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MULTIPLE FUNCTIONS OF COMMON PROPERTY REGIMES

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MULTIPLE FUNCTIONS OF COMMON PROPERTY REGIMES

Ruth S. Meinzen-Dick and Brent M. Swallow

The papers in this workshop summary were presented as a panel at the Sixth Annual Meeting of the International Association for the Study of Common Property in Berkeley, California, June 5-8, 1996. The panel was sponsored by the CGIAR System-Wide Program on Property Rights and Collective Action and all of the presenters were affiliated with that program[1].

The overarching goal of this program is to contribute to policies and practices that alleviate rural poverty by analyzing and disseminating knowledge on the ways that property rights and collective action institutions influence the efficiency, equity and sustainability of natural resource use.

The program stresses comparative research to yield international public goods. The conceptual framework that guides and provides focus to the Program deals explicitly with the effects of different biophysical, socio-economic and policy factors on the operation and outcomes of property rights and collective action institutions. Insight into those factors and their effects is obtained through comparisons that cut across countries, ecoregions and resources. An understanding of the factors that facilitate or inhibit effective local organizations and appropriate property regimes for one resource can be valuable for developing policies for another resource.

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'Accommodating multiple uses and multiple users of a resource has been identified as a one of the priority themes for Program, based on its importance for natural resource management, policy formulation, relevance to the goals and mandate of the CGIAR, and potential application across resources and regions.'[2] This theme explores the role of property rights and collective action in developing systems that allow women and men, farmers and herders, or other categories of users to share land, water, or forest resources, for a variety of purposes. Most analyses of the efficiency of natural resource management have failed to recognize that resources often have multiple uses and that there tend to be sub-groups of users who are characterized by their use patterns. For example, the same piece of land may be used for different crops, grazing, and gathering; the same water source can be used for irrigating, washing, watering animals, or other enterprises; the same area of forest can be used for timber, fruits, leaves, firewood, shade, or other products. Some resource uses are complementary, others are competitive, most are somewhere between. Some groups of resource users are mutually exclusive, others are overlapping, most are somewhere between. Recognition of the multiple use - multiple user character of common property regimes suggests more complex problems for policy and programs: How can the resource use patterns of different types of users be accommodated? How do changes in property institutions affect the different uses and users of a resource system?

While public and private property may have overlapping uses, issues of accommodating multiple uses and users are especially critical in the case of the commons. Common property regimes often perform multiple functions for a collective including allocation of multiple resources among multiple uses and users. Among these are the tangible goods such as inputs for production or consumption and intangible goods such as safeguarding against environmental risks or exploitation of economies of scale and scope. Multiple-function common property regimes have been poorly represented by the economic models of strategic interaction (game theory) and dynamic optimization (optimal control). Misrepresentations

[2] Other priority themes include: 1) implications for adoption of technology and natural resource management practices; 2) structuring devolution; 3) role of environmental risk; 4) feminization of agriculture and demographic change; and 5) changing market relationships.

lead to misunderstandings and deficient policy prescriptions. Negative impacts on short-term and long-term human welfare may be the consequence.

Recognizing the multiple uses and users of a resource reorients thinking about both efficiency and equity. Property regimes and resource management systems that maximize output of a single product may appear to be most productive under conventional analyses, but other regimes (especially common property regimes) may produce a higher value of output when all products are considered and valued. Thus, a private forest monocropped for timber may not be as productive as a forest commons that provides timber, fodder, fruits, rattan, kindling, and medicinal plants. Non-tangible functions, such as risk management or the formation of social relationships of trust (social capital), may also be critical to individual preferences and social choices about resource management institutions. Our understanding of equity shifts when we take into account all the users of a resource. For example, it goes beyond looking at whether land or water is evenly distributed among farmers, to seeing how access to the resource is balanced between a much wider range of users who often differ by class, ethnicity, gender, and place of residence. In contrast to private property regimes that tend to ascribe the entire bundle of rights to a single "owner," many common property regimes assign overlapping or conditional rights to many different users.

The papers in this panel explore several dimensions of multiple-function common property regimes. The overview paper explores the conceptual and analytical challenges of multiple-function common property regimes. Two papers discuss the importance of understanding the competitive and complementary nature of different uses of water and land resources by different users. The final paper focuses on a less tangible function of common property: construction and maintenance of social capital.

In the overview paper, Brent M. Swallow provides an analytic framework for examining the multiple functions of common property regimes, and illustrates this with examples from rangelands. In addition to producing material goods such as crops, trees, and grass, natural resource systems have other valuable environmental or social functions, such as preserving biodiversity or providing security and mitigating risk. The stakeholders in such resource systems are not homogeneous, but are composed of individuals and sub-groups with different endowments, rights to the resources, and different values and priorities for their use.

Applying this framework to African rangelands, the paper shows how these considerations can affect size, structure and boundaries of resource management institutions.

Ruth Meinzen-Dick and Lee Ann Jackson's paper on use of water resources focuses primarily on the tangible uses of water, but shows how even these are much broader than conventional sectoral approaches to irrigation or domestic water supply have recognized. Although water is vital for production, domestic consumption, and environmental protection, in the process of allocating formal rights, minor water uses such as livestock, gardens, and other domestic micro-enterprises are often ignored and those who use water for such purposes lose access. The paper reviews alternative allocation mechanisms, and finds that common property management systems which explicitly acknowledge the validity of different claims offer potential mechanisms for accommodating the needs of multiple users of water resources.

The paper by Timothy O. Williams deals with a heterogeneous resource base, as well as heterogeneous users of common property resources in the cultivated zone of semi-arid West Africa. These resources--including fallow fields, crop residues, water points, permanent pastures and woodlands--provide both tangible economic benefits as well as a range of less tangible (though not less valuable) social benefits. As in the case of water resources, there are many different types of users, who may not all be local "residents". In addition to increasing the total productivity of land resources, managing the resource to accommodate a large number of heterogenous users can reduce production risks. However, appropriate rules that reconcile divergent interests and resolve conflicts are required to prevent such multiple uses from contributing to resource degradation.

In T. Anderson White's paper on watershed management in Haiti, the multiple functions of common property resources extend beyond tangible products of the natural resource base, to include intangible benefits from the formation and maintenance of social capital. The paper finds that many individuals contribute to collective action for reasons not related to direct economic benefits, such as building good relations with others. Pre-existing collective action groups such as labor exchange or farmers' associations were a major factor in the performance of watershed management groups. Thus, the development of social capital should be considered a significant function of collective resource management regimes. These

relationships benefit not only the present enterprise, but other collective activities in the future.

Much research remains to be done on institutional mechanisms to accommodate multiple uses of natural resources and multiple functions of resource management institutions. The papers from this panel indicate some of the directions such research might take and some of the issues that emerge. In addition to the contributions to theory and policies, the practical examples of institutions that allow different groups to make use of a common resource base in a variety of ways can lead to the development of more productive, equitable, and sustainable resource management.

THE MULTIPLE PRODUCTS, FUNCTIONS AND USERS OF NATURAL RESOURCE SYSTEMS

Brent M. Swallow

ABSTRACT

This paper[1] presents an analytical framework for guiding studies of the use and management of natural resource systems in which: (i) several goods and services of value are produced; (ii) resource users have multiple objectives vis-a-vis collective management of the natural resource system; and (iii) sub-groups of resource users are distinguished by their property rights, endowments and preferences. The framework is motivated and validated by reference to rangeland systems in Africa. Several implications for research and policy emerge.

INTRODUCTION

Economic models of resource management regimes tend to focus on the advantages and disadvantages of different property institutions for allocating a single resource among a group of homogeneous users, e.g. water among irrigation farms, a species of fish among commercial fishers, timber among foresters, grass among grazers. But most resource management regimes actually govern the use and management of landscapes or ecosystems that provide a number of products valued by people. A woodland, for example, might provide several goods -- food from plants and animals, medicinal plants, fuelwood, building materials -- and services -- erosion control, nutrient cycling, carbon sequestration, habitat for

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wildlife, reservoir of biological diversity, groundwater recharge, recreation and aesthetic enjoyment (Bingham et al. 1995; Gottfried et al. 1996). Some products emanate from the ecosystem or landscape as a whole, others from particular components or niches within the ecosystem or landscape. Similarly, some of the institutions that govern multiple-product landscapes or ecosystems apply to the whole, others to particular products or components, still others to inter-related sets of products or components. Developing policies and institutional arrangements for good management of such multiple-product ecosystems or landscapes is a major challenge to analysts, policy makers and communities.

A second challenge is that the resource management institutions often perform several related functions vis-a-vis property rights and collective action for management of the ecosystem or landscape. Different individuals or sub-groups may value different functions or the same functions differently. A third related challenge is that the individuals and sub-groups who use and value the products of a landscape or ecosystem often have different rights to those products and different endowments with which to capitalize on those rights. Individuals and sub-groups may differ, inter alia, by their endowments of productive capital, production efficiency, physical location vis-a-vis the resource, operational power and bargaining power.

This paper responds to those challenges by presenting and applying a framework for analysing multiple-product, multiple-function and multiple-user natural resource systems. Section 2 presents some background information on the problem situation that is used throughout the paper to motivate and validate the analytical framework. Section 3 presents an analytical framework for guiding the study of landscapes and ecosystems that generate multiple products, are used and valued by heterogenous groups of people, and whose institutions perform multiple functions. The framework is used in Section 4 to explore the issue of the optimal sizes of natural resource systems and resource management regimes. The results imply that some well-known resource management principles may not have the general applicability often proposed. Section 5 is a concluding discussion.

AN OVERVIEW OF AFRICAN RANGELAND SYSTEMS

Many of the points made herein are motivated with examples from African rangelands. There are four reasons for choosing this example. First, rangeland utilization is one of the most important and ubiquitous types of land use in Africa and elsewhere in the developing world. Eighty-two percent of the agricultural land in Africa is classified as permanent *pasture* (World Bank 1996, 367). Second, large numbers of very poor people are directly affected. In sub-Saharan Africa there are about 25 million pastoralists (people belonging to households that obtain more than half of their gross household revenue from livestock) and 240 million agro-pastoralists (people belonging to households that obtain 10-50 percent of their gross household revenue from livestock), most of whom obtain significant quantities of livestock feed from natural pastures (Swallow 1994). Nearly half of those people live in absolute poverty.[2]

Third, most of the rangelands in sub-Saharan Africa are governed by resource management regimes that proscribe private rights to some components or products, common rights to other components or products, and no specific rights to other components or products. A relatively small share of the total area of rangeland in sub-Saharan Africa is governed by purely private, purely common or purely state property regimes. Fourth, most African rangelands generate multiple products (Le Houerou 1980) and are used by heterogeneous groups of users (Scoones et al. 1993).

In this paper the term 'rangeland' is used to refer to the grasslands, scrublands, bushlands and woodlands that are used as natural pastures for domesticated livestock. Rangelands contain grasses, but also a variety of tree species. Le Houérou (1987) estimates that only about 20 percent of rangelands in Africa are grasslands; the remaining 80 percent are scrublands, bushlands or woodlands. Trees on rangelands are important sources of animal feed; Le Houérou (1980) estimates that woody species contribute 10-20 percent of livestock feed in the Sahel. Trees are also important sources of goods and services in addition to animal

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[2] About 92% of the permanent pasture in sub-Saharan Africa is contained in 19 countries. The rural population of these 19 countries is about 287 million, 134 million of whom live in absolute poverty (calculations based on statistics given in World Bank (1996).

feed. Human food, energy, building materials, raw materials for industry, boundary demarcation, fencing, shade, soil management, water management and wind shelter are tree products valued by local populations (Raintree 1991).

Many rangelands in the driest areas of Africa are not suitable for crop cultivation and thus are appropriately referred to as permanent pastures. But large areas of Africa's rangelands are located in somewhat more humid areas and thus can be cultivated or are contiguous to areas that are cultivated. In southern Burkina Faso, for example, almost all land (much of which is now considered to be scrubland, bushland or woodland) has been cultivated at some time during the twentieth century (personal communication with Ann Fournier, ORSTOM, Burkina Faso). An important function of such long-term fallows, therefore, is the buildup and conservation of nutrients for future crop cultivation. Livestock are often managed to facilitate the transfer of nutrients from rangelands to nearby croplands (Powell and Williams 1995).

