



In pursuit of comparable concepts and data about collective action

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Abstract

Empirical research must overcome two major obstacles: conceptual inconsistency and the scarcity of comparable data. These problems are particularly severe for interdisciplinary research on topics such as the study of collective action. There is no agreement on the appropriate unit of analysis (who should act collectively), measures of successful collective action, ways to distinguish among forms of collective action, or how best to measure independent variables. These disagreements limit the inferences that can be drawn from empirical research. We discuss the implications for scientific advancement in this area of research and present the strategies developed by the International Forestry Resources and Institutions research programme to overcome each of these problems.

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1. Introduction

Efforts to resolve scientific puzzles through empirical research confront two major obstacles. First, the key factors expected to affect outcomes of interest are often

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inconsistently conceptualised and measured. Inconsistent terminology and measurements may obscure consistent patterns or suggest patterns where none exist. Second, the scarcity of comparable data makes it impossible to evaluate the relative importance of many of the variables identified in the literature in influencing outcomes of interest. Case studies are extremely important, but case-study authors tend to identify different variables to study, and making the findings from case studies comparable is extremely difficult. Problems related to the comparability of concepts and data affect empirical research on any topic. They are likely to be especially prominent when multiple disciplines study a topic, as in the case of research on collective action related to the use and governance of forests.

The scientific community has made considerable progress in understanding variation in collective action. Once the possibility for divergence between individual and social goods was recognised (Hardin, 1968; Olson, 1971 [1965]), many scholars and policy analysts saw prisoners' dilemmas and tragedies of the commons everywhere. The supposed ubiquity of collective-action problems justified nationalisation or privatisation of renewable natural resources around the world.¹ Yet, important differences exist among the types of collective-action problems that individuals and communities confront. It is important that we begin to identify conditions that facilitate or hinder collective action.

Collective action is not problematic under all circumstances. Problems arise from inadequate information, conflicting interests, or the nature of the good itself. Game theorists have developed a variety of basic games to capture common aspects of social interaction. Several types of collective-action problems exist that have relevance for natural resource management. When people lack information, coordination becomes difficult despite common goals (assurance games). Use and maintenance activities need to be coordinated to avoid crowding or achieve economies of scale. If multiple solutions exist to a collective-action problem but have different distributional consequences, competition over distributional issues can result in failures to cooperate (chicken games). The beneficiaries of alternative management strategies are often vastly different, for example, making agreement and cooperation difficult to achieve (battle of the sexes games). Rivalry in consumption and difficulty of exclusion make provision and sustenance of common-pool goods particularly challenging (social dilemma games – more specifically, common-pool resource games). Obstacles to exclusion encourage individuals to free-ride on the efforts of others. Difficulty of exclusion and rivalry of extraction characterise many natural resource systems, including forests, watersheds, and fisheries. These conditions can result in underprovision of management and degradation of common resources.

Although collective-action problems differ in severity, an extensive case-study literature (Baland and Platteau, 2000 [1996]; Bromley et al., 1992; McCay and Acheson, 1990; Ostrom, 1990) and evidence from laboratory experiments (Ostrom et al., 1994; Ostrom, 2000; Udéhn, 1993, pp. 254–256) demonstrate that many varieties of collective-action problems can be overcome. The on going challenge is to

¹ See Ostrom (1990) for a discussion and critique of these two approaches to natural resource management.

understand better the sources of variation in the success of collective action. Many factors have been identified as facilitating collective action, including characteristics of the collective problem,² characteristics of the group, institutional arrangements, technology, and the actions of national governments and other external actors (Agrawal, 2001; Baland and Platteau, 2000 [1996]; National Research Council, 2002; Ostrom, 1990; and Wade, 1994).

Despite significant progress, many questions about the prospects for collective action have yet to be solved. Lists of important variables differ (Agrawal, 2001). Debates continue about whether and how particular factors, especially group size and heterogeneity, affect prospects for successful collective action (Agrawal and Goyal, 2001; Baland and Platteau, 1999; Bardhan and Dayton-Johnson, 2002; Gibson and Koontz, 1998; Johnson and Libecap, 1982; Quiggin, 1993; Ruttan and Borgerhoff Mulder, 1999; Varughese and Ostrom, 2001). Little consensus exists on the relative importance of explanatory factors or the nature and significance of interactions among them. The variety and number of factors associated with successful collective action, while encouraging for social relations, make analysis difficult.

