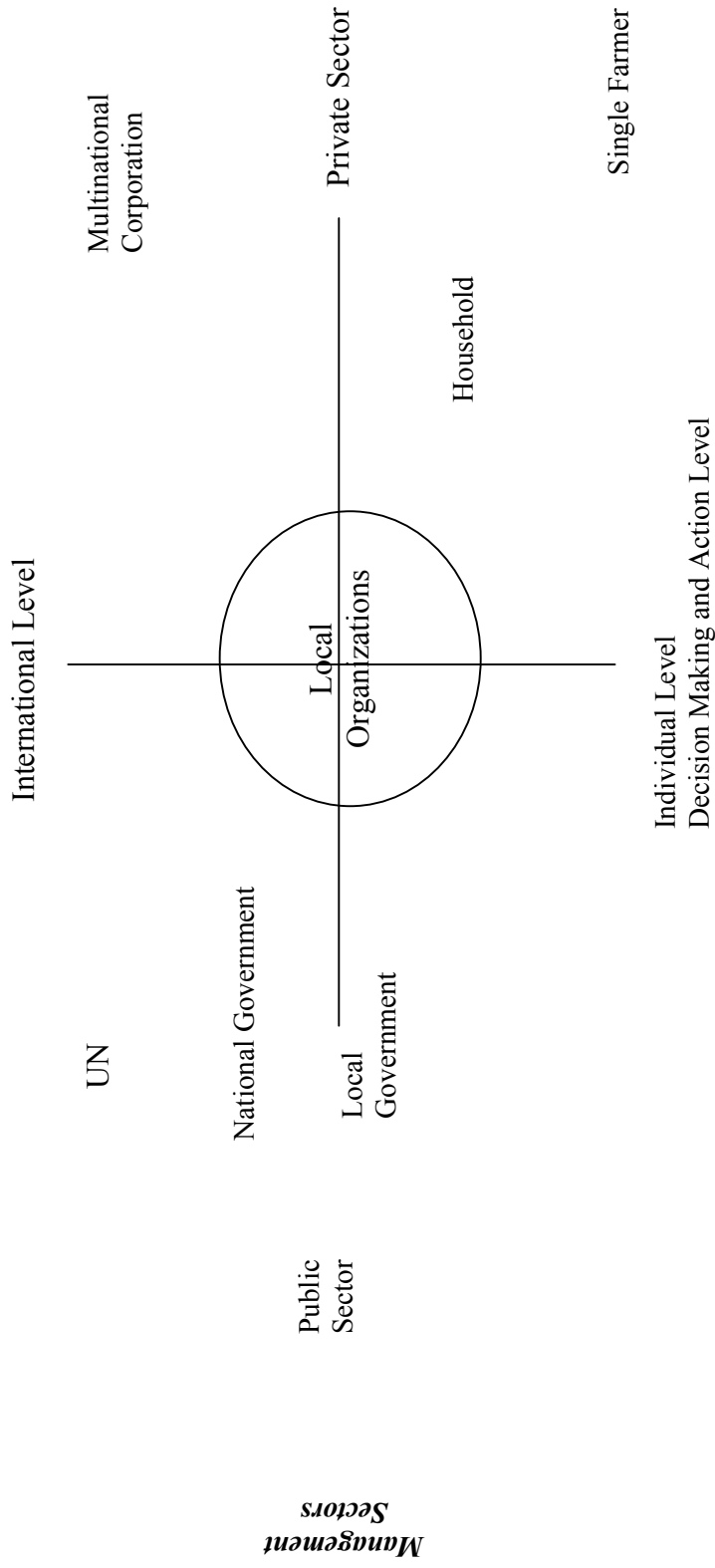
If the two continua of international to individual levels and private to state management are seen as intersecting at right angles (as illustrated in Figure 2), local

organizations for NRM occupy the central position. Empirical cases of management entities can then be placed at different points, depending on the composition of incentives and levels at which they operate. For example, local governments would be state sector and local level, while multinational timber companies might be represented as private sector and international level. In practice, a given resource may be affected by a combination of management entities such as private individuals, local organizations, national regulatory agencies, and even international trading firms, but it is useful to consider the incentive structure and level of operation of each.