ANALYTICAL FRAMEWORK OF NATURAL RESOURCE SYSTEMS

Terminology

Before presenting the analytical framework it is important to clarify some terminology. The term *natural resource system* is used throughout the remainder of the paper to refer to landscapes or ecosystems, the goods and services those landscapes or ecosystems generate, the inter-relationships between and among components, products, and resource users, and the institutions and organizations that govern those inter-relationships. Natural resource systems may include, therefore, *property rights regimes* -- sets of institutions that define the conditions of access to, and control over, goods and services arising from a natural resource system (adapted from Edwards and Steins 1996, 2). The property rights regime of a natural resource system may proscribe private, common or state property rights to the whole landscape or ecosystem, but in most cases proscribes private, common and state property rights to different components or products of the landscape or ecosystem. Natural resource systems may also include *organizations and institutions for collective action* in natural resource management.

Overall Analytical Framework

This section provides a formal description of the overall analytical framework. The next three sub-sections describe the components of the analytical framework in much greater detail.

A natural resource system produces r products according to r inter-related production functions. Of the r production functions, c ($c \leq r$) include variables under direct human control; the remainder [r - c] are determined recursively through intermediate outputs. e of the production functions ($e \leq r$) include stochastic environmental variables. A group [G] of n economic agents derive benefits from the r products. Besides belonging to G, the n economic agents also belong to one of k sub-groups. Each sub-group [gj, j=1, ..., k] is comprised of between 1 and n members

Each sub-group is comprised of one or interest groups or clubs; the likelihood that interest groups or clubs exist depends, *ceteris paribus*, on the demand for the possible functions by the group or sub-groups, the number of individuals comprising the group, and the personal characteristics of the individuals that comprise the group. Each individual can be characterized according to their property rights [PRi], endowments [Ei] and preferences [Pi].

k=1 implies that all individuals in G have the same interests in the natural resource system and there is no collective action within the overall group. k=n implies that all individuals in G have different interests in the natural resource system and there is no collective action within the overall group. $1 < k < n$ implies that there are two or more sub-groups; sub-groups are likely to be defined by their interests in the products of the natural resource system or the functions of the resource management regime.

The Multiple Products of Natural Resource Systems

Gottfried (1992) suggests that natural resource systems that provide several inter-related goods and services are appropriately modeled as "multiple product productive assets that may be long-lived." The productive asset in the case of African rangelands is a geographical area of bushland, some of which is used to produce food crops. The three primary products of the bushland are crops, trees and grass. Those primary products are

often combined with other inputs (e.g. labour, capital, livestock) to provide goods and services of value to people, including: (i) human food -- meat and milk from domesticated livestock, bush meat, gathered foods and cereals; (ii) energy -- trees, tree products, manure; (iii) building materials -- tree products, material for thatching, material for handicrafts; (iv) conservation of biological diversity -- including the special cases in which local residents benefit from tourism and safari operations; and (v) sequestration of atmospheric carbon -- especially in the roots of deep-rooted trees and grasses. The inter-related production functions are given by equations (1) to (5). Other products such as livestock per se and soil nutrient management are intermediate between the primary products and the products of value to people.

Equation (1) models food as a function of the three primary products of the rangeland -- crops, trees and grass, two inputs under human control -- labour and livestock, and climate (a stochastic variable). Equation (2) models energy as a function of trees and labour and equation (3) models building materials as a function of trees, grass, labour and livestock. Equations (4) and (5) indicate that biodiversity preservation and carbon sequestration are not under direct human control but are indirectly affected through the production of trees, grass and crops.

(1) Human food = f1 (Crops, Trees, Grass, Labour, Livestock, Climate)

(2) Energy = f2 (Trees, Labour)

(3) Building materials = f3 (Trees, Grass, Labor, Livestock)

(4) Biodiversity preservation = f4 (Trees, Grass, Crops)

(5) Carbon sequestration = f5 (Trees)

The Multiple Functions of Resource Management Institutions and Regimes

A maintained hypothesis in this paper is that the property rights and collective action institutions that often mediate the relationships between people and natural resources depend in part upon the motivations of those who value the products of the natural resource system. To some extent, therefore, institutions are functional and institutional change is endogenous. Economic models of property rights institutions typically assume that the primary motivations

for property rights institutions are, first, to internalize the benefits of new investments or resource-conserving behaviour and, second, to minimize the related transaction costs.

Another maintained hypothesis in this paper is that people, especially those living in less developed countries, often have other motivations for wanting changes in the property rights and collective action institutions. The various motivations are described in this sub-section.

Internalization of environmental externalities. Gottfried et al. (1996) discuss the advantages of small-scale cooperatives or common property regimes for managing heterogeneous landscapes. The need for some form of public regulation or cooperation among the users of such natural resource systems arises from at least two sources: (i) the spatial pattern of resource use within a natural resource system affects the mix of goods and services supplied by the ecosystem or landscape; and (ii) ecosystems are inter-related so that the way in which one ecosystem is used has spillover effects on contiguous ecosystems. Wear (1992) (cited in Gottfried et al. 1996) refers to the effect of spatial pattern on landscape output mix as 'economies of configuration.'

The use of common property regimes as mechanisms for capturing 'economies of configuration' is now being tested by the Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) in Zimbabwe. CAMPFIRE is a "holistic rural development program that aims to improve people's livelihoods by developing their capacity to manage their indigenous resources (grazing, forestry, water, wildlife) better" (Child and Peterson 1991, 7). In the decade or so that CAMPFIRE has been in existence, it has focused almost exclusively on the management and commercial exploitation of wildlife. The configuration of land use is very important for maintaining the habitat of the wildlife that generate the greatest revenues. An optimal landscape configuration will protect patches of landscape that are large enough to support herds of elephant and buffalo (with appropriate forage supplies and water sources) and corridors between patches of habitat (personal communication with David Cummings, WWF, Harare, Zimbabwe).

Management of environmental risks. Analysts of property institutions for grazing and fishery resources often note the importance of property institutions for managing the

environmental risks related to the use of resources that are variable across space and time. In economic terms, there are two distinct components of the risk management function: risk pooling and sequential adaptation. *Risk pooling* refers to the fact that, everything else equal, the greater the number of resource patches available, and the lower the co-variation between patches, the lower the total variability in resource supply available to an individual resource user (Wilson and Thompson 1993). The potential benefits of risk pooling depend upon the level of environmental risk, people's attitudes toward risk, and the availability of alternatives sources of income. Livestock owners in Africa tend to be exposed to high levels of environmental risks, particularly where average annual rainfall is low and evapotranspiration is high (Ellis 1995). I propose that most African livestock owners are averse to forage supply risk since the survival of their animals depends upon access to minimum levels of forage. They often have no access to markets for insurance or forage.

While the importance of the risk-pooling function of property rights institutions depends upon people's attitudes toward mean-preserving risk, *sequential adaptation* or 'tracking' is desirable regardless of people's attitudes toward risk. The essence of sequential adaptation is that variable environmental conditions result in landscapes comprised of patches generating different qualities and quantities of resource benefits over time. As long as there is not perfect correlation between the patches, the best quality resources will be available in one patch one period, a second patch the next period, and so on. The ability to move animals between patches as those patches generate forage of different quantity and quality is crucial to the efficiency and sustainability of extensive livestock production systems in the drier areas of sub-Saharan Africa (Scoones 1995; Dyson-Hudson 1991; van den Brink et al. 1995).

The presence of environmental risk and people's attitudes toward that risk have implications for the structure and operation of property institutions. First, the greater the environmental variability and lower the correlation between resource patches, the greater the benefits from property rights institutions that allow individual resource users access to a large number of resource patches. Second, the higher the costs of moving between patches, the lower the value of sequential adaptation (van den Brink et al. 1995). Third, the smaller the size of the patches, the smaller should be the herds and more frequent the movements between patches (Dyson-Hudson 1991). Fourth, an effective market for insurance would

reduce the risk pooling incentive for common property but not the sequential adaptation incentive.

Ways to ensure access to a variety of resource patches within a natural resource system include: (i) common property institutions that define and enforce group rights to an area (or areas) that contain complementary patches; (ii) private property institutions that define and enforce individual rights to particular patches and efficient markets for the exchange of those rights; and (iii) private property institutions with non-market exchange relations between the owners of particular plots. Examples of each type of institutional structure, and variants thereof, can be identified in sub-Saharan Africa, although common property appears to be most prevalent.

Security and equity in resource access. Related to the risk management function of common property are the livelihood security and equity functions. There is evidence from India that common property resources are important sources of subsistence, particularly during stress times and particularly for the rural poor. Jodha (1992) analyzed the contribution of common property resources to the welfare of rich and poor households in 82 villages in dry areas of 7 of India's states. He found that the poor derived much larger proportions of their fuel supplies, animal grazing, employment and total income from common property resources than did the wealthy. For example, the poor and wealthy derived an average of 80% and 20% of their grazing needs, respectively, from common property resources. Common property resources contributed 14-23% of the income of the poor but only 1-3% to the income of the wealthy. The contribution to the income of the poor increased to between 42% and 57% during times of drought.

The evidence is less clear for Africa. Wilson (1990) found that the rural poor in Zimbabwe relied on foods gathered from common property resources more than the wealthy and that those foods were particularly important in drought years. Hopkins et al. (1994) found that the poorest households in rural Niger (the bottom tercile) generated a high proportion of their money income from common property resources (8-9 percent) than did the more wealthy households (6 percent), even though the more wealthy households generated more in absolute terms. Hopkins et al. (1994) also found that common property

resources were particularly important to women, generating 15 - 18 percent of their cash income. A series of studies undertaken by the Centre for Applied Social Studies in the Bulilima Mangwe District of Zimbabwe show that the reliance on resources governed by a common property institutions varies by product. Relatively wealthy cattle owners rely more on common lands for grazing than the poor, while relatively poor households rely more on common lands for collection of thatching grass and gathered foods (personal communication with Elias Madzudzo, Centre for Applied Social Studies, January 1997).

Again, common property is one of the possible alternatives for securing livelihoods and for enhancing equity in resource access. Possible alternatives to common property for those functions include private property with reciprocity or efficient markets for wage labour, credit and insurance. Imperfections in the markets for labour, credit or insurance consequently increase the incentive to use common property in this manner. In such circumstances, common property can thus become “the employer of last resort” or "communal bank upon which the community or its members individually may draw under certain predetermined circumstances" (Baland and Platteau 1996, 211-218).

Increasing returns to scale in production and transaction. Quiggin (1993) argues that a primary *raison être* for common property and collective action in natural resource management is the capture of increasing returns to scale in agricultural production. Increasing returns to scale exist when the average cost of producing a unit of output declines with the number of outputs produced. For example, when most land is open for extensive grazing and browsing of livestock, average herding costs per animal tend to be lower in herds with greatest numbers of animals (see examples in Itty 1992). As the percentage of cultivated area increases, grazing animals need to be monitored more closely to prevent them from damaging crops, and the economies of scale disappear.

There are at least three ways that property rights and collective action institutions can facilitate the exploitation of these economies of scale in rangeland systems. First, large livestock production units could operate on large areas of private rangeland. Second, the landscape could be zoned into areas for exclusive grazing, cropping and other uses and the collective herds of individual owners herded on lands held under private or common property.

Third, particular patches of the landscape could be designated as common lands with prohibitions on certain types of land use to preclude uses that interfere with the exploitation of economies of scale. Toye (1995) notes that the optimal mechanism for capturing the benefits of increasing returns to scale will depend upon whether there are increasing or decreasing returns to scale in transacting.

The Multiple Users of Natural Resources

The individuals who use or otherwise benefit from the products of a natural resource system are likely to differ in a number of important respects. Those differences will affect their individual strategies toward resource use and the benefits and costs they expect to obtain from property rights and collective action institutions. Three types of criteria are used here to distinguish resource users -- property rights, endowments and preferences. The following sub-sections describe those criteria in more detail.

Property rights. Following Swallow and Bromley (1995, 107), a right is a guarantee given by a collective authority system to those who comprise the entity and a property right is a right to a potential future benefit. Property rights to the products of a natural resource system may be the same for all those who benefit from those products. Often, however, the rights held by an individual are conditional upon his or her ethnicity, location of settlement, length of time settled in a particular area (Saul 1993), gender (Agarwal 1994) or caste (Thomas-Slayter and Bhatt 1994). Property rights can differ by the types of rights held or by the products to which they apply. For example, Moorehead (1989) describes a case in the Niger Delta in Mali where different ethnic groups had primary rights to different resources available in the delta: animal forage, fish, swamplands for producing rice, and uplands for producing millet, and more general secondary rights for gathering products such as fonio, forest fruits, water-lily seeds, tubers, young wild birds, and wood for smoking fish or domestic use.