Contributions of empirical research to the study of collective action will be limited unless the challenges of conceptual consistency and data comparability can be overcome. This paper describes an ambitious effort to meet these dual challenges: the International Forestry Resources and Institutions (IFRI) research programme. To accumulate a large number of cases using a comprehensive set of variables, an international network of research centres was created, consisting of scholars committed to using the IFRI protocols in data collection and contributing their data to a common database. To achieve consistency of concepts and empirical measurement, IFRI researchers developed a common set of data collection instruments and common methods of data collection.

The remainder of the article is organised in five parts. First, we provide an overview of the IFRI research programme. The second section concerns the need for comparable data and how the IFRI research strategy helps meet that need by building a sizeable database of comparable cross-national data more quickly than would have been possible for any single researcher or research centre. We discuss the challenges of conceptual consistency and empirical measurement, and how researchers have used IFRI protocols to study collective action and various factors expected to influence success, in the third section. Despite the progress made, IFRI continues to struggle with conceptual consistency and the difficulty of analysing complex processes. The fourth section identifies several such issues. Fifth, we summarise and conclude.

2. The International Forestry Resources and Institutions research programme

The IFRI research programme engages an international network of scholars in long-term, comparative research on forests, the people who use forest resources,

² See Blomquist et al. (1994) for a specific analysis of how different aspects of a resource system affect collective-action problems.

and institutions for forest management (Ostrom, 1998).³ IFRI grew out of on going efforts to study collective action for the management of common-pool resources (CPRs). An initial CPR database drew upon existing case studies, mostly about fisheries, groundwater basins, and irrigation systems, and provided the basis for two major volumes (Ostrom, 1990; Ostrom et al., 1994). It was followed by the Nepal Irrigation Institutions and Systems (NIIS) database. NIIS began by coding existing case studies, but then added relatively rapid field visits to verify accuracy of the original case study and to fill in data points addressed ambiguously or not at all in the original study. An inquiry from Marilyn Hoskins, then heading the Forest, Trees, and People Programme at FAO, about the possibility of developing a similar database for forest resources prompted creation of the IFRI research programme. IFRI built upon the theoretical framework, empirical findings, and database structure of its two predecessors. IFRI differs considerably from these earlier efforts in its primary reliance on fieldwork rather than existing studies, the shift in attention to more complex and multiple product forest resource systems, and in its organisation as a research network.

The international research network includes Collaborating Research Centres (CRCs) in Africa, Asia, Europe, Latin America, and North America. IFRI studies encompass a wide array of forests and institutions. With studies in temperate forests in the US, the mountain forests of the Himalayas, and tropical moist and tropical dry forests in Africa, Asia, and Latin America, the research programme encompasses diverse ecological conditions. As of February 2004, there are 13 IFRI CRCs in 11 countries (see <http://www.indiana.edu/~ifri/crcs.htm>). The first were established in 1993. Revisits have begun in Kenya, Nepal, Uganda, and the USA (see Becker and Ostrom, 1995; Gombya-Ssembajjwe, 1999; Schweik et al., 1997).

IFRI forests range from a 1 ha cultural or sacred forest in Uganda to a Bolivian forest reserve of just under 45,000 ha. Many IFRI forests are owned and managed by a national government, reflecting the prevalence of state control of natural resources in recent times. Other IFRI forests fall under private or communal ownership. These categories mask further diversity in property arrangements. Communal management, for example, occurs when governments grant villagers formal control, but also when local residents exercise *de facto* control in the absence of formal rights. A number of IFRI forests, owned as private property by groups of unrelated individuals, do not fit common understandings of private or communal property. A variety of management regimes exist in these forests, ranging from management for timber production, protection for wildlife or biodiversity conservation, to management for multiple uses.