4. INSIGHT FROM ANALYSES OF EMPIRICAL STUDIES

There are a large number of case studies examining local organizations for natural resource management from various disciplinary perspectives. Following in the wake of the "Conference on Common Pool Resource Management" held by the National Academy of Science in 1985 (see proceedings from the conference: National Academy of Science 1986), there have been great efforts to synthesize the findings from these case studies and develop a general framework for the analysis of natural resource management situations.

Figure 2 Levels and sectors identifying natural resource management entities



The factors identified in the literature which condition local organization can be divided into three categories of variables (Tang 1992; Uphoff 1986):

- physical and technical characteristics of the resource;
- characteristics of the group of users;
- attributes of institutional arrangements.

The relative importance of these factors as determinants is likely to depend on local conditions. Specific dimensions of each of these which have been discussed in the literature are explained in the following discussion. A summary of the factors identified under each heading by a number of key authors in this area are presented in Table 1.

Table 1 Factors identified by key authors as affecting local organizations for natural resource management

	Ostrom (1990, 1992b)	Wade (1988)	Bardhan (1993)	Nugent (1993)	Oakerson (1985, 1992)	Tang (1992)	Bromley & Cernea
Physical and technical characteristics of the resource system	Physical Structure: Size Clarity of boundaries Flow patterns: Predictability in time, across space and in quantity Condition of the resource Technology For withdrawing resources For exclusion	Boundedness of resource Size Cost of exclusion technology	Boundedness of resource	Nature of resource - excludability	Capacity of the resource Excludability of the resource Subtractability/jointness Divisibility - physical boundaries	Area size Resource supply Possibilities of substitution	Nature of the resource
Characteristics of the group of users	Number of members Time horizon Proximity to resource and between users Extent of interaction -individualized or collective action Skills and assets of leaders Homogeneity v. heterogeneity of interests Norms of behavior/culture Stability	Size of user group/number of members Boundaries of the group Location of resource and residence of users Users' knowledge Users' demand Power structure Mutual obligations	Size of group Shared norms Group identification Egalitarian structures/homogeneity Openness Stability: migration and mobility possibilities	Competition between alternative organizations Tradition/norms		Number of users Homogeneity Sources of income -dependence on resource	Characteristics of the user of the resource

Institutional arrangements	<p>Design principles</p> <ul style="list-style-type: none"> Member and access rules Resource boundary rules Appropriation (withdrawing) and provision rules Collective choice arrangements Monitoring and sanctioning rules Recognition of rights to organize by external agents "Nested enterprises" - multiple layers of nested enterprises <p>Market conditions for the resource</p>	<p>Existing arrangements for discussion of resource problems</p> <ul style="list-style-type: none"> Punishment rules Relationship between users and state -external rules and intervention 	<p>Structures of punishment/sanctions</p> <ul style="list-style-type: none"> Monitoring mechanisms External authorities' recognition of local norms 	<p>Rules of monitoring and sanctioning rules</p> <ul style="list-style-type: none"> Ability to change rules Governance structure - internally Governance structure - externally 	<p>Decision-making arrangements</p> <ul style="list-style-type: none"> Operational rules Collective choice rules External arrangements 	<p>Operational rules</p> <ul style="list-style-type: none"> Collective choice rules Form of governance - community vs bureaucratic system 	<p>Characteristics of the decision making-process</p> <ul style="list-style-type: none"> Type of resource regime - property rights Legal, political environment
Relationships		<p>Noticeability: ease of detection of rule-breaking free riders</p>	<p>"Ecological stress"</p>			<p>Relationship between resource, group and institutions</p>	<p>Ecological stress: supply and demand conditions</p>