Swallow and Bromley (1995, 111) note that rights are more difficult to implement than other types of institutions. To implement the rights of groups or sub-groups, there must be a central authority system that is able to interpret the aims of the larger society, judge between

the rights and duties of competing groups, and enforce sanctions on individuals, groups and collectives of groups. To implement the rights of individuals, the central authority system must interpret the aims of the group, judge between competing rights, and enforce sanctions on individuals and collectives of individuals. Many natural resource systems, especially those in less developed countries, do not have central authority systems with such power and authority and thus do not have property rights institutions. In those situations, resource use may be coordinated by rules, conventions or contracts. Resource users are distinguished on the basis of their endowments and preferences.

Endowments. The endowments of people who benefit from natural resource systems can be defined in several ways:

(1) Endowments of productive physical assets, labour and management resources. Chopra et al. (1990) found that endowments of cultivable land, cattle and particular machines determined households' use of common forest and grazing lands in India. Harris-White (1995) points out that the importance of asset endowments depends upon the specificity of the assets and the structure of markets for assets and capital.

(2) Production efficiency -- McCarthy (1996) characterizes cattle-owning households by the marginal cost of input they incur to raise livestock on a common rangeland. Differences in marginal costs may be directly dependent upon endowments of productive assets, labour and management resources.

(3) Location vis-a-vis the natural resource system -- Location can affect the quality of the resource products available (e.g. top-enders versus tail-enders in irrigation systems), the intensity which with one's actions are monitored, and the transaction costs that must be incurred to access the resource.

(4) Operational power. Individuals with operational power influence the "operational rules" that shape the day-to-day decisions of individual resource users (Edwards and Steins 1996, 14). The operation of customary property regimes in many parts of Africa have depended upon the combinations of coercion, exchange and conditioned power held by different resource users and customary authorities (Swallow and Bromley 1995; Peters 1995).

(5) Bargaining power. Individuals with bargaining power are able to change the "collective-choice rules" that comprise the institutional framework in which resource users operate and operational rules are established (Edwards and Steins 1996, 14).

Preferences. Resource users may also be defined by their preferences. Perhaps most obvious are differences between people who are concerned about different products of a multiple-product natural resource system. An increasing problem in the developed countries is that different individuals and groups have preferences for different products of grazing lands, woodlands and wetlands. For example, in the SIWAA area of southern Mali, resource users include urban-based cattle owners, sellers of fuelwood and charcoal, transhumant pastoralists, and local agrosilvopastoralists (Joldersma et al. 1994).

Resource users can also be defined on the basis of their preferences toward the different functions of the resource management institutions. For example, preferences toward the risk management function will depend upon people's attitudes toward variation in the supply of products from the natural resource system, which in turn depends upon their capacity to generate income from alternative sources and access to markets. Preferences toward the environmental extermality function will depend upon whether people are the generators or recipients of external benefits or costs.

Implications of heterogeneity. There is some agreement in the literature that heterogeneous preferences and endowments are detrimental to cooperative use of a natural resource system. Murty (1994); Quiggin (1993) and McCarthy (1997) developed separate models that illustrate that groups with homogeneous endowments of productive assets are more likely to sustain effective resource management. On the other hand, Baland and Platteau (1995) argue that heterogenous rights can have positive effects on cooperative resource use.

Interest Groups And Clubs

Heterogeneity in property rights, endowments or preferences creates fertile ground for the sprouting of interest groups and clubs. Here I consider an interest group to be a subset

of individuals with shared interests in a particular product of a resource management regime or a particular function of a resource management regime. Interest groups may be informal groupings of individuals, nascent clubs, or formalized clubs.

"A club is a voluntary group deriving mutual benefit from sharing one or more of the following: production costs, the members' characteristics, or a good characterized by excludable benefits" (Cornes and Sandler 1986, 159). Clubs are voluntary, there are both costs and benefits associated with additional members, and there is some mechanism for excluding non-members. A club may provide a single product or multiple products. *Ceteris paribus*, clubs are most likely to form within a group when: (i) a minimum number of individuals perceive benefits from joining a club or clubs apart from their membership in the overall group (e.g. economies of scale, provision of an impure public good); (ii) the costs of club membership are low relative to the benefits; (iii) the costs associated with the establishment and operation of the club are low; (iv) the costs associated with the exclusion of non-members from the benefits of club membership are relatively low; (v) the optimal size of the club (or clubs) is smaller than the size of the overall group; (vi) there are relatively homogeneous subsets of individuals within the overall group; and (vii) individuals derive different levels of enjoyment from the attributes of the other group members (e.g. culture, language, endowments, preferences) (drawn from Cornes and Sandler, pp. 159-210).

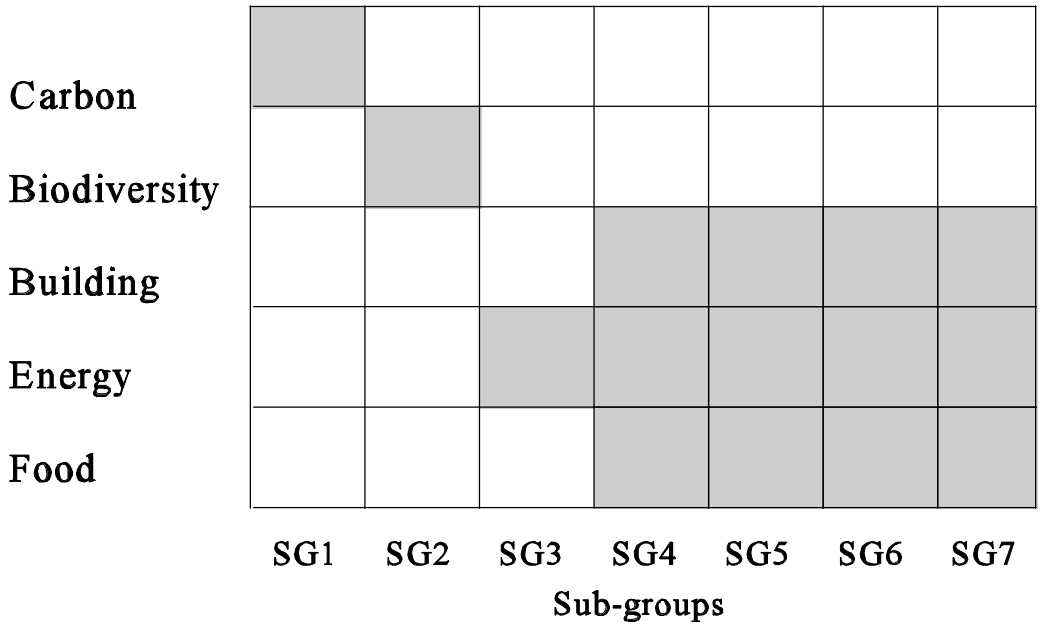
IMPLICATIONS FOR RESOURCE MANAGEMENT

This section illustrates the potential application of the analytical framework. First, the framework is specified for the case of a stylized African rangeland system. Second, implications are drawn for the optimal sizes and boundaries of natural resource systems and management are drawn.

A Stylized African Rangeland System

The rangeland system described in section 3.3 produces human food, energy, building materials, biodiversity preservation and carbon sequestration. The number of products, r, thus equals 5. The number of production functions affected by variables under direct human control, c, equals 2. The five products are arrayed along the vertical axis of Figure 1, with

Figure 1. Natural resource products and user sub-groups



interactions between products explicitly described by equations (1) to (5) above.Assume that there are 7 sub-groups of resource users (g1 ... g5), each of which contains 2 or more members. All n resource users belong to one sub-group and the sub-groups are mutually exclusive. The members of each sub-group are identical to one another in terms of endowments and preferences. Sub-groups are defined by differences in the endowments and preferences of their members. In terms of their preferences, the sub-groups are defined as follows: SG1 is an industrial producer of atmospheric carbon interested in the potential for co-implementation of carbon emission standards; SG2 is an environmental organization (club) whose members reside outside of the rangeland system per se; SG3 is a sub-group of fuelwood and charcoal sellers who enter the rangeland system to harvest wood products produced by the system; SG4, SG5, SG6 and SG7 are sub-groups concerned about the food, energy and building materials provided by the rangeland system.

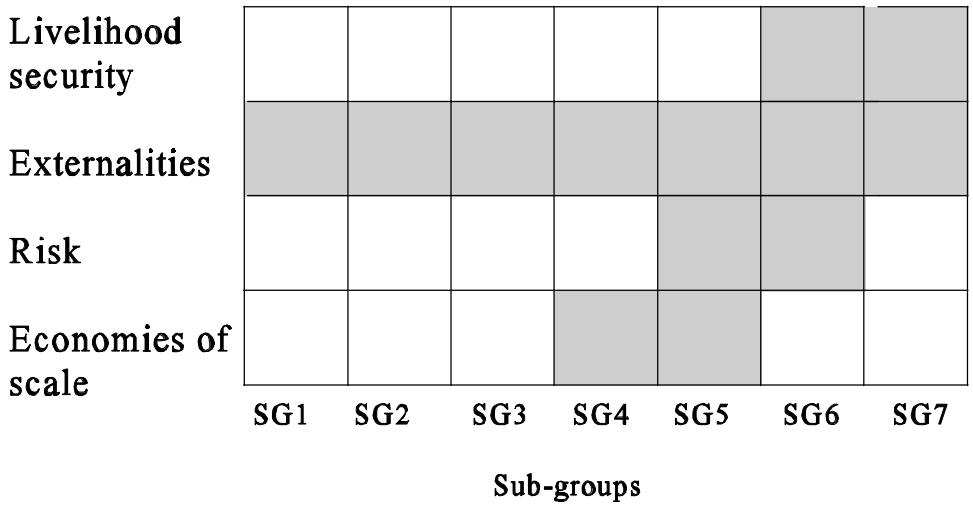
The sub-groups are arrayed along the horizontal axis of Figure 1 with the shaded cells illustrating the products of interest to each sub-group. Obviously the products of interest to SG1 and SG2 are completely different than those of interest to the other sub-groups. Equation (5) shows that the amount of carbon sequestered by the rangeland (of interest to

SG1) depends upon the biomass of trees and the intensity of burning. Tree biomass is an intermediate outcome from the production of food, energy and building materials. Equation (4) shows that the preservation of biodiversity (of interest to SG2) depends upon the intermediate outputs of trees, grass and crops. The interests of sub-groups SG1 and SG2 depend upon the labour and livestock that sub-groups SG3 to SG7 apply to the production of food, energy and building materials. The overlap of interests between SG1, SG2 and the other groups is an empirical matter that depends upon the parameters of the inter-related production functions.

Figure 2 illustrates the interactions between the seven sub-groups, again arrayed along the horizontal axis, and the functions of the resource management institutions, arrayed along the vertical axis. As described above, the four functions are: internalisation of environmental externalities, management of environmental risk, capture of economies of scale, and livelihood security. Sub-groups SG1, SG2 and SG3 are as defined above. Sub-groups SG4, SG5, SG6 and SG7 have identical preferences, but different endowments. SG4 is a sub-group of commercially-oriented producers who have diversified endowments of productive assets and good access to markets; SG5 is a group of pastoralists and agro-pastoralists whose primary assets are large herds of livestock; SG6 is a group of relatively poor pastoralists and agro-pastoralists whose primary assets are small herds of livestock; and SG7 is a sub-group of households that own no livestock nor cultivated land.

All of the sub-groups are concerned about different types of environmental externalities. Sub-groups SG1 and SG2 are concerned about environmental externalities that link tree biomass and biological preservation to the production of food, energy and building materials. There is no rivalry among the members of SG1 or SG2, but there may be rivalry between SG1 and SG2. Sub-group SG3 is only concerned about the environmental externalities among its members and between its members and the members of sub-groups SG4, SG5, SG6 and SG7. Sub-groups SG4, SG5, SG6 and SG7 are concerned with the externalities associated with the allocation of land between cultivation and grazing, the crowding of livestock on fixed areas of land, and the inter-temporal externalities that arise when current stocking rates and management practices (e.g. burning) affect future rangeland

Figure 2. Functions of property rights and collective action institutions and user sub-groups



conditions. In addition, SG4 is concerned with the possibility of undertaking collective action to establish and maintain new sources of water (a club or clubs). Sub-group SG5 has the same concerns as SG4, but is also concerned about the management of environmental risks. The members of SG6 are concerned about environmental risks and the same externalities as SG4 and SG5, but lack the necessary resources to invest in new water sources even if a suitable organization or club was established. Sub-groups SG6 and SG7 are concerned about access and availability of 'fall-back' resources, especially during periods of stress.