The initial design of the IFRI research and training programme began in the fall of 1993 and involved the advice and input from more than 100 researchers and policymakers from multiple disciplines located in all regions of the world. We consulted with officials who were implementing National Environmental Action Plans to ascertain the types of information they needed for future policy. We worked with several forest departments to add measures that were of importance to them. We sought the

³ This section draws heavily on Poteete and Ostrom (in press).

help of researchers who have a major interest in questions of biodiversity and forest sustainability as well as the impact of institutional arrangements. We pretested the initial protocols in Bolivia, India, and Uganda to make sure that they could be used in widely-differing settings by scholars who were trained in forest mensuration, ecology, natural resource management, and social sciences more generally. Given the variety of interests that needed to be taken into account, the 10 core measurement protocols went through many revisions and it took about two years before they were finalised. The core protocols were designed so that additional questions could be addressed in specific studies designed by collaborating researchers by adding a specific set of questions to one of the existing protocols, or by adding a new protocol such as a household survey.

Data collection for the IFRI research programme encompasses biophysical measures of forest conditions, climatic and soil conditions, demographic and economic indicators about the population of forest users, as well as details about institutions affecting use of forest resources. IFRI researchers conduct repeat studies of forest sites every three to five years. The interdisciplinary approach allows assessments of hypothesised relationships among biological, demographic, economic, and institutional variables. Analysis of social and institutional processes that take years to unfold becomes possible with the accumulation of time-series data.

The IFRI research strategy addresses two major challenges to empirical research on collective action. The use of common research instruments and techniques for data collection provide a foundation of conceptual consistency. Organisation as a network of research centres results in more rapid accumulation of comparable, cross-national data. Further, data are collected by researchers who are closely familiar with local languages, customs, and ways of organising. Graduate students associated with IFRI centres inherit a rich source of data for further analysis and contribute to the store for those who follow. It is possible to return to a site at relatively low cost to check out missing data or do a complete follow-up visit. In sum, IFRI brings to the empirical study of collective action an international database of comparable studies from all over the world using a common research framework and methodology.

3. IFRI and the challenge of comparable data

In a recent review of research on common-pool resources, [Agrawal \(2001\)](#) identified 33 separate explanatory factors that have been repeatedly identified in the literature as important. Given the large body of literature confirming the potential influence of each variable, he contends that analysis that excludes any of these factors should at least discuss the likely biases of the missing variables. Inclusion of such a large number of variables in most statistical analyses, however, is not feasible, barring the use of Boolean algebra ([Ragin, 1987](#)) or very large data sets subject to multivariate analysis. Multivariate analysis can incorporate numerous variables, but a very large number of data points is required to assess relationships reliably.

The empirical complexity of many variables of interest implies that substantial investments in fieldwork are required to obtain reliable data; as a result, scholars have been hard-pressed to build large databases for the study of common-pool resources. Large databases can be built by coding existing studies, as demonstrated by Tang (1992) and Schlager (1994). Since existing empirical studies typically address only a subset of the factors identified in the literature, missing data inevitably limit analysis. This sort of analysis also confronts differences in conceptualisation and the empirical measurement of variables by different authors. Some researchers have collected data on relatively large sets of cases (Bardhan, 2000; Dayton-Johnson, 2000; Lam, 1998; Jodha, 1990; Shivakoti and Ostrom, 2002). Ultimately, since there are limits to the time and financing available for data collection, a trade-off exists between the number and type of variables measured and the number of cases for which data can be collected. Careful sampling can control for some factors and limit the degree of bias likely in results. Nonetheless, it may not be possible to control for all variables excluded from data collection and analysis.

Organisation as a network of research centres facilitates comparative research. Members of the IFRI research network collect data on a common set of variables, use the same methods for data collection, and share data in a growing international database, thereby maintaining the comparability required for cross-national analysis. Beyond this core data collected at all sites, many IFRI research teams collect supplemental data to address specific research questions. By early 2004, data for 181 sites with 320 forests and 387 forest user groups had been entered into IFRI's common database. In each forest, a random sample of forest plots is made and the diameter at breast height, height, and species of each tree is recorded. In total, 7669 plots and 116,178 trees have been recorded. Updates of the common database occur periodically, as new data come in from collaborating research centres. The relative breadth of variables included in the IFRI protocols and the large number of data points in the database enable more complex multivariate analysis than would otherwise be possible.

4. The challenge of conceptual and empirical consistency

If empirical research is to contribute to further progress in understanding conditions favourable for collective action, greater clarity is needed in the conceptualisation of the unit of analysis, the conceptualisation of dependent and independent variables, and how these concepts are operationalised for data collection and analysis.