PHYSICAL AND TECHNICAL CHARACTERISTICS OF THE RESOURCE

The degree of **excludability** and **subtractability or rivalry** of the resource have been stressed by numerous authors as characteristics used to distinguish the type of the resource. Excludability relates to the cost of preventing others from using the resource, while subtractability refers to situations in which use of the resource by one individual reduces the amount available to others. Resources which have high excludability can be managed efficiently as private property; those with low excludability but also low subtractability are public goods which the state can provide; but those with low excludability and high subtractability are common pool resources, which are most susceptible to degradation through the "tragedy of the commons" if management entities are lacking. Excludability and subtractability, in turn, are influenced by the **size** of the resource system and the **natural boundedness** of the resource (Oakerson 1986; Uphoff 1986; Vermillion 1991: 20; Ostrom 1992b: 295-96). The **technology** used for the withdrawing of resources and for enclosing will, according to Wade (1988) and Ostrom (1990), affect the possibility of interaction between the individuals as well. These factors are essential to the **flow** or **supply** of the resource, which can be described by the extent of predictability in quantity, over time and space (Bromley and Cernea 1989, Ostrom 1990; Tang 1992).

CHARACTERISTICS OF THE GROUP OF USERS

This category focuses primarily on the sociological characteristics of the group of users. First of all the users' **demand for, dependence on, and knowledge of the resource** are important factors in terms of characteristics of the group which increases incentives for organization for NRM (Uphoff, Wickramasinghe and Wijayaratna 1990; Wade 1988).

The **number of users** in the resource system has also considerable effect on the possibility of voluntary organization. The general hypothesis claims that with an increasing number of participants, the possibility of voluntary organization will decrease (Bardhan 1993; Nugent 1993; Ostrom 1990; Bromley 1992). One of the arguments which has been used to support this hypothesis is that the smaller the group, the more homogeneous the interests of the members are likely to be. According to this argument **degree of homogeneity** becomes an intermediate variable between size of the group and degree of organization. This intermediate variable is positively linked to the dependent variable. In a natural resource management context it is not surprising that similarity in, for example, **resource access** and **perceptions of the risk** of the long-term resource exploitation will enhance the possibility of cooperation (Ostrom 1992b: 229). But also the consistency in **norms** in general has been identified as a crucial factor affecting the degree of organization (Nugent 1993; Bardhan 1993; White and Runge; Ostrom; 1990).

Though **homogeneity** is identified by several authors as an important factor facilitating organization, Baland & Platteau (1994: 273-284) question the validity of this relationship. Ostrom (1986; 1992) makes the same point, claiming that heterogeneity in asset structure can actually favor the possibility of organization, particularly where there is a need for leadership and entrepreneurship.

The existence of voluntary organizations is facilitated by the **proximity** of the residence of the users to each other as well as the proximity of the residence of the users and the location of the resource (Wade 1988; Ostrom 1990). Also the extent of interaction and **organizational experiences or density** in other types of activity than natural resource

management and the expectations about the **time horizon** of the activity are hypothesized to be positively related to the possibility organization for NRM (Ostrom 1990; Cernea 1993).

Finally the **openness** and **stability** of the community in general is a crucial determinant of cooperating. The higher the rate of migration, mobility, and market integration, the lower the possibility of voluntary cooperation or organization (Baland and Platteau 1994; Bardhan 1993; Ostrom 1990).

INSTITUTIONAL ARRANGEMENTS

In identifying and examining the determinants of local organizations, the issue of the institutional arrangements has received a great deal of attention. It is useful to distinguish between three levels of institutional arrangements: operational rules, collective choice rules, and constitutional rules.

The **operational rules** directly affect the use of the resource: who can participate, what the participants may, must and must not do (permit, require, and forbid), and how they are rewarded and punished. Rules can be either formal or informal shared understandings. The content of the following five categories of operational rules are important for the possibility of organization:

- boundary and access rules defining the resource system in terms of area and members;
- allocation rules--who is getting what;
- input rules--in what way the users contribute;
- penalty rules--monitoring and sanctioning;
- conflict resolution rules or mechanisms.