The efficiency, equity and environmental sustainability of resource use and management in this rangeland system will depend upon the characteristics of the inter-linked production functions, the interactions between resource users within each sub-group, and the interactions between sub-groups. For example, the production of biodiversity preservation and carbon sequestration do not depend upon the actions of the members of SG1 or SG2; sub-groups SG1 and SG2 may seek to provide incentives to sub-groups SG3, SG4, SG5, SG6 and SG7 to enhance the positive interactions between biodiversity preservation, carbon sequestration and food, energy and building materials. The members of SG4 and SG5 are concerned about the creation and function of a club for provision of a new water supply point; the members of SG6 are concerned about the negative impacts that the well may have on their access to fall-back resources during times of stress.

Optimal Sizes of a Resource Management Regime

It is argued that one of the most important features of a resource management regime is its size. Olson (1965) argues that the members of a group will only act in their common interest if the number of members is 'quite small' or if there is a source of coercion that enforces compliance. Baland and Platteau (1996) discuss several reasons why cooperation is more likely in small groups. First, because each member of a small group bears more of the costs associated with his or her own actions, he or she has more incentive to act in the common interest. Second, members of small groups tend to engage in repeated interactions in a variety of domains, including resource use. These interactions give rise to trust and support for moral norms about good behaviour. Third, people in small groups are likely to be well-informed about each others' actions and preferences. But if small groups have so many advantages, why have groups at all? Why choose common property if private property is an option?

The analytical framework suggests that a variety of benefits are associated with groups of different sizes and that there are different ways that group sizes may be accommodated within a natural resource system. Each component of the framework has implications for the 'optimal' sizes of natural resource systems and resource management regimes. First, the inter-related production functions may indicate convexities, economies of scale, or economies or scope in generation of the multiple products of the natural resource system. Indeed convexities (e.g. minimal necessary size of production unit) and economies of scale are likely to differ across the products generated by a natural resource system. For example, the preservation of large mammals typically requires patches of much larger size than the production of food crops. Economies of scope (cost advantages from co-production of two or more products) are also likely to vary for different combinations of products.

Second, the functions provided by the resource management institutions may have different implications for optimal size. For example, some of the environmental externalities associated with water and soil management in the Nile river system can be accommodated at the level of the micro-watershed; others can only be accommodated through the coordinated efforts of nation-states. The evidence from the arid areas of Africa suggests that the optimal

size for capturing economies of scale in livestock herding is smaller than the optimal size for optimal sequencing of resource use.

Third, the resource management regime may be defined on the basis of the characteristics of the resource users. This may be particularly evident when there are large differences between sub-groups of resource but relatively small differences within sub-groups.

An integrated assessment of multiple products, functions and users suggests at least four ways that the size implications of these three dimensions can be resolved:

(A) No resolution -- The sizes of the natural resource system, the resource management regime and the sub-groups that comprise the resource management regime may be defined separately and their boundaries overlaid.

(B) Compromise -- The size of the natural resource system may be a comprise between the size implications of the multiple products, multiple functions and multiple users.

(C) Separation -- The natural resource system may be partitioned into niches or patches producing particular products; the individuals comprising the group of resource users may be divided into homogenous sub-groups with each sub-group assigned full property rights to a particular niche or patch; and the institutions comprising the resource management regime may be restricted to a single function (e.g. environmental externalities) and market alternatives put in place to accommodate the other functions.

(D) Accommodation -- The overall size of the natural resource system could a compromise between the benefits associated with one of the functions, e.g. sequential adaptation, and the associated transaction costs. Within the overall system, clubs of different size and function form depending upon the motivations of different sub-groups of resource users and the production characteristics of the goods.

Which of these situations pertains will depend in part upon: (i) characteristics of the natural resource system -- productivity, spatial heterogeneity, degree of temporal variability; (ii) characteristics of the local economy -- existence and efficiency of markets for insurance, credit, labour and productive assets; and (iii) characteristics of the local society -- heterogeneity of endowments, preferences and property rights, availability of alternative risk pooling mechanisms and costs of different types of transactions. I hypothesize that, ceteris paribus:

(H1) Results A and B will tend to be inefficient, in terms of achieving the goals of those who value the products of the natural resource system, and ineffective in terms of maintenance of the long-term productivity of the system.

(H2) The greater the coincidence in boundaries under Result A, the greater the likelihood of effective collective action and natural resource management.

(H3) Results A and B are more likely to pertain when the natural resource system is unproductive and heterogeneous across space and time; when the markets for insurance, credit, labour and productive assets are missing or highly inefficient; when the transaction costs associated with exchange and organization are high; and when state agencies attempt to replace customary management systems without a good understanding of the natural resource system and its use.

(H4) Result C is more likely to pertain when the natural resource system is highly productive and reliable across time; when the markets for insurance, credit, labour and productive assets are present and efficient; and when the transaction costs associated with exchange are low and the transaction costs associated with organization are high.

(H5) Result D is more likely to pertain when the natural resource system is highly productive but variable across space and time; when the markets for insurance, credit, labour and productive assets are missing or inefficient; and when the transaction costs associated with exchange are high and the transaction costs associated with organization are low.

DISCUSSION

Natural resource systems provide an array of goods and services of value to people. Good management of those systems requires improved understanding of the value of those services to different groups, inter-relationships between services, and how different goods or services are affected by policies, technologies and climatic changes. Good management also requires improved understanding of the multiple functions of different types of resource management regimes and sub-groups of resource users. This paper has presented an analytical framework for facilitating such understanding and has demonstrated the usefulness of the framework for analysing multiple-product rangelands in Africa.

The framework should also be useful for analysis of other systems and for identifying problems and themes cutting across different types of resource systems. The framework draws particular attention to: (i) the products of the system and linkages between those products; (ii) the motivations that people have for establishing and maintaining resource management institutions; (iii) the possibility of different types of property rights for different products, components or niches within the natural resource system; (iv) the effects of markets and other exchange mechanisms on those motivations; (v) the potential positive and negative effects of interest groups and clubs within an overall resource management regime; (vi) the vested interests of different sub-groups within a regime; and (vii) the implications of any changes in existing institutions for the welfare of different sub-groups.

This approach has potential implications for the size, structure and boundaries of natural resource systems and resource management institutions that may be inconsistent with the conclusions drawn from some previous studies. For example, Wilson and Thompson (1993) proposed that the existence of sub-groups, 'compensating coalitions' with pastoral *ejidatarios* in Mexico was evidence that the common property regimes had broken down, in part because they were too large. The multiple production, multiple function and multiple user approach suggest that the coalitions could be an appropriate response to the needs of different sub-groups and thus a sign of an adaptive and flexible regime. This is very similar to the argument used by Dyson-Hudson (1985) in his depiction of 'organizational flexibility' among East African pastoralists.

Ostrom (1994, 4-5) argues that clearly-defined boundaries and membership criteria are necessary pre-conditions for collective action for common property management.

> So long as the boundaries of the resource and the definition of the individuals who can use the resource remain uncertain, no one knows what they are managing or for whom. Without defining the boundaries of the CPR and closing it to 'outsiders,' local appropriators face the risk that any benefits they produce by their efforts will be reaped by outsiders who do not contribute to those efforts.

The approach adopted in this paper suggests that such statements need to be considered with caution. First, if the resource management institutions are designed to facilitate sequential adaptation and access to fall-back resources, it may not be practical to have boundaries that are fixed and well-defined for every possible contingency. In an uncertain world with

transaction costs, it may be preferable to have boundaries that are flexible or fuzzy (Behnke and Scoones 1993). Here I consider a flexible boundary to be one that is subject to change as a result of negotiation and agreement among resource users and a fuzzy boundary to be one that does not separate territories into discrete mutually-exclusive land units. Second, a natural resource system comprised of a number of heterogeneous resource patches and sub-groups of resource users is likely to characterized by a large number of internal boundaries. It would be possible, but misleading, to interpret multiple boundaries as being ill-defined.

The relationships depicted in the framework are too numerous and complex to be translated into a tight mathematical model. Simplifying assumptions will need to be made; this paper implies that particular care should be given to the appropriateness of different assumptions in different circumstances. An alternative approach would be to use the framework as the guide for the development of a simulation model.

A multiple-product, multiple-function and multiple user approach to the analysis of natural resource systems has several implications for policy. First, the governments of some African countries have recognized the failure of many of their past efforts to govern resource use through centralization of ownership and strict rules on use. One solution to those past failures is to devolve responsibility and authority for natural resource management to local-level administrative units and users' groups. Governments should consider devolving authority for different products and niches of the natural resource system to different levels of administration and different groups of resource users. Second, most African governments are implementing programmes of structural adjustment and market liberalization. Those changes are likely to result in greater heterogeneity among resource users and the formation of clubs to further the interests of particular sub-groups. Such clubs may improve or deter the efficiency of the overall system. They are likely to operate to the advantage of the individuals and sub-groups with the most operational and bargaining power and the disadvantage of the individuals and sub-groups with the least power. Governments should consider how they can facilitate the formation of clubs that are more inclusive, especially for key resources like water. Governments should also consider ways to safeguard the interests of disadvantaged groups.

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MULTIPLE USES, MULTIPLE USERS OF WATER RESOURCES

Ruth S. Meinzen-Dick and Lee Ann Jackson[1]

ABSTRACT

Increasing demands for water for irrigation, municipal, industrial, and environmental uses have created scarcity and competition for vital water resources in many parts of the world. Systems of formalized individual water rights are developing in response to this increased competition. In the process of allocating formal rights, minor water uses such as livestock, gardens, and other domestic micro-enterprises are often ignored and those who use water for such purposes lose access. Common property management systems, which explicitly acknowledge the validity of different claims, offer potential mechanisms for accommodating the needs of multiple users of water resources. This paper reviews examples of institutions that successfully allocate water resources among different uses and different categories of users. It emphasizes the ways local communities have developed to accommodate diverse water needs, and on the ways of mediating conflict over water.

INTRODUCTION

Increasing demands for water for irrigation, municipal, industrial, and environmental uses are creating scarcity and competition for vital water resources in many parts of the world. Usually these competing demands are considered on a macro inter-sectoral scale and policy makers are primarily concerned with addressing competition among agriculture,

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industry, and municipal water supply systems. However, competition for water is also important at the local level, affecting water availability within sectors for various uses and users.

Some water use sectors, in particular irrigated agriculture, provide water for many types of water needs besides their primary stated purpose. Although the success of irrigation systems is predominantly evaluated in terms of their ability to provide water for agricultural production, irrigation systems also provide water for other uses. The quantities of water used in these activities may be small, but these uses have high value in terms of household income, nutrition, and health. The importance of non-agricultural uses of irrigation water in livelihood strategies has implications for irrigation management and water rights, especially as increasing scarcity challenges existing water allocation mechanisms. Greater attention to the allocation of water is needed; that is, to the assignment of water rights and decisions on when, how, and where water will be delivered.

Systems of formalized individual water rights are developing in response to increased competition for water. In the process of allocating formal rights, minor water uses such as livestock, gardens, and other domestic micro-enterprises are often ignored and those who use water for such purposes lose access. Common property management systems, which explicitly acknowledge the validity of different claims, offer potential mechanisms for accommodating the needs of multiple users of water resources.

The purpose of this paper is to provide an overview of the ways in which common property water regimes may be suited to accommodate multiple uses of irrigation water. In the first section we examine different types of water uses and the critical issues associated with these uses using irrigated water as an example. Next, we discuss the existing public allocation mechanisms, trends towards formalization of water rights and the implications of these for existing water rights regimes. The next section provides an overview of various levels of rights to water resources and discusses how these bundles of rights shift according to changes in social and physical conditions. Finally, using irrigation systems as examples, we examine the potential and challenges of common property management of water resource.

MULTIPLE WATER USES

Water is an essential element in biological, social and economic systems. Humans, animals, and plants require predictable intake of water to survive. In ecological systems water cycles through the atmosphere, soil, plants and animals, providing a critical input in the food chain. Water plays an environmental role in maintaining aquatic ecosystems and protecting endangered species. Household livelihood strategies also depend upon water at the most basic level, such as for washing or for food production.

Most institutions for water management deal only with one set of uses and users. As a result, strategic planning and decisions on how water should be used are often poorly developed. This is not problematic as long as there are "unused" sources of water to tap for increasing supplies. But water for different uses does not flow in neatly separate channels in most developing country contexts: it is drawn from common sources, and wastes from each use mingle with the source for other uses.