4.1. Collective action by whom?

For most discussions of collective action, “the group” is the unit of analysis. For research concerning natural resources, this means “the group that uses the resource” or “the user group”. In theoretical work and empirical studies, the group is often a point of departure rather than subject of inquiry. Yet, in research conducted in the

field, people do not present themselves to researchers as unambiguously demarcated groups (Agrawal and Gibson, 1999, 2001; Turner, 1999). Rather, empirical researchers have to determine how to conceptualise – and recognise in the field – the relevant set of people for analysing the problem of collective action.

In the abstract, it is simple enough to say that the relevant group includes individuals who face a collective-action problem – which is to say, who share some interests in common. In practice, people have a number of interests, even within a single sphere of activity such as natural resource management. Membership in the set of individuals with the potential for collective action depends upon the problem under consideration. Subsets of individuals with an interest in sustaining a resource system may organise to pursue particular interests while the more encompassing set of individuals fails to act collectively.

The implications of collective action at one level of aggregation for collective action at other levels of collective interest are not uniform. Consider two examples. Individuals who collect medicinal herbs organise while those who collect firewood do not. If the herb collectors see the lack of collective action among firewood collectors as a problem for themselves, they may attempt to mobilise collective action at a level that encompasses both groups. If, however, timber harvesters have organised while those using a variety of non-timber forest products (NTFPs) have not, the incentive for timber harvesters to facilitate collective action among all users of forest resources is less apparent. Not all empirical studies about collective action for resource management explicitly address the possibility of multiple levels of collective action. Programmes for community-based resource management often assume the presence of a clear community of interest at the level of the resource system.⁴

The IFRI research programme uses a modular approach to evaluate the existence and consequences of collective action for forest management. The basic social unit of analysis is a user group, defined as a set of individuals with the same rights and responsibilities to forest resources. This definition does not require formal organisation or existing collective action. More than one user group may exist in relationship to any one forest. Groups that have organised institutions for collective decision-making are considered forest associations. Forest associations may bring together more than one user group, although many studies find a one-to-one relationship between user groups and forest associations. Recognition that groups with common rights and responsibilities may or may not be involved in collective action, or have institutionalised rules for collective decision-making, makes it possible to analyse this variation rather than assuming it away. This strategy for data collection allows analysis of collective action and its absence within groups with comparable rights to resources.

In many forests, IFRI methods identify multiple user groups. Because user groups are defined according to their rights and responsibilities to the forest, the number of user groups says little by itself about the degree of specialisation in use of forest

⁴ See Campbell et al. (2001) and Turner (1999) for critiques of community-based programmes for resource management. See Agrawal and Gibson (1999, 2001) for a more general critique of the use of the term “community” in the literature on natural resource management.

products. Two user groups may use different sets of forest products, although overlaps in the products used are common. Forest associations may encompass a large proportion of forest users, or they may be formed by a subset of forest users. The presence or absence of a forest association is an indication of collective action for the creation of institutions to manage forest resources. By itself, the existence of a forest association does not reveal what proportion of forest users is acting collectively in this manner. The IFRI database includes information about the scope of representation by forest associations, but a researcher would have to dig around to access these data and get them into a form amenable to analysis.

IFRI's distinction between user groups and forest associations greatly facilitates the empirical study of collective action. It provides a common standard unit for observing and measuring potential collective action. It also ensures the collection of data about groups that have overcome collective-action problems as well as those that have not. Since groups may act collectively for some but not all aspects of forest management, this modular approach to collective action also facilitates analysis that distinguishes among types of collective action (see below). IFRI's use of commonality in rights and responsibility relative to a forest as the defining characteristic of a user group is less helpful for research concerned with the scope of collective action or about the "community" as the social unit of analysis.

4.2. Is this group acting collectively?

The difficulty of recognizing informal institutions and discerning the effectiveness of formal institutions on forest conditions represents an important challenge for institutional analysis. Biophysical data about forest conditions can be used to discern the effectiveness of collective action for forest management. If forest users have developed rules of forest management, whether formal or informal, and those rules effectively alter behaviour (i.e., they are "rules-in-use"), changes will occur in their patterns of forest use. IFRI's research strategy involves the collection of descriptions of rules and evaluates their effectiveness through interviews and participatory sessions. Further, the collection of detailed data on a sample of forest plots generates accurate information about forest conditions. With both social and biophysical data, it becomes possible to check social scientific data about rules for management against biophysical data on forest conditions.