The presence of operational rules will not in itself tell anything about the possible degree of organization. However, if the rules can be described by a high degree of **simplicity, flexibility** and **fairness**, it seems to enhance the possibility of local organization for natural resource management (Baland & Platteau 1994: 265-267).

The **collective choice rules** give guidelines for formulating, changing and enforcing operational rules (Tang 1992). These rules define who is eligible and how the future operational rules will be made (Ostrom 1990: 141-142). Veto rights to individuals or groups are an example of such collective choice rules (Oakerson 1992). The extent of participation of the individuals affected by the operational rules has been emphasized as a crucial factor at this level of institutional arrangements.

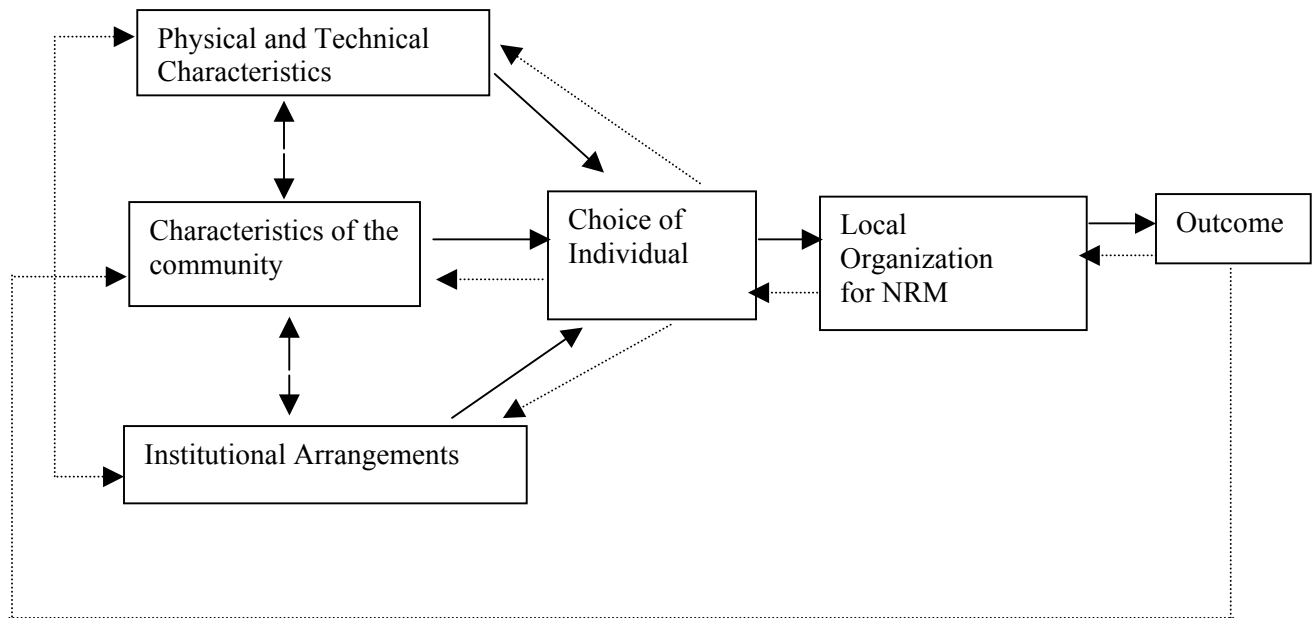
At the third level, **constitutional rules** are defined both internally and externally. In local organizations the collective and constitutional rules are difficult to separate.

The **external arrangements** include any public regulation of relevance, such as property rights, delegation of decision-making competence to the local level, rights of reorganization, environmental and natural resource regulation. Also market arrangements and, consequently, economic conditions within which the natural resource management takes place have importance for the level of organizational activity (Oakerson 1992). The form of the relationship between external arrangements and degree of organization will depend on the specific content of the former. Generally the external authorities' recognition of local practices and norms are emphasized as facilitating effective local NRM (Wade 1988; Bromley and Cernea 1989; Bardhan 1993; Ostrom 1990). Local organization becomes easier when the arrangements in the external environment are supporting the process.