Although one obvious purpose of irrigation systems is to provide water at the appropriate time and quantities to agriculture, these systems also provide water for a wide variety of less documented non-agricultural needs. An understanding of these non-agricultural uses is essential in the development of flexible water management systems which can meet the needs of a variety of water users (Yoder 1981; Salem-Murdock et al. 1994). These uses include consumptive uses (such as gardening, drinking water, livestock watering, fodder production and construction), and non-consumptive uses (such as washing and bathing, fishing, and religious and recreational uses).

Irrigation systems which are channeled through villages provide a convenient water supply for a variety of household consumption needs (Pitana 1993). Since in many systems water is diverted from the main canals to homes through small side channels, the distance to water supply is an issue in determining the level of use. In those areas where irrigation water is close to the house, water will often be diverted from canals to irrigate homestead crops or may be collected for drinking water (Zwarteveen et al. 1994). Canal water is also used for construction activities such as for mixing mud for bricks (Fleuret 1985).

Although they do not explicitly encourage these activities, irrigation departments often take steps to ensure that the physical structures do not suffer from repeated non-agricultural

uses. Steps may be built on canal banks to control damage to canal walls by washers and bathers or lined to protect from damage by livestock use (Yoder 1981). In some systems special water outlets are constructed which divert water from canals into pools for livestock drinking water and bathing (Fleuret 1985). When grazing is scarce, water may be diverted out of the main canal system to promote the growth of grass for fodder (Stanbury 1991; Fleuret 1985).[2]

The vast majority of irrigation water goes to field crops, particularly cereals. But water is also diverted from irrigation or domestic water supply systems to irrigate gardens. Because these are smaller in scale (and often under the control of women), gardens are generally overlooked as a form of irrigated production. But because they grow horticultural crops, gardens can be a significant source of income and household nutrition (especially micronutrients).[3]

Water plays a critical role in ritual in many religions. This link is strongly articulated in Balinese subaks, which serve as both religious and water management societies. Many South Indian temples maintain their own tanks for religious bathing, but the water may also be used for other purposes. Even mosques require water for ritual washing before prayers.

The water stored or conveyed in irrigation systems can also be used for non-consumptive activities, such as fishing and recreation (Keller 1989). Hydropower--from both big dams and micro-systems in hill areas--is yet another important use. The irrigation systems (and the artificial "wetlands" created on irrigated fields) can be important for the preservation of wildlife, especially migratory birds. With the rise of environmental movements, a number of countries are reserving a certain amount of water for critical biodiversity and ecosystem preservation. Even non-local constituencies can therefore become stakeholders in the water

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[2] This process may actually lead to the degradation of land resources surrounding water sources. For example, Peters (1994) cites an example from Botswana where, under drought conditions, the concentration of livestock around boreholes aggravated already severe overgrazing.

[3] In a comparative study of irrigation systems in Zimbabwe, small-scale gardens on dambo wetlands were found to have significantly higher productivity per unit land and per unit water than formal smallholder irrigation systems (see Meinzen-Dick, Sullins and Makombe 1994).

use in irrigation systems, when these environmental services are considered (see Edwards and Steins 1997).

RELATIONSHIPS BETWEEN USES

Clearly many different groups use irrigation water for essential functions which are not directly related to irrigated agriculture. Each type of water user will have specific needs for quantity, timing and quality of water depending upon the intended use. Although all users benefit from having access to water from irrigation systems, these uses are not necessarily in conflict with one another, either because they do not consume water or because the water requirements occur at different times. Nevertheless, because the water resource is shared, different groups of water users participate in implicit and explicit relationships revolving around the provision and use of the water resource.

Quantity and timing of water needs affects the relationship of different types of users (Pitana 1993). Some uses, such as domestic water supply require constant predictable water supplies throughout the year. In other situations, especially those related to food production, water needs will be correlated with growing cycles and fluctuate accordingly. Non-consumptive uses, such as hydropower, fishing and recreation, do not alter the quantity of water but may require certain amounts of water be held in reserve, or alter the timing of its use by other sectors.

The interrelated nature of water uses, and the impacts of return flows are often neglected (Vaux and Howitt 1984). The drainage from agricultural fields becomes the source of irrigation for other fields, gardens, or other uses. Surface irrigation systems are a major source of groundwater recharge, which is used for domestic water supply systems or other irrigation. Acknowledging the link between irrigation and domestic uses is particularly critical. For example, a subak system in Bali, Indonesia was originally constructed for domestic water supply, and then used the surplus for irrigation. As a result, consistent availability of water for all users is a priority, so instead of a timed rotation, each "share" receives a small flow over a proportioning weir. But in Bangladesh, many handpumps drawing domestic water from shallow aquifers have gone dry seasonally or permanently because of increasing use of groundwater for irrigation (Sadeque and Turnquist 1995).

Consumptive uses, such as domestic water supply, depend upon having access to water of particular quality. Some uses, such as the use of canal systems for washing and bathing, change the quality of the water. However, perceptions of quality vary from situation to situation and may not always coincide with the actual cleanliness of water from irrigation canals. In one case in India villagers considered water which had been filtered through the earth to be clean, and water at the surface to be of lower quality (Rosin 1993). Islamic law considers running water to be pure for drinking and ablutions (Wescoat 1995; Ahmed 1994). The use of water by other ethnic groups or castes may be perceived as contamination. Perception of cleanliness, regardless of whether the perception accurately reflects the physical condition of the water resource, will influence water use decisions.

Although the many uses detailed above may not directly conflict with one another, when water demand increases, or when water supply decreases, competition for water resources follows. Increases in demand from agricultural as well as urban and industrial sectors are contributing to scarcity situations. Even when two uses do not directly compete (e.g. hydropower and irrigation), the need to negotiate between user groups (including relevant government agencies) increases transactions costs, so that one set of users may seek to assert primary rights to the water. When changes in water rights lead to changes in access some users will also experience scarcity and water users who once had adequate water for their needs, no longer have access to quantities and quality of water which they need. Water scarcity challenges existing property rights systems which were able to allocate water under conditions of surplus.

CONCEPTUALIZING WATER RIGHTS

Property right regimes shape all systems of natural resource management. The assignment of property rights and the incentives which encourage cooperation will influence the interaction among resource users and the relationship of users to the resource.[4] Systems

[4] Resource characteristics, such as boundedness and storage capacity, will also determine how property rights for resources can be assigned and therefore influence resource management.

of rights may be highly individualized, such as in private property regimes, or they may include diverse groups of users, such as systems of collective action. Privatization usually entails full ownership by individuals or legal individuals (i.e., corporations) whereas other property regimes include more complex systems of rights held by groups of users. In these types of systems, users often have overlapping rights to the resources which shift according to physical and social conditions.

In general property rights to natural resources can be conceived of as a hierarchy ranging from limited, short term rights to extensive, long term rights to the benefit stream as follows (Schlager and Ostrom 1992):

- access
- withdrawal
- management
- exclusion
- alienation

Rights of access allow resource users to enter a defined physical property.[5] Rights of withdrawal allow users to obtain the benefits from that property. Management rights give users the right to regulate use patterns, thus transforming the resource and potentially altering the stream of benefits from that resource. Management rights also give resource users the ability to define withdrawal rights. Exclusion rights determine who will determine who will have access to the resource. Individuals who have rights of exclusion can define access rights. Alienation rights give individuals the rights to sell or lease either of the previously mentioned collective choice rights.

Individuals, groups, or other legal entities can hold some or all of the above rights. The rights are cumulative and groups or individuals can hold well-defined property rights while not holding the entire set of rights (Schlager and Ostrom 1992).

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[5] Uphoff (1986) distinguishes between water allocation and water distribution. Allocation assigns official water rights to specific users, whereas distribution is the actual process of delivery of water to users in specific quantities at specific times.

In this hierarchy of rights, access to water is critically important in the determination of who will be able to benefit from irrigation canal water. Spatial distribution of the canal systems, as well as the rules of water use which determine who has the right to access this water, will influence access (see discussion below on nested resources).[6] Many sets of rules exist and may overlap for even one type of use. Statutory legal frameworks, but also customary law, religious law, and other institutional and normative repertoires provide basis for claiming rights to water. The coexistence of such different legal and normative frameworks, or legal pluralism, means that individuals can orient their behavior and rationalize their decisions based on a number of normative repertoires. These decisions will be based on knowledge, expediency, and relative power of the various actors (Spiertz 1995).

NESTED RESOURCES

At any one time access rights to a variety of products from water may be in place. For example, domestic water users may take water from canals, at the same time that fishing is occurring off of the canal banks, at the same time that the water is being used for irrigation. Recognition of overlapping domains of property rights which are defined by space, time and product can contribute to the development of equitable systems of water rights (Rocheleau and Edmunds 1997).

Access rights will vary over time depending on seasonal, as well as periodic events. Seasonality introduces predictable water scarcity which can influence the type of access rights that exist for specific types of water uses. For example, in the dry season, the relationship between users who depend upon irrigation water for domestic use and livestock owners who use canal water to water their animals may change. Periodic events, such as drought, also change the hierarchy of needs and will influence the system of property rights which influences the control of water use.

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[6] In Islamic law animals have the right to drinking water and often customs exist which provide them access to canals (Wescoat 1995).

USER GROUPS

User identity and the relation of user groups to other users are particularly important in determining what types of users have rights to access and use of irrigation water and how they will be affected by changes in water rights. Irrigation research documents rarely acknowledge the social differences among various users. Some of the relevant dimensions of user characteristics include gender, kin relations, patron-client relations and ethnicity.

Women often have many fewer explicitly acknowledged rights to water access and withdrawal. Although they depend upon irrigation water to water cattle, irrigate homestead crops, cultivate vegetables, as well as for domestic purposes such as washing, bathing and drinking water, their rights for non-domestic uses are often minimal (Zwarteveen 1995). Women usually have fewer property rights to productive resources, such as land and livestock and men's use of water often takes precedence over women's use (Cleaver and Elson 1995). Men usually have greater access to formal decision making bodies and local organizations which are involved in water management decisions, while women depend upon informal mechanisms to ensure their access to water.

Kin groupings and ethnicity provide easy identification of who should have access to resources controlled by that group (Bruce, Fortmann, and Nhira 1993). Ethnicity provides signals of group membership, and usually has embedded in it explicit and implicit power relationships among various ethnic groups. In South Asia, caste has particular significance for water use. Lower castes are seen as polluting water with which they come in contact. They may therefore be excluded from using many sources, or have to depend on higher castes to draw the water and give it to them (Sadeque and Turnquist 1995). Where occupations (e.g. pastoralism, agriculture, or crafts) are divided along ethnic or caste lines, control of water sources by particular ethnic groups may also determine the sectoral use of that source. Similarly, patron-client relations and other forms of social differentiation establish hierarchies of user group with varying degrees of power.

As mentioned above, a hierarchy of claims on irrigation water exists and shifts according to physical and social conditions (Fleuret 1985) Although agriculture often has first claim to irrigation water, the hierarchy of priority shifts under different scarcity conditions. For example, in the Taita hills of Kenya during the driest season the use of canal

water for providing adequate watering for domestic animals takes priority over other uses. This situation may, however, result in an inequitable distribution of water because, in the short term, it favors those people who own livestock (Fleuret 1985).

These various relationships among users and their property rights have implications for management of irrigation systems, particularly those systems which are under transition. Therefore, the establishment and maintenance of community based management systems will depend upon a clear definition of water rights, the identification of the range of uses and user groups, and an understanding of their overlapping and/or conflicting needs. This identification is particularly important for the less powerful members of society who will suffer the most from the lack of definition of rights because they are less able to protect their access to water resources.

WATER ALLOCATION AND FORMALIZATION OF WATER RIGHTS

As long as resources are abundant, there is little need to assign rights. But with population growth and economic development, demand for water increases dramatically, so that many countries (and especially local areas) experience water scarcity and competition between uses and users. In these contexts, open access regimes need to give way to some form of water rights. What type of water rights will accommodate the many types of uses and users?

There are three major types of water allocation: administrative, market, and user-based allocation. These three allocation mechanisms correspond to the three sectors in which water resource management can take place: (a) the public sector; (b) the private sector; and (c) the collective action sector. Property rights in the public sector are assigned to the state, in the private sector to individuals, and in the collective action sector to groups.

In practice, different types of allocation mechanisms often overlap. For example, there may be public allocation between sectors and within large-scale irrigation systems, with user-based allocation through organized groups of farmers on tertiary units, and market allocation of groundwater used conjunctively. User groups may also allocate water within domestic water supply systems, supplemented by private water vendors.