In general, harvesters of forest products are expected to engage in optimal foraging strategies unless rules-in-use constrain their behaviour (Gibson, 2001). Optimal foraging implies that humans follow a cost-benefit calculus in their harvesting behaviour. First, they will use forest products that are the most valuable (in terms of yield minus cost of extraction). When the value of forest products does not vary with location, then optimal foraging implies that the most accessible resources will be harvested first. All else equal, proximity to settlements and to roads lowers the cost of extraction. Steep slopes, impassable rivers, and other physical impediments increase the difficulty of extraction, and are usually utilised after more geographically accessible areas. In the absence of institutions that alter patterns of forest use, the biophysical data should reveal evidence of extraction that reflects proximity and

physical accessibility. Smaller, younger trees should be found closer to settlements and roads, and in flatter areas, with larger, older trees deeper in the forest and on steeper slopes. If effective institutions for forest management are in place, however, the institutions alter the cost-benefit calculus. Depending on the nature of the management rules, patterns of harvesting should change in ways that will be reflected in biophysical data from forest plots. Four recent IFRI studies (Schweik, 2000; Banana et al., 2001; Becker and León, 2000; Gibson, 2001) compare actual forest conditions with predictions based on optimal foraging theory to evaluate the influence of institutions upon forest conditions.

In Nepal, partial enforcement of national rules for forest conservation had the unintended consequence of shifting extraction from areas near the villages and roads to a more ecologically vulnerable watershed (Schweik, 2000). Officials charged with enforcing national policy and local villagers faced the same physical terrain. Because the officials could more readily monitor forest use in areas near roads, near settlements, and on lower slopes, villagers experienced tighter enforcement in these areas. Data from forest plots revealed that villagers had shifted harvesting activities to the steeper slopes further from their settlements. These physically less-accessible areas represent a more ecologically vulnerable portion of the forest. Both the forest and the villagers would be better off in the absence of national forest rules than with their current haphazard enforcement.

Likewise, the limited capacity of the Ugandan forest department results in reasonably tight enforcement of a ban on timber harvesting near the capital city, but in consistently high levels of illegal harvesting further away (Banana et al., 2001). In the absence of rules affecting timber harvesting, one would expect heavier levels of extraction closer to Kampala, because the higher concentration of people in the capital city represents a large market. In the absence of spatial variation in the level of enforcement, the ban should decrease timber harvesting throughout Mpigi district, in which Kampala lies. One would still expect higher levels of illegal harvesting in the vicinity of the capital. The presence of greater evidence of timber harvesting *further away* from the capital city strongly supports a general sense that levels of enforcement decrease with distance from Kampala.

In Bolivia, deviations from use patterns associated with optimal foraging among the Yuracaré challenged assumptions that such indigenous peoples lack systems for forest management (Becker and León, 2000). In the early 1990s, the Bolivian government adopted a policy that allows indigenous people to gain formal title to their territories, but requires that they first develop a formal management plan for the forest resources. The policy suggests the absence of indigenous systems for forest management. Data from forests managed by the Yuracaré revealed that they do have an effective system for managing fruit trees, but have not yet devised rules for managing timber resources. Building upon the existing system makes more sense in this situation than developing a management plan from scratch, as called for by government policy.

In contrast, evidence that extraction closely matched patterns associated with optimal foraging bolstered Gibson's (2001) claim that two villages in Guatemala lacked institutions for forest management. Villagers might not report rules about

forest management because they were suspicious of outsiders, or the researchers might fail to recognise informal rules, but the biophysical evidence eases such doubts about the lack of social scientific evidence of rules. Where biophysical evidence of optimal foraging confirms that communities truly lack rules for forest management, external intervention could raise awareness of indirect benefits associated with forest conservation and encourage the development of rules for forest management. After an IFRI study in Loma Alta, Ecuador revealed the absence of local institutions for forest management and a lack of appreciation for the forest's role in watershed protection, a series of participatory studies organised by a non-government organisation demonstrated dramatic differences in fog interception associated with variable forest conditions (Becker, 1999, 2003). The villagers subsequently decided to protect a portion of their forest for watershed management.