Finally, it has been argued that organizational activity will be positively affected by links to other organizations. Uphoff (1991) points out the importance of both horizontal and vertical linkages. In other words, existing organizations seem to be better off if they are a part of a larger organizational system than if they are performing in isolation (Uphoff 1991: 496). Similarly Ostrom (1990) finds the use of "nested enterprises" constituted of a number of organizations on different levels to be a design principle for stable natural resource management in more complex systems.

Figure 3 summarizes the relationships among the variables that affect local organization. Broken lines are used to illustrate the dynamics and complexity of organizational changes.

Figure 3 Relationships among factors affecting local organization



At this stage of the analysis it is essential to draw attention to the **interaction** among the three factors conditioning local organizations. Some aspects - such as "**ecological stress**" or **scarcity** of the resource - can only be understood as a result of interaction among factors from all three categories (e.g., supply of the resource, the user's dependence or reliance on the resource, and operational rules regulating access to the resource).

While the hypotheses generated from comparisons of case study material are rich, this methodology for studying organizations for NRM has a serious drawback in the lack of rigorous indicators through which degree of organization can be studied as a dependent variable. In the empirical case studies, the analysis of the organizational variable is usually approached in a rather descriptive and qualitative way. If the issue of indicators of organizational activity is discussed explicitly, the discussion is often fairly abstract. Thus, there is still a great need for development of such indicators. Existing case studies can be used to identify indicators in an inductive and systematic manner, as has been done in identifying determinants of organization. Such indicators are needed to test hypotheses about the determinants of organization, as well as to test the relationship between local organizations and natural resource management outcomes.

5. INSIGHT FROM COLLECTIVE ACTION AND GAME THEORY LITERATURE

The growing body of game theory has been used extensively to address the question of whether or not individuals are capable of cooperation and will choose to cooperate and organize voluntarily. In this literature, the choice the individual confronts is generally viewed as a comparison of expected benefits and costs of alternative choices of actions, with the economic concepts of costs and benefits defined rather abstractly (Oakerson 1992: 49).

Numerous games have been developed, starting from the classical Prisoner's Dilemma Game. This game has, to a great extent, been the underlying argument for the pessimism on cooperation within the natural resource management literature (Bardhan 1993: 634; Feeny, Berkes, McCay, and Acheson 1990; Ostrom 1990). The application of other games to NRM situations leads to more optimistic views. While a full discussion of this literature is beyond the scope of this paper, we focus on the assumptions which are made in the different games, in order to identify the factors which are expected to condition cooperation and organization.

THE PRISONER'S DILEMMA GAME

Hardin's widely recognized "The Tragedy of the Commons" (Hardin 1968) can be formalized into a classical Prisoner's Dilemma (PD) game.¹ In a 1-shot version of this game the players face a payoff structure which implies a dominant strategy of defection or noncooperation, and makes unlikely the possibility of voluntary organization. From an individual standpoint this choice of strategy in a 1-shot PD game is rational, but it becomes irrational from an overall view. Everybody would be better off if they cooperated instead of defected.

Consequently the PD game has been used as an argument for nationalization as well as privatization of natural resources. The former is based on the argument that the original payoff structure in the PD game can be changed by the state in such a way that cooperation becomes a dominant strategy. For example, regulations and penalties can create a new payoff structure that encourages people to cooperate (Ostrom 1990: 8-12). This, however,

¹ The PD is presented in several sources. See for example Ostrom (1990: 2-14); Feeny, Berkes, McCay, and Acheson (1990: 1-3); Baland and Platteau (1993: 17-28).

assumes that the state (and its representatives) has proper motivation, sufficient knowledge, and enforcement ability to provide optimal resource management. It ignores the need for extensive local information for monitoring and enforcing regulations, in which the state has no comparative advantage, and problems caused by rent-seeking by agency staff who have low incentives to successfully manage the resource.