In recent years there has been increasing attention to the allocation of water rights, with particular emphasis on the potential for market allocation of tradable water rights (Rosegrant and Binswanger 1995). But much of this analysis has tended to evaluate systems in terms of the efficiency of water use, and in practice efficiency is often defined in terms of maximizing output of one product per unit water (ignoring subsidiary uses). In the remainder of this paper, we examine the scope for alternative allocation mechanisms to accommodate a diversity of water users, and the implications of this concern for the definition of water rights.

In most countries the state holds the rights to water, allocating it to users through administrative and political procedures. Administrative allocation of water includes publicly managed allocation of water among nations, across sectors, or within basins and irrigation systems, through quantity distributions or administered water pricing schemes. Quantity-based administrative water allocation is the traditional mode of operation in most large developing country irrigation systems and is by far the most common mechanism in use at all levels in the developing world today. With current trends in economic liberalization and increasing water scarcity and water demand, these allocation mechanisms are being called into question.

Heavy state involvement in water allocation has been justified based on the strategic importance of the resource, scale of systems required to manage it, and positive and negative externalities in its use (World Bank 1993). The large-scale systems used to deliver much of the water for irrigation and municipal needs lend themselves to natural monopolies, and would be beyond the capacity of most communities or private firms to organize and fund. The positive externalities of irrigation systems in improving national and regional food security, or of domestic water supply systems in improving public health, have also been used as justifications for state involvement in such systems. The high individual costs of internalizing negative externalities such as deterioration of water quality from agricultural runoff, sewage, and industrial effluent, or deterioration in groundwater levels, provide further arguments for a strong state role.

While public allocation or regulation is clearly necessary at some levels, particularly for intersectoral allocation, problems with this form of allocation are seen in poor performance of government-operated irrigation systems, leaking municipal water supply systems operated

by public utilities, licensing irregularities and inadequate controls over industrial water use, and damage to fish and wildlife habitats. A major reason for such problems lies in the failure of public allocation to create incentives for water users to conserve.

Under public management the dominant incentive to comply is coercion; that is, setting regulations and using sanctions for those who break them. But this type of incentive is only effective if the state detects infractions and imposes penalties. In many cases the state lacks the local information and ability to penalize, e.g. for breaking water delivery structures or for excessive water withdrawals. It is relatively more effective where there are fewer points to monitor; for example, main canals of large irrigation systems rather than tertiary delivery structures or small-scale irrigation, or withdrawal and discharge points for a few large factories rather than for many small business enterprises.

Furthermore, most implementing agencies dealing with water resources have only sectoral responsibility (e.g. to deal with irrigation or drinking water or industry or environment). While the state as a whole has responsibility for overall water use, the executing agencies have neither mandate nor incentive to create integrated projects or to balance the needs of various users (Yoder 1981). Thus, the agencies operate within strict limits on the quantity of water use, or respond only to single constituencies (e.g. farmers, industrialists). This provides very little flexibility to respond to changing patterns of water demand, and the decision-making mechanisms for allocation are either unclear or highly politicized.

Economists argue that market allocation may be the most efficient means of allocating water to its highest value use. Market allocation of tradable water rights attempts to structure economic incentives for water users, whether irrigation, industrial, or municipal users, to consider the full opportunity cost of water when making water use decisions (Rosegrant and Gazmuri 1994). Compared to the other allocation methods, the design and implementation of policies to encourage the establishment of tradable property rights and the development of markets in water have not been vigorously pursued. However, market allocation of water may be difficult due to the existence of market failures, public goods nature of water supply, and high transactions costs (Svendsen and Meinzen-Dick forthcoming).

Fundamental to market allocation is the establishment of well-defined, quantifiable, and tradable water rights. This means assigning the full bundle of rights, including alienation rights, to a single holder. The existence of subsidiary rights for other uses complicates the assignment of rights.

Traditional water rights systems which facilitate coordination of uses are invisible to the state will also complicate the allocation of water rights. For example, farmers may have complex hierarchies of rights which shift under changing demand and supply of water (Ambler 1994). The danger of transitioning to more formalized systems of rights is that in the process of allocating rights to water users, the less acknowledged rights will be ignored.[7] This is particularly troubling because these types of uses tend to be integral parts of livelihood strategy for poorer, less powerful water users (Vani et al. 1995). Rather than replacing customary systems, it may therefore be preferable to look to such institutions for mechanisms to allocate water among the many uses at the local level.

Effective market allocation requires that third-party effects of water trades can be identified and accurately quantified, and the associated costs are fully taken into account in the exchange process (Meinzen-Dick and Mendoza 1996). From the equity viewpoint, compensation for these third party effects should be paid to those who have been harmed as a result of the agreement. Ideally, this would include those who depend on water for domestic supply, fishing, or other uses. Mexico's new water law provides explicitly for the protection of the environment. Third party impacts are being incorporated in the current legal reforms in Chile. However, legal processes can be long and arduous, and claiming compensation for third party impacts through the legal process may be nearly impossible, especially for those who held informal rights for non-productive or minor uses.

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[7] Rocheleau and Edmunds (1997) make a similar argument in the case of forest resources. "Unfortunately, because women's rights to resources do not generally include the primary rights of disposal and control, interventions which invest exclusive ownership rights in a single individual undermine women's customary rights of access...Outside agents, in designing their projects and programs, can better protect women's access rights by allowing for multiple uses of specific spaces and resources by multiple users, prioritizing nonconsumptive uses...which do not preclude most other uses."

WATER RESOURCES AS COMMON PROPERTY

Common property resource regimes have a number of advantages in resource management situations where multiple users depend upon the resource. Such allocation systems are controlled by users with a direct stake in the use of the water, often operating within the confines of a pre-defined water right. Examples include irrigation districts, groundwater districts, cooperatives, irrigator associations, village-based organizations, or more informally constituted user groups.

A major advantage of user allocation is the potential flexibility to adapt water delivery patterns to meet local needs. Because those directly involved in water use--either for agriculture, home consumption, or industry--have more information on local conditions than the agency staff possesses, they do not have to rely on rigid formulas for allocation. For example, certain fields may be given more water than others, based on the water retention capacity of the soils. User organizations may also take into account local needs for watering animals, washing clothes, bathing, or other small enterprises--needs which a sectoral agency has no mandate to meet. The result can be improvements in output per unit water, or in equity, or both.

Farmer-managed irrigation systems provide one of the clearest examples of user-based water allocation. Studies of such systems have shown a wide diversity of rules for allocation within such systems; by timed rotation, depth of water, area of land, or shares of the flow (Yoder 1994). In the domestic water supply sector, user-based allocation is seen in community wells and handpump systems, as well as in a growing number of more sophisticated systems under the control of water and sanitation associations (Watson et al. 1994). Intersectoral allocation by users is seen in the management of village tanks or other local water sources used for domestic water, irrigation, and even animal watering or other activities.

User-based allocation requires collective action institutions with authority to make decisions on water rights. While empirical studies of common pool resource management (including water) have shown that such institutions can develop spontaneously or through an external catalyst, the institutions are not always in place or strong enough to allocate water efficiently. The creation and ownership of irrigation property--including water and structures-

-form the basis for relationships among the irrigators, which "become the social basis for collective action by irrigators in performing various irrigation tasks." The cohesive force of property is important in many aspects of water management, but it is especially critical for allocation. User groups cannot make decisions regarding water if they have no rights--*de facto* or *de jure*--over that water.

Common property institutions can be limited in their effectiveness for inter-sectoral allocation of water because they do not include all sectors of users. A village community may readily identify with the needs for domestic use, animals, and irrigation, though the particular interests of different groups within the village (e.g. women's greater interests in domestic water, pastoralists in animal supplies, farmers in irrigation) will differ (see Boschmann 1994). But industrial demand is often seen as "outside" the local community, and therefore not amenable to user-based allocation. A recent study of negotiations for water rights for textile factories in rural West Java (Kurnia and Bruns 1996) shows that this is not necessarily true, especially where the same families have members employed in fields and factories. However, the power differences between factory owners and small farmers mean that existing community institutions are often unable to assure that all needs are met.

The tanks of South India provide a clear illustration of such locally-managed multiple use. Many of these earthen dams and reservoirs, ranging from a few hectares to over a thousand hectares, date back hundreds of years. Although their largest consumptive use is for irrigation, the water is also used for bathing, laundry, watering animals, and raising fish and trees. Village panchayats, local temples, or specialized tank associations have traditionally managed the tank resources, deciding such issues as how much water should be released for irrigation or retained for fish, animals, and domestic uses. However, since the colonial period the state has taken on an expanded role in managing the tanks, which have come under the Public Works Department for irrigation, the Fisheries Department for fish, and various other authorities. This has eroded the user-based management institutions, and caused greater problems for inter-agency coordination.

Local management institutions for dambo wetlands in Zimbabwe provide an example of local multipurpose land and water use. These wetlands are important sources of water for livestock, domestic use, building materials, as well as gardens. The state does not sanction

water rights for garden irrigation on dambos. In fact, the Streambank Protection Regulation and the Water Act officially prohibit irrigation on wetlands or streambanks. But traditional authorities in many areas do allocate implicit water rights when they give permission to establish garden plots, while reserving other land for grazing and other uses. Careful study of four sites with effective local institutions indicated that they were balancing water allocation to gardens with other needs (especially livestock): "The farmers' perceptions of the availability of resources are generally accurate and they are willing to limit the expansion of their [irrigation] systems when land and water resources become fully allocated (Andreini 1994:93)."

The need to accommodate multiple uses presents both challenges and opportunities to user groups. The challenges arise in developing institutional mechanisms that allow different users a voice in how the water is managed. Even within the community, women's interests in convenient, clean water for domestic purposes or gardens may be less strongly represented than men's interests in water for irrigating fields (Cleaver and Elson 1995; Zwarteveen 1977). The problems are even more complex when water uses cross community boundaries, as when pastoral and agricultural ethnic groups share water sources.

Multiple uses of water provide an opportunity for user groups because they broaden the base of support for water management, and increase the resources that can be used to manage the systems. Pitana (1993) provides a more recent case of a locally-developed multipurpose water delivery system in Bali, Indonesia. After a serious drought, a group of 70 villagers in Bunutin identified a water source in another village. They raised $50,000 plus local materials and voluntary labor to construct a dam, tunnel, and canal, with the state providing only technical advice. "The villagers voluntarily assisted the group because the water would be used not only by group members, but by all villagers who would have access to it for domestic purposes (Pitana 1993:14)." When water supplies exceeded domestic needs, the remainder was allocated for irrigation in equal shares for all group members. However, the need for continuous flow for domestic use influences the type of water distribution: instead of a timed rotation, each "share" receives a small flow over a proportioning weir.

Control over fishing rights or other water uses can also be a source of revenue for water user groups. Because water users' associations cannot operate at a deficit, and farmers are often unwilling to pay high fees for water, the financial viability of such groups, and their ability to pay for adequate maintenance, is a serious concern (Meinzen-Dick et al. 1997). Traditional irrigation associations in South India auction fishing rights, or rights to trees planted along the irrigation system as an additional source of revenue (Meinzen-Dick 1984; Wade 1988). Cross subsidization from fishing, recreation, and other uses has become a significant source of revenue for local irrigation management in China (Svendsen and Changming 1990).

The operation of users' associations for irrigation or water supply and sanitation are receiving increasing attention (e.g. Meinzen-Dick et al. 1997; Watson et al. 1997), as sectoral agencies seek to transfer responsibility to user groups. By contrast, the functioning of local institutions (including organizations and norms) involved in intersectoral allocation have received little attention. We therefore need to study local decision-making processes and institutions for water allocation in order to learn from successful examples, and identify policies that can promote efficient, equitable, and environmentally sustainable water use.

Some of the difficulties associated with user based allocation mechanisms are related to matching rights to management responsibilities. Water users will have rights to particular products, but these rights will be subject to various rules regarding timing and amount of withdrawals. The challenge of user based management is to structure incentives and compliance measures so that individuals will also fulfill their designated responsibilities. Responsibilities will include maintenance activities related to maintaining water withdrawal and conveyance structures, as well as monitoring of withdrawals in order to maintain specific stocks of water resources. Incentives for continued compliance are critically important since group management of resources without these incentives may lead to "free ridership" and accelerated deterioration or decreased investment in critical resource management activities at the individual level.