4.3. *Collective action for what?*

Collective action can take many forms, including the development of institutions (e.g., rules for resource management), resource mobilisation (e.g., to hire guards or invest in maintenance activities), coordination of activities (e.g., to avoid crowding), and information sharing (e.g., about techniques or the location of mobile resources). Scholars generally state clearly the nature of collective action under consideration in any particular analysis, although there is a tendency to claim that findings have broader implications for the study of collective action. Efforts to synthesise findings from multiple studies face the challenge of evaluating the analytically relevant similarities and differences among different types of collective action. Even within any category of collective action, such as institutional design or resource mobilisation, the difficulty of acting collectively can vary dramatically.

IFRI scholars study various forms of collective action. The studies discussed in the section on optimal foraging were concerned with institutional development in the form of management rules. These scholars were less concerned with the formalisation of management rules in a forest association. Indices developed by both Varughese (1999) and Chakrabarti et al. (2001) recognise the importance of distinguishing between the creation of collective rules and action to implement and enforce collective rules.

Varughese (1999), in a study of 18 sites in Nepal's middle hills, developed an index including the presence of collective rules constraining access to and harvesting from forests, organisation of group activities related to forest management, and monitoring activities by group members as evidence of collective activity. The presence of group activities and rules for management indicate a moderate level of collective activity; high scores on this index require monitoring of rules for forest access and use. This study found that forest conditions were more closely correlated with higher scores on the index of collective action than with population pressure.

For an analysis of 12 sites in North Bengal, India, Chakrabarti et al. (2001) developed an index based on collective action on a set of 18 forest management activities (e.g., planting seedlings, harvesting, marketing of forest products). For this index, a group earns 0.5 points for each management activity for which it has adopted a rule;

actual coordination on implementation of collective rules earns 1.0 point per activity. This analysis also found a positive correlation between forest conditions and levels of collective action. Higher levels of collective action were more common in communities with prior experience with self-governance through *Panchayati Raj* (local government) institutions and in communities with greater heterogeneity in wealth and education.

Another set of studies focuses on collective action for the mobilisation of resources required for effective monitoring and enforcement of rules for forest management. Monitoring and enforcement is costly. In some communities, responsibility for guarding rotates among households. Other communities raise funds to hire individuals to guard forest resources on behalf of the community. For the community to hire guards, it must mobilise resources for this collective goal (Agrawal, 2000; Agrawal and Goyal, 2001). Hiring a guard is a lumpy good; the guard must be retained for a minimal number of months to effectively protect forest resources. A series of articles about forest councils in Kumaon, India measures collective action in terms of resource mobilisation as the monetary value of the contribution per household, the group budget for protection, or the number of months each community was able to pay the guard (Agrawal, 2000; Agrawal and Goyal, 2001). These studies revealed a curvilinear relationship between group size and collective action for resource mobilisation: the smallest groups had less success than somewhat larger groups in mobilizing the resources required for forest protection.

The IFRI research network has not limited its attention to any single form of collective action. Openness makes the research programme attractive to a variety of scholars with overlapping but not identical research questions. Diversity of approaches has merit; comparisons of alternative conceptualisations of hypothesised relationships can help advance knowledge more rapidly. The lack of consistency in measurement of collective action does raise the risk of miscommunication between scholars who use the same terms to describe somewhat different phenomena. Clear explanations of variables and how they have been measured offer the best defence against miscommunication.

4.4. *What affects collective action?*

The conceptual and empirical challenges related to independent variables that may affect the likelihood of collective action are even more extreme. When scholars debate the importance of group size, for instance, it is not clear that a common frame of reference exists. Is a group of 100 individuals large or small? What about a group of 1000 individuals, or of 50? Likewise, scholars concerned about the implications of heterogeneity for collective action discuss a number of different forms of group diversity (Varughese and Ostrom, 2001; Keohane and Ostrom, 1995). Many studies on heterogeneity focus on economic inequality, but even economic inequality may refer to either income or assets (Baland and Platteau, 1999; Quiggin, 1993; Ruttan and Borgerhoff Mulder, 1999). Others have examined heterogeneity in values (Gibson and Koontz, 1998), of knowledge and skills (Johnson and Libecap, 1982), of location (Ostrom, 1996; Varughese, 1999; Varughese and Ostrom, 2001), or of interest in

maintaining the resource. It is not at all obvious how one should compare findings from studies that use the same terms for very different concepts – as with heterogeneity – or, for varying classifications of empirical situations – as with group size.