On the other side, the "property rights school" argues that the existence of a set of well defined property rights is the most appropriate way to make individuals internalize the externalities and thus avoid resource degradation. It even argues that the institution of private property will emerge spontaneously whenever a cost-benefit comparison makes it appear as more desirable than any other system (Baland & Platteau 1994: 29-30). This approach is premised upon the existence of complete and perfect markets, including futures markets. In practice, such conditions are often absent for many natural resources in developing countries, where information and bargaining asymmetries, high transactions costs, and non-divisibility of the resource violate the assumptions of the property rights school.

GAMES IN FAVOR OF COOPERATION

The structure of the PD game is highly artificial, and does not represent the conditions actually faced by individuals in most NRM situations. A number of alternative games have been applied by those who believe that the constellation of costs and benefits of collective action on natural resources is often of a kind which is much more favorable to the possibility of cooperation than the PD game predicts (Bardhan 1993: 634; Nugent 1993: 624). These games take into account the interactions between individuals. Theorists such as

Axelrod (1984), Elster (1989), Runge (1986), and Taylor (1988) have argued that if certain conditions are present, the players will face a payoff structure which makes voluntary cooperation possible, even desirable. The major game structures which support this conclusion are:

Chicken Game (CG)

Assurance Game (AG)

Repeated Prisoners' Dilemma (PD) with tit-for-tat strategy

Fairness Game (FG)

Despite the similarity of the conclusions drawn by these authors, it is important to note that the games they are referring to are not the same. The assumptions that are made and the factors which have been identified to condition organization differ in the games. Rather than discussing these differences in any detail, this paper focuses on identifying factors which determine organization, particularly the variation along two fundamental variables: **size of the group** and the **time horizon** of the game situation and analysis.

The Chicken Game (CG) is the simplest of the four games. It describes a one-shot situation in which at least one of the players will cooperate simply because both players want to avoid a dominant strategy of defection--which is the least favorable strategy in terms of comparison of costs and benefits (see Taylor 1988). Each player would rather cooperate than have universal defection, but given the cooperation of the other, each player has an incentive to defect. Therefore, the worst possible outcome is averted, but universal cooperation is also not achieved.

The Assurance Game (AG) is a coordination game. In this game the payoff structure the players face is not as favorable as in the CG, and each player prefers symmetric solutions

(see Runge 1981; 1984). Thus, universal cooperation or universal defection are possible equilibriums. Accordingly there is no dominant strategy. Under these circumstances the degree of **communication** between players will be a crucial to the possibility of cooperation or organization. Extension of the AG to multi-player games assumes that each player will only choose to cooperate if at least a critical mass of the other players is doing the same. Thus **catalysts** can play an important role in getting cooperation started. Furthermore the choice of action will depend on the **mutual expectations** and at last the **degree of trust** of the members of the group (Baland & Platteau 1994; Runge 1984).

The more complex dynamic analysis of the repeated games appear to be most useful for identifying factors of organization. The Tit-for-tat strategy (TS) of cooperation is a result of a repeated PD game situation. If cooperation gets started, it will be **reciprocated** (Axelrod 1984; Nugent 1993:625), as each player plays whatever the previous player played. The argument is that "each player accumulates experience of the behavior of his opponent since he meets him personally at each round of the game and is able to recall his past moves" (Baland and Platteau 1994: 101). In other words, according to the Tit-for-tat strategy, an organization can emerge and be maintained if there the group is **small**, there is in the beginning a **willingness to give the cooperation a trial**, and certain **stability** of the group which allows the **continuous interacting for a longer period of time** between the same members.² Unlike the AG, the choice of the players in dynamic games will not only build on expectations but also on observed past behavior (Bardhan 1993: 635).

² While most of the results in game theory depend on infinite time horizon games, they often are reproducible in finite games with uncertain horizons, i.e. games in which the players are uncertain when the game ends.