Another challenge to user based management systems is the development of local organizations with representation of all user groups. When new organizations develop as off-shoots of existing organizations, they are likely to reflect existing societal prejudices and may

perpetuate inequity rather than providing a forum to meet the needs of diverse user groups. For example, in many situations, women are under-represented in organizations and thus have limited input into management decisions, and less ability than men to lobby for their own needs. If occupations of user groups fall along ethnic lines, traditional social organizations will also have more trouble meeting all needs.

CONCLUSION

Although user based allocation mechanisms for water may not be suited for all water management situations, they are well suited for situations in which multiple users depend upon the water resource. The flexibility of these mechanisms is particularly important to address the shifting social and physical conditions that alter the relationships among user groups. As policy makers become increasingly interested in developing formalized systems of water rights to address competition for water resources, traditional rights regimes may provide lessons on how to structure user based allocation mechanisms to meet the needs of many types of users. Although tradable water rights have recently begun to attract attention as a solution to water scarcity, caution must be exercised to ensure that the rights of "minor" water uses (which may play a major role in local livelihoods) are safeguarded or adequately compensated. Instead of formalizing simple ownership rights to water resources, it may be that "a flexible multi-user tenure framework is the only way to bring all these issues of space, time, . . .products and end uses together on a dynamic and shifting base (Hoskins 1994)."

Where water rights are being formalized, maintaining access to water for critical livelihood uses depends upon the careful evaluation of all uses of the water resource. Maximizing the output of a single product may not provide the optimal solution. Although cost-benefit analyses should consider all costs and benefits associated with resource use, in practice most secondary uses remain invisible. Stakeholder analyses can capture many of these uses, but only if the definition of stakeholders is broad enough. The consideration of full economic and social returns to all water uses is necessary to increase the accuracy of evaluation of alternative water development strategies.

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MULTIPLE USES OF COMMON POOL RESOURCES IN SEMI-ARID WEST AFRICA: A SURVEY OF EXISTING PRACTICES AND OPTIONS FOR SUSTAINABLE RESOURCE MANAGEMENT

Timothy O. Williams

ABSTRACT

Common pool resources such as rangeland, forests, fallow fields, and ponds provide an array of social and economic benefits for a wide variety of users in semi-arid west Africa. However, poor definition and enforcement of the institutional arrangements governing the use of these resources sometimes lead to social conflicts and resource degradation. This problem arises partly due to the multiple functions and temporal variability of common pool resources and partly due to the heterogeneity and overlapping rights of users. These features and increasing concerns about the future productive capacity of the natural resource base raise important questions concerning the choice of institutions most likely to promote sustainable management of common pool resources. This paper presents evidence from field studies on the current status, use and management of multi-product, common pool resources in semi-arid west Africa. The evidence suggests that the large number of heterogenous users and the multiple functions of these resources permit an intensive use of land and serve to minimize production risk. The divergent interests and preferences of various user groups, however, need to be reconciled to prevent resource degradation. The paper provides guidelines on institutional arrangements and policy measures to promote improved management of common pool resources in semi-arid west Africa and other areas with similar agro-ecological conditions.

INTRODUCTION

Common pool resources are natural or man-made resources used simultaneously or sequentially by members of a community or a group of communities. In semi-arid west Africa, they include rangeland, uncultivable fields, fallow fields, crop residues, forests, inland water ways, seasonal ponds and low-lying wetlands. The wide dispersion of these resources within the landscape and the variety of resource units they produce make them particularly useful to a diverse set of users.

Common pool resources share two important characteristics: excludability and subtractability (Oakerson 1986; Berkes et al. 1989; Feeny et al. 1990; Gardner et al. 1990). The first attribute - difficulty of exclusion - arises from several factors including the cost of parceling or fencing the resource and the cost of designing and enforcing property rights to control access to the resource (Ostrom and Gardner 1993). The second attribute -- subtractability -- creates rivalry between different users. The resource units (e.g. bundles of firewood or fodder) that one user extracts from a common pool resource are not available to others. Each user is thus capable of subtracting from the benefits that others derive from a common pool resource. Because of these characteristics, common pool resources are potentially subject to over-exploitation, depletion or degradation. A broad challenge in the management of common pool resources is how to coordinate use by individuals as population grows in order to prevent over-exploitation.

This paper presents an overview of common pool resources in semi-arid west Africa. In so doing, it is intended to highlight the multiple functions they perform, the complex interplay of interests which surround their use, and the institutional problems involved in improving their management. Across the region, common pool resources (CPRs) continue to be a significant component of the land resource base and are widely used by farmers, pastoralists and other rural dwellers. However, changing land use as a result of rapid population growth and declining rainfall has increased the pressure of production on CPRs. Adaptation to increased resource pressure requires innovative institutional arrangements and policies to reconcile the different resource use priorities of heterogeneous users and to prevent resource degradation.

The next section of the paper describes the functions, rights and restrictions governing the utilization of CPRs in semi-arid west Africa. The emerging problems in the use and management of CPRs are discussed in section 3. The types of institutional arrangements most likely to promote sustainable management of CPRs are examined in section 4. The paper concludes by suggesting ways through which institutions and organizations established at multiple levels can be coordinated to improve the management of CPRs in semi-arid west Africa.

FUNCTIONS AND MANAGEMENT OF COMMON POOL RESOURCES IN THE SAHEL

Common pool resources provide food, fuel, fodder, herbs, construction materials and income to rural and urban dwellers across the region. In this dry zone where annual rainfall is low and its distribution erratic, the products obtained from CPRs have been critical elements in the livelihood and survival of many rural communities, particularly in times of drought (Bernus 1988). The collection of leaves, fruits and twigs from forests has long been a method of assuring household subsistence during droughts and in resolving imbalances in the diets of rural households. In Niger, in dry years when the millet (Pennisetum glaucum) crop fails, fruits of trees (e.g. *Boscia senegalensis and Ziziphus mauritiana)* are collected and pounded into a flour that is used to prepare different kinds of food. Similarly, the leaves of *Maerua crassifolia*, a tree that remains green all year round, are often eaten to relieve hunger. The sale of products - stimulant leaves, fruits, fodder, and firewood - collected from CPRs provide an important contribution to household income.

Common pool resources are the main sources of fodder and water for livestock in semi-arid west Africa. The spatial dispersion of common pool grazing resources and the temporal fluctuations in their availability make them an important resource for livestock production in the region. During the rainy season, pastoralists move animals away from the cultivated zone into the drier areas of the semi-arid and arid zones to take advantage of the flush of high quality forage produced by annual grasses on rangeland and to prevent damage to food crops. At this time, animals make use of water available from surface ponds. During the dry season, animals are moved back to the cultivated zone to graze crop residues on harvested fields. As

the dry season progresses further, the vegetation on fallow fields is used as temporary pasture.[1] This seasonal and alternating use of CPRs by pastoralists is not an isolated example. The flood plains of the inner delta of the Niger river in central Mali are traditionally used by fishing communities during the flood season and by pastoralists and rice farmers in the dry season. These and other cases clearly demonstrate the ability of a set of users to appropriately time their use of a common pool resource to a period when others are not exploiting it.

The seasonal use of CPRs also creates opportunities for mutually beneficial exchange relationships between various user groups. The exchanges of grain, crop residue and water owned by farmers for the manure produced by pastoralists' livestock have linked crop and livestock production for many years in the Sahel and served to increase land productivity (McCown et al. 1979; McIntire and Gryseels 1987; Williams et al. 1995).

With respect to access control and use rights, CPRs are held under a variety of property-rights regimes, including state property, communal property, private property and open-access (non-property) regimes. A few CPRs can be easily classified under a property-rights regime. For example, forests, lakes and river banks are often considered as state property and are administered through specialized government agencies. For this category of CPRs, various codes and legislative edicts prescribe in considerable detail usufruct rights for different users and penalties for infractions (Elbow and Rochegude 1990). For many other CPRs, a neat classification is not possible. Furthermore, a given resource may produce flows that are subject to two different property regimes seasonally or over the long term. For example, in areas of low population pressure, fields that are cultivated by individual households often revert to communal use after grain harvest or when they are left in fallow so that crop residues and natural vegetation on these fields can be freely grazed by the entire

[1] It has been observed in many parts of west Africa that fallow fields produce as much forage as natural range. Hiernaux et al. (1983) reported that in the semi-arid zone of Mali, vegetation yields from fallows were equal or greater than from range and include more legumes which provide more nutritious forage than grasses. In the sub-humid zone of Nigeria, Powell and Waters-Bayer (1985) found that fallows provide more forage dry matter per unit area than natural savanna.

village herd or collected by those households who need them. This serves to mitigate inequality in land ownership and access to feeds in many villages.

Concerning inter-group relations in the utilization of CPRs, communities that possess primary use rights often allocate rights of access to subsidiary groups. Groups holding secondary or tertiary rights may be women, other ethnic groups engaged in a different occupation or the poorest members of the community. For example, sedentary farmers may give concurrent or sequential rights for arabic gum collection or livestock grazing to migratory gum collectors and pastoralists. These rights may shift over time or from one resource to another leading to conflicts or renegotiation of access rights.

Nonetheless, the heterogeneity of users and the multiple functions of CPRs in semi-arid west Africa suggest that at low population pressure, existing methods of utilizing these resources permit an intensive use of land and complementary interactions that increase land productivity. Communal use of forests and rangelands allows the varied phenology and production dynamics of natural vegetation to be fully exploited and serves to minimize production risk, especially for transhumant livestock producers whose production methods depend on having access to pastures in diverse locations.

EMERGING PROBLEMS IN THE USE AND MANAGEMENT OF COMMON POOL RESOURCES

Climatic, demographic and economic changes are beginning to threaten the existence and long-term sustainability of CPRs in the region. Although the Sahel has always experienced wide variations in annual rainfall, available evidence indicates that rainfall has been consistently below the long-term average every year from 1969-1990 (IUCN 1989; Sivakumar et al. 1993). At the same time, the region has experienced a rapid population growth of about 3% per annum (World Bank 1990). The combination of increasing aridity, drought and population pressure has resulted in substantial shifts in land use and put stress on common pool resources. In the absence of sufficiently rapid and widespread technological change, population growth and declining rainfall have led to the expansion of area under cultivation. Since 1961, the area farmed in Chad, Burkina Faso, Mali, and Niger has increased by over four million hectares (estimated using data in FAO 1996). This expansion has

involved mainly the conversion of large areas of CPRs such as forests, wetlands and rangelands into cropland, with farmers overriding and ignoring the traditional use rights of other groups to these resources (Cleaver and Schreiber 1994).

These changes have had devastating consequences on pastoralists whose mode of production make them to be particularly dependent on common pool resources. The long periods of low rainfall and severe droughts have accelerated the deterioration of rangelands. At the same time, arable land expansion has resulted in a reduction of natural rangeland and seasonal inaccessibility to remaining pastures due to fragmentation caused by cropping low-lying areas previously used for dry-season grazing (Turner 1992). The net effect has been a restriction in the mobility of pastoralists' herds and the concentration of increasing numbers of livestock on smaller areas which destroys pasture vegetation and contributes to range degradation (Gorse and Steeds 1987; Falloux and Mukendi 1988). The loss of rangeland through alienation and encroachment of farming has heightened conflicts between farmers and pastoralists.