Even when the concept is clearly agreed upon, differences may arise from operationalisation in data collection and analysis. Some concepts are unavoidably subjective. What is an adequate level of monitoring? How much disagreement is consistent with a common understanding? How can the level of trust in a community be determined objectively? In the case of trust and many other variables, measurement is both subjective and indirect. Some conceptual variables have many components, empirically. Wealth, for example, may take the form of livestock, capital assets such as houses and tools, and cash. The same concepts may be used to refer to data that reflects different aspects of the same phenomenon. The problem grows all the more complicated when empirical manifestations of a concept, like wealth, are contextual.

The distinction drawn in data collection between user groups and forest associations is characteristic of IFRI's modular approach to data collection. Participants in the design of the IFRI research instruments knew they needed measures for several factors suspected to influence collective action. These included population pressure, group size, market pressure, local autonomy, heterogeneity, economic and subsistence salience of the forest, difficulty of exclusion, and difficulty of understanding how forest resources respond to human actions. For each of these concepts, multiple empirical indicators existed. IFRI data collection protocols were designed to capture multiple indicators of potential concepts of interests, and to do so in a way that allows a number of different combinations.

The lack of consistency in concepts used by multiple disciplines, or even within a single field, and their empirical measurement represents a major challenge for the accumulation of knowledge about the factors affecting collective action related to resource management. Apparently contradictory findings may not actually contradict; apparently similar findings may actually refer to different issues. Synthesis of findings becomes very difficult under these conditions. Without a valid understanding of what is reliably known from past studies, the design of new empirical studies to advance knowledge further becomes quite difficult.

5. Continuing challenges

The IFRI strategy has not eliminated all challenges, nor is it possible to do so. It is, of course, not possible to meet all of the challenges of analysing complex human-natural resource dynamics in general. The reliability of IFRI's common database relies upon consistency of concepts and methods across research teams. That consistency is reinforced through an annual nine-week training program at Indiana University plus the growing development of regional training programs. Insistence on conceptual and methodological consistency, however, runs counter to the evolutionary (and sometimes revolutionary) nature of learning (Kuhn, 1962). Knowledge advances through the refinement of concepts and methods in response to findings from past studies. IFRI researchers recognise the need to balance consistency with

revision following learning, and are grappling with ways to do so. Biennial meetings of the full network offer opportunities to discuss modifications to the research program. Attitudes toward change have been conservative. Although conservatism limits the ability to incorporate new knowledge, it also guards against the loss of comparability across studies conducted at different times.

IFRI has always allowed researchers to supplement the common core of data collection. By supplementing the core data collection instruments, research teams can try out alternative measurements and methods without endangering comparability of the common variables. Efforts are currently underway to increase communication across the network about various efforts to develop new or alternative measurements. Supplementary measures of interest throughout the network could become candidates for incorporation into the core instruments, perhaps as substitutes for current measures that proved to be less effective. This has not yet occurred.

Despite the accumulation of IFRI data, only a few IFRI studies have attempted to use data from multiple countries (Poteete, 2001a,b; Hayes, 2004; Gibson et al., in press). Many IFRI publications concern either a single case or a paired comparison (Gibson et al., 2000). IFRI colleagues who have completed a larger number of sites have begun to do multivariate analyses, but usually limit themselves to data from their own sites (Agrawal and Yadama, 1997; Agrawal and Goyal, 2001; Banana et al., 2001; Gautam et al., 2003; Varughese and Ostrom, 2001; Varughese, 1999). The scarcity of cross-national analysis reflects the difficulty of drawing comparisons across ecological zones, cultures, and political boundaries. Ecological measures of forest condition, such as height or diameter at breast height or species diversity, are strongly affected by a variety of localised ecological conditions and topography. Measurements of healthy forests in the Himalayas, in the moist tropics of Guatemala, and arid tropical areas of Mexico or Uganda will differ considerably in many of these indicators.