In other dynamic game strategies such as the Fairness Game (FG), the importance of **social norms** has been identified as a crucial factor determining organization. In particular, Elster (1993:101) highlights the role of the "Norm of fairness': cooperate if and only if most other people cooperate." In FG there will be a dominant strategy of cooperation, and the argument is that the players will not hesitate to cooperate because they know that, if they do so, the other players will follow suit.

On the basis of the discussion of CG, AG, TS, and FG in the literature, the following factors can be identified as affecting the degree or possibility of cooperation in local organizations:

- relative benefits of cooperation (over alternatives);
- size of the user group;
- users' perceptions of time horizon;
- degree of communication between players;
- expectations;
- degree of trust;
- a willingness to try cooperation;
- catalysts to start cooperation;
- stability of the group;
- existence of other cooperative structures;
- non-anonymous relationship between members; and
- content of social norms.

Accordingly, there is a basis for local self-governed organizations to arise spontaneously and voluntarily in some situations, and they will be an effective solution for NRM. Thus state regulation or privatization do not provide the only effective forms of

management for natural resources--there can also be a collective action sector in which resources are managed in common. The importance of the distinction between a situation where the management takes place in the collective action sector and an open access situation is stressed by the "common property theorists" who argue that theorists of nationalization and privatization often are overlooking this important distinction. Thus Bromley and Cernea (1989) suggest that what Hardin calls "The Tragedy of the Commons" should rather be called "The Tragedy of Open Access".

6. GAPS IN THE LITERATURE

Despite the burgeoning literature related to local organizations for NRM, and despite the convergence between game theory and empirical synthesis studies, several critical gaps remain. There will always be more natural resource management situations, and more organizations to be described and analyzed in detail. The priorities for such work depends on whether these require further research to develop new principles and insights, or only require the application of existing principles. For the purposes of both understanding the critical factors in group formation, and particularly for developing policies to encourage local organizational efforts to manage natural resources, a number of key areas merit further attention.

Game theory has provided a number of important insights into the incentives for group formation and collective action. The growing sophistication of game structures, as the artificial rules and structures of the games are modified to include norms, values, and other social factors, make the insights more applicable to the real world. However, a major limitation of the games presented in this paper is that they still consider only a limited set of

possible strategies confronting the players. As a result they do not capture the complexity of the numerous alternative strategies the users actually confront. More refinement is also required to deal with implications for cooperation among large numbers of players, and for dealing with heterogeneity among actors. While the games structures are evolving to take into account social interactions, they need to be further adapted to address the complexity of natural resource management situations.

Even with the many empirical case studies and attempts to synthesize lessons from studies of local organizations, we are far from having ready prescriptions for successful NRM. One reason for this is the large number of dimensions and variables which need to be taken into account--with very few (if any) studies providing evidence on all of the critical dimensions. Indeed, the number of variables and the ways in which they are measured appear to grow faster than the number of cases, so that little systematic analysis is possible.

The lack of rigorous comparative research places a serious limitation to synthesizing and testing factors that affect organizations on the basis of empirical studies. Particular case studies emphasize different factors as being critical to the success of certain local organizations, but they rarely provide enough information about other factors to be able to compare cases and generate or test alternative hypotheses. We are therefore, out of necessity, left with drawing upon the expert opinion of each study's authors as to what factors led to success or failure in each case. As a result, many of the findings remain open to different interpretations.

Part of the reason for the lack of such comparative research lies in the difficulty of operationalizing many of the key concepts relating to the resource base, the users, and the organizations themselves. For example, it is difficult to measure "boundedness" of the

resource, or its predictability; the time horizon and leadership among the users; or procedures for monitoring and rules for sanctioning. Even more basic concepts such as "size" of the resource unit, "heterogeneity" of the group, or property rights over the resource present complex problems to specify accurately enough to compare, particularly across different resources or geographic areas. Development of indicators which apply across a broad spectrum of situations is still a great methodological challenge that needs to be met, if empirical work is to move beyond insightful, but idiosyncratic, studies.