There has also been an erosion and breakdown of customary laws and institutions that previously governed the use and management of CPRs (Lawry 1989; Mariko 1991). This has occurred under the pressure of rapid population growth and has been exacerbated by large-scale inter-regional migrations in many countries and by changing social values and power structures. Politically powerful groups and elites with preferential links to various organs of the state (e.g. civil servants, wealthy traders and religious leaders) have frequently appropriated CPRs for their own use and in the process introduced new use and management structures. In Senegal, there are several accounts dating back to the 1950s of how the powerful *Mouride* Islamic brotherhood has been able, with government backing, to convert large tracts of communal rangelands into peanut fields. In 1991 alone, the Senegalese government gave permission for 45,000 ha of forests to be converted to peanut fields (Freudenberger 1991). Furthermore, shifts in the relative authority of customary and state institutions are evident in many countries. The state has frequently undermined the capability of customary institutions and organizations to manage CPRs by transferring authority to government agencies and by imposing tight controls that conflict with traditional use patterns. This intervention is viewed as legitimate, and even necessary, to prevent the resource

degradation that would result if users were left to their own devices. Thus in many countries, laws are established to redefine local users rights and duties with respect to forests, rangeland and fishing grounds. However, this intervention often arises from an insufficient understanding of the intricacies of customary institutions with their emphasis on differentiated access rights and the often subtle, but important, sanctions that are utilized to regulate resource use. With this wrong perception, government's interventions have frequently resulted in unintended, but disastrous outcomes. For example, the installation of deep boreholes in pastoral areas in the 1960s served to open up remote pastures but created other problems as it destroyed the basis of the social and institutional structures that previously regulated access to pastures. Before the introduction of boreholes, shortage of water and tight control, by local herders, of water available from surface ponds prevented degradation of rangeland. With the introduction of boreholes, it was possible for animals to graze for longer periods as water was no longer a constraint. Outside herders attracted by the wells refused to abide by the old rules since the wells were considered as state property. Insufficient number of wells and free access to the few available ones led to situations where the number of animals congregating around available boreholes exceeded the carrying capacity of the surrounding rangeland causing rapid deterioration (Crotty 1980). Another example is the decline of the effective and comprehensive customary institutional arrangements that were used in the 19th and early part of the 20th century to manage the CPRs of the inner Niger delta in central Mali (Moorehead 1991). Once the colonial authorities nationalized the resources and the post-colonial governments provided all Malians equal use rights to these resources, the complex rules governing access began to unravel leading eventually to over-exploitation of the delta resources. Other examples, including unsuccessful grazing, forestry and fishery schemes in many parts of semi-arid west Africa, indicate that resources that were under effective communal management have, as a result of inappropriate state intervention, been converted into de facto open access resources (Thomson 1987; Vedeld 1992). This conversion is often accelerated due to the inability of the responsible government agencies to provide effective management programmes because of poor staffing and inadequate technical and material provision by the government for the work of these agencies.

CREATING APPROPRIATE INSTITUTIONS FOR THE MANAGEMENT OF COMMON POOL RESOURCES

The problems highlighted in the previous section indicate that new and effective institutional arrangements are needed to improve the long-term management of CPRs in semi-arid west Africa. A growing recognition of this need is evident in the region. In most countries, state property regimes in which government officials exercise exclusive decision making powers on resource use and management are being de-emphasized in favour of decentralized and participatory management of natural resources. The specific approach used to encourage active local participation varies from one country to another. In Niger, it has taken the form of a legislative reform of land tenure and natural resource management policy conducted over a ten-year period from 1985 to 1994 (Republique du Niger 1994; Elbow 1996). In Burkina Faso and Mali, land-use planning based on the concept of "village territories" has become very popular (Freudenberger and Mathieu 1993; Benjaminsen 1995). In all cases, governments have sought to clarify tenure issues and reinforce the rights of local communities to manage their resources through granting of legal recognition and decision making authority. While experience with implementing these new programmes is still limited, they nevertheless represent a departure from the top-down, centralized resource management policy of the past. However, simply assigning authority to local users, without ascertaining the range of uses of a resource, the diversity of interests among users and the capability of existing local institutions to take on additional responsibilities, will only complicate rather than solve the problems associated with the appropriation and management of CPRs.

This is because common pool resources in the region have multiple functions and are exploited by a wide variety of user groups. These heterogenous users have different objectives, production strategies and priorities in resource use. In general, differing scales of exploitation, overlapping rights, and frequent contestation and negotiation of access rules characterize the use of CPRs. In this situation, devolution of power must be conducted cognizant of the spatial and temporal aspects of existing formal and informal usufruct rights. Failure to recognise the rights of all existing users will lead to the appropriation of key resources by the more powerful groups or those practicing a particular system of production, which may eventually result in social conflicts or inefficient utilization of the diverse set of

CPRs. This is one reason why the village territory approach has come under criticism. Because the concept is more applicable to settled farming villages with a clearly defined territory and set of resources, it has been argued that there is a danger that the approach may empower sedentary farmers to exclude transhumant pastoralists from grazing resources they previously had access to, especially where the farmers themselves are beginning to manage their own animals (Lane and Moorehead 1994; Painter et al. 1994). This implies that the specific attributes of the resource and the resource sharing arrangements that exist between users need to be considered in the devolution process. Devolution of power, if it is to be effective and equitable, needs to take into account the multiple functions and heterogeneity of users of CPRs.

More importantly, governance arrangements for complex, multiple-use CPRs need to recognize and make use of institutions and organizations available at different levels (Ostrom 1995). Both local-level and wider-scale institutions have important roles to fulfill. Local-level institutions have a comparative advantage in dealing with issues related to resource use and preservation at the community level. Thus, detailed provisions for access, use and management of CPRs are best handled by mixed associations of local user groups (e.g. farmer-pastoralist associations). However, local associations vary widely in their organizational and management capabilities. Given that some potential local organizations may not form at all even when given formal authority, state institutions will be needed to provide support for the formation or strengthening of local organizations where they are non-existent or are weak. Institutional strengthening and training can be provided by government agencies in such areas as management and leadership skills and program planning.

Also, given the wide variety of users and the complex set of overlapping rights that are continuously contested, the need for conflict mediation will be fairly constant. Governmental institutions will be important in resolving disputes, reconciling the different interests of various user groups, and providing an appropriate legal framework to support and enforce resource use agreements worked out by different local groups.

With respect to the management of CPRs, local users generally possess inadequate scientific knowledge to complement their own indigenous knowledge. Yet, access to reliable information on resource conditions and the effects of different resource use patterns is

essential for the long-term management of CPRs and the sustenance of livelihoods that depend on them. State institutions can assist local users by carrying out environmental assessments of resource use patterns and determining resources which are being degraded or at risk, and providing training on improved management techniques. Considering these various functions, it is clear that the state has a continuing and facilitative role to play in the management of CPRs.

CONCLUSION

The wide variety of users and the multiple functions of CPRs attest to the vital importance of these resources in semi-arid west Africa. Sustaining the productivity of CPRs remains an essential task given the growing scarcity and increasing demand for these resources. The challenge is to devise governance arrangements that are supportive of the diverse needs of heterogeneous users, yet protective of the long-term productive capacity of these resources. Institutional arrangements for governance must take into account the multiple ownership, use and management structures of CPRs in semi-arid west Africa. Past experience has shown that centralized governance units, with an ethic of regulation and control, are ill-equipped to regulate and manage multi-product, multi-participant resource systems with fluctuating benefit streams. Effective management of CPRs requires an appropriate mix of local and state institutions and organizations. The exact mix will vary according to particular circumstances, but the emphasis and focus would need to remain on the revitalization of local institutions and organizations. The variety of response capabilities needed to manage complex, multiple use resource systems can only be provided through institutional arrangements developed at multiple levels and made to function in a complementary fashion.

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PRIVATE EXCHANGE AND SOCIAL CAPITAL: MULTIPLE FUNCTIONS OF COLLECTIVE ACTION IN HAITI[1]

T. Anderson White

ABSTRACT

Policy makers face a major challenge in understanding the appropriate roles and limits of state, private and collective action in managing local resources. Meeting this challenge requires full understanding the functions that each type of action perform for individuals and for society. This paper focuses on the option of collective action and contributes to the debate by exploring the multiple functions of collective action to manage small watersheds in Haiti. Research results indicate that a substantial percentage of individual participation could be explained by motivations associated with the process, rather than the output, of action and that high levels of pre-existing collective action groups were a necessary condition for the emergence of the watershed regimes. Labor exchange groups serve as fundamental antecessors of the watershed regimes and more complex forms of public goods-producing groups. This last finding indicates that individual choice to purchase or exchange labor is not socially neutral and that governments should carefully reconsider policies that discourage labor exchange. This study supports claims that collective action regimes emerge from, maintain and extend social capital, and that social capital contributes to economic and political development. The study concludes that full understanding of the roles and limits of collective action requires clear perception of the social and ideological dimensions of action, and

[1] This paper draws heavily on works published previously by the author and C.F. Runge: (White and Runge 1995; White and Runge 1994) and includes extensive contributions from Glenn Smucker. In addition, it has benefitted from the helpful comments of Norman Uphoff, Mats Lundahl, Ruth Meinzen-Dick, Hans Gregersen, Robin Mearns, Brent Swallow, Eric Trimble, Cathy O'Connor, Nancy Branberg and Alexis Gardella.

furthermore, that policy makers should protect and enable fundamental forms of social capital and invest in research to better understand the social and economic benefits of social capital.

INTRODUCTION

Today, policy makers face a major challenge in understanding the appropriate roles and limits of state, private and collective action in managing local resources. Meeting this challenge requires full understanding of the functions that each type of action perform for individuals and for society. While theories and evidence of the multiple functions of state and private forms of governance are generally well developed, understanding of collective action forms is embryonic (Uphoff 1996). Ironically, this lack of understanding parallels recent, and often enthusiastic, policy support for all things local - evidenced in new trends to promote decentralization, common property systems, and community-based management systems (de Janvry, Sadoulet and Thorbecke 1993).

This paper contributes to the debate by exploring the multiple functions of collective action to manage small watersheds in Haiti. The paper builds on the data and research results previously described in White and Runge (1994 and 1995). The paper will first review the conceptual background for the analysis of multiple functions of collective action, describe the research and analyses, discuss findings and conclusions, and then assess the implications of these findings for research and policy in Haiti and in general.

CONCEPTUAL BACKGROUND: INDIVIDUAL CHOICE, SOCIAL CAPITAL AND ECONOMIC DEVELOPMENT

Full understanding of the desirability and limits of collective action regimes for managing natural resource systems includes understanding why individuals choose to create such regimes (e.g. water user associations, community forest groups, or range management groups) and the conditions affecting their performance.[2] Research in this domain often assesses individual motivations for participation strictly in terms of their potential to gain from

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[2] In this paper the term collective action refers to the process and consequences of individual decisions to voluntarily coordinate behavior (White and Runge 1995). The term collective action regime refers to the set of institutional arrangements governing a collectively managed activity or resource.

the direct output of the regime (e.g. the managed forest, irrigation system or range). Increasingly, practitioners and researchers realize that individuals often contribute to collective actions for reasons other than those of narrow self-interest, and other than those associated with the output. These "other" reasons can include minimizing risk; fulfilling social obligations, banking favors; enhancing personal prestige, or other ideological/personal/cultural reasons (cf. Kanbur 1992; Mearns 1996; Swallow 1996). Evidence indicates that these "other" functions can be as important as, and sometimes more important than, narrow incentives to capture gains from action in explaining the emergence and performance of collective action regimes (Kanbur 1992; White and Runge 1995).

In addition to performing multiple functions at the individual, or private level, collective action regimes also perform multiple functions at the social, public level.[3] Of course, a primary social-level function is to address a particular collective issue, but as at the individual-level, there are undoubtedly a host of "other" social-level functions. These functions are less well studied and understood, but perhaps no less important. For example, Albert Hirschman (1984) found that the collective action groups he studied in Latin America were mutations and extensions of pre-existing groups and that the individual and collective experience of developing skills, trust and norms within each group enabled the construction of new and more complex organizations. In this manner, a key social function of each group was to facilitate the formation of another, thereby enabling society to address new needs and seize new opportunities. He termed this transformative process "the conservation and mutation of social energy".[4]

More recently, politicians, development practitioners, and noted academics alike have shown great interest in the role of collective action and other forms of social capital in

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[3] Differentiating between private and social functions is of course very problematic. The difference is made here to facilitate analysis and the organization of the discussion.

[4] More recently, Francis Fukuyama coined the phrase “spontaneous sociability” to describe the same phenomenon (1995a).

government performance and economic development.[5] Robert Putnam (1993), for example, argues that efficient and responsive government in Italy (and by inference, democratic governments in general) can largely be explained by the presence and strength of social capital. Putnam (1995) further claims that social capital "can improve education, diminish poverty, inhibit crime, boost economic performance, foster better government and even reduce mortality." Francis Fukuyama (1995a) claims that "...virtually all serious observers understand that liberal political and economic institutions depend on a healthy and dynamic civil society for their vitality." Fukuyama (1995b) further predicts that "The character of civil society and its intermediate associations, rooted as it is in nonrational factors like culture, religion, tradition, and other premodern sources, will be key to the success of modern societies in a global economy." And the feature of social capital most important in enabling modern economic success, according to Fukuyama (1995b), is the capacity of a society to innovate and transform its social organizations to meet new needs, i.e., the "conservation and mutation of social energy".

If the claims by Messrs. Putnam and Fukuyama, and the many other promoters of social capital as a powerful driver of political and economic development are even partially true, then collective action regimes, and other forms of civic action, perform a valuable role in societies, not only by the particular issues they address, or economic gains they generate, but by their subtle and generalized