Comparative analysis that includes forest condition as the dependent variable or as an important independent variable depends upon techniques or proxy measurements that allow comparisons across ecological zones. Even for analyses that do not include biophysical data, differences in culture and policy environment across countries may affect outcomes. Indeed, inclusion of dummy variables for Uganda, the USA, and Nepal revealed noteworthy country-specific effects on efforts by user groups to exclude others from forest resources (Poteete, 2001b). Limitations to comparability do not make cross-national analysis impossible but do make it more difficult. The analytical difficulty of cross-national analysis and the possibility of context-specific patterns are just two good arguments in favour of a strategy of testing hypotheses first with data from a single country and then scaling up to cross-national analysis.

The potential of the IFRI network does not depend solely upon an increase in cross-national analysis. Communication about findings within the network enhances their incorporation into the design of future studies. Regular communication about research activities depends upon declining telecommunication costs, especially for Internet access, and more frequent opportunities for face-to-face exchange. Regular

synthesis of findings identifies emerging themes, disseminates findings to a larger audience, and influences future studies.

It is, of course, a challenge to keep any large-scale, long-term project going. Fortunately, the National Science Foundation, the Ford Foundation, and the MacArthur Foundation have all been willing to provide funding in three- to five-year increments – longer periods than frequently is available for research projects. Individual donors have supported work related to specific sites within a country but have not been a source of long-term sustained funding. Given the high productivity of the program, we are hopeful that it will be possible to continue it for a much longer time period.

6. Conclusions

It is difficult to write a “concluding section” when one is describing the efforts of an on going research program to solve extremely challenging puzzles that underlie all efforts to build systematic knowledge about collective action. Users of forestry resources are interacting with complexly, adapting ecological systems and are themselves a part of a human, complex, adaptive systems. Both ecological and human system exist at multiple scales over time. Consequently, the challenge for all researchers and policy analysts is to gain a slow accumulation of knowledge about the processes within these complex systems and how they adapt to change over time.

The IFRI research programme is an effort to use a consistent set of concepts and ways of measuring these concepts in order to facilitate the long-term understanding of collective-action processes as related to forests. The effort has already produced a better understanding of how the heterogeneity of users can lead to strong distributional effects (Poteete, 2001b) that can be offset to some extent by rules designed to provide different roles, duties, and benefits to different groups of users (Varughese, 1999). Our colleagues in Nepal conducted a major seminar at the Institute of Forestry in Pokhara during March of 2002 and submitted a report on *Human-Institutional-Natural Resources Interactions* to FAO in Rome (NFRI, 2003). We have learned that whether individuals are motivated to think about engaging in collective action is strongly affected by their perceptions of the condition of a resource – not by the “actual” condition (Agrawal, 2000; Gibson et al., 2002; Gibson and Becker, 2000; Tucker, 1999). Those perceptions can in turn be changed by a variety of techniques that give more accurate feedback to users about the functioning of the relevant ecosystem and its condition (Becker, 1999). We have learned that distance between a forest and a large urban area has several impacts on forest conditions, including the capacity to monitor harvesting rates as well as the cost of transporting forest products (Banana et al., 2001). And, we have learned many other interesting relationships that we and other scholars will continue to explore in the coming years as we all try to gain clearer conceptions of key variables and processes and find better ways of measuring them.

IFRI studies also help to pinpoint areas where external interventions are most likely to make a difference, as demonstrated by the studies in Bolivia and Ecuador.

The IFRI team in Bolivia worked together with the Yuracaré to develop the forest management plan required by the government to gain legal title to their forest. Knowledge about the strengths and limitations of the Yuracaré's existing, but unwritten, system for forest management provided a solid basis for developing a management plan that built upon it rather than ignoring it. After the IFRI study in Loma Alta, Ecuador, determined that residents were destroying their forest because they had not drawn a connection between forest cover and water availability, an NGO engaged residents in participatory research that illustrated the connection and ultimately contributed to their decision to establish a forest reserve (Becker, 2003). Misperceptions are not the only reason why people engage in destructive behaviour. Educational programs fall flat if the underlying problem is really one of property rights or poverty or some other issue. IFRI offers the tools required to distinguish situations where participatory research and even extension activities are likely to make a difference from those where reforms to systems of property rights or other institutional arrangements are more important. At the local level, IFRI's contributions to policy discourse and practice depend on conceptual consistency to only a limited degree. Comparable concepts, both within our own work and between our work and that of policymakers, become more important when engaging policy debates at the national or international level.

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