As difficult as it may be to measure the "independent" variables or factors affecting local organizations, the lack of consensus and coordination regarding indicators of organizational activity presents an even greater impediment to our understanding in this field. Researchers are often adept at identifying which are "good" organizations in the field, but it is much more difficult to specify what constitutes "good" (or "strong") organizations. For example, does a high frequency of meetings indicate an active organization, or a high degree of conflict within the organizations? A further complication lies in separating indicators of organization from resource management outcomes. Thus, the degree of success in managing the resource is taken as an indicator of whether an organization is operating. Alternatively, the activity of a local organization may be taken as an end in itself, without considering how effective it is. If we are to understand the factors that affect local organizations, and the role of such organizations in NRM, we need to be able to distinguish between and measure the independent variables, the organizations themselves, and the outcomes for the resource base.

While both game theory and empirical studies have shown that collective action is possible, further study of the limitations of voluntary local organizations would also be valuable. There is a selection bias in the sample of LOs which have been studied, favoring

successful organizations. Organizations which have failed, or locations in which collective action has not emerged are less likely to be examined. Yet identifying the problems and barriers is also important for our understanding of how to facilitate local organizations.

The policy focus has generally been missing in studies of local organizations. That is, the factors affecting organizations and NRM are seen as given, without examining how they can be controlled or influenced. This may lead to considerable academic insight, but has limited applicability to changing or improve resource management outcomes. For this we need to identify and emphasize the "leverage points". This particularly leads to further examination of the legal framework and state regulations. The important question to address is what kinds of external support is helpful in strengthening local organizations, rather than taking over or undermining them.

There is also insufficient understanding of how local communities shape not only the organizations and the resource management outcomes, but even environment in which they operate. Although process documentation of action research traces out many of these linkages for particular cases, such feedback loops are missing from many conventional studies. Policies, in particular, are too often seen as exogenously determined, without recognizing the effect of lobbying efforts by the organizations themselves. Thus, in addition to internal dynamics, further attention to the external relations of local organizations is needed. Indeed, one indicator of organizational effectiveness may be the extent to which they are able to influence state policies.

While many studies have focused on traditional organizations, these do not represent the full range of LOs involved in NRM. As states withdraw from attempts to manage natural resources at the local level, the role and complexity of LOs often increases. Federations of

base-level organizations, for example, allow the users to coordinate between groups and manage resources over a larger area. There are also more instances of joint management between government agencies and LOs. Capturing the crucial features of such complex institutional arrangements requires going beyond the emphasis on internal arrangements and individuals' incentives to participate in the groups, to give greater attention to inter-group relations.

7. CONCLUSION

There is now ample evidence showing that organizations are able to develop and be sustained spontaneously and voluntarily under certain circumstances. Both the theoretical and empirical literature have turned attention to identifying the factors which affect the degree of organization, with a growing overlap between these in terms of the conditions for organization.

Even though the PD game does not predict the emergence of voluntary organization, it draws attention to the importance of the property rights arrangements, which is also pointed out in the empirical literature. Both the empirical literature and the more optimistic games share an emphasis on sociological variables. The size of the group, shared norms, degree of communication, stability in the group, and perceptions of time horizon are identified as crucial factors conditioning voluntary organization. Such convergence between theoretical and empirical literature increases confidence in the importance of these variables.

Finally, one can ask what implications these conclusions have in terms of policy considerations. First of all, the evidence of the possibility of voluntary organization indicates that extreme caution should be applied before moving to nationalize or privatize natural resources which can be managed as common property. This does not mean that one should expect that local organizations will or can solve any collective action problem. It should not be a pretext for the external agents such as politicians, public servants, national and international NGOs to do nothing. Policy initiatives can be designed to reduce or remove potential physical-technical, sociological or institutional obstacles to local organization with the purpose of facilitating this process. For this, knowledge of the factors which condition local organization should be applied as an analytical tool when exploring the policies to

support local organizations for natural resource management, both in general analysis and in site-specific situations at the macro as well as the micro level.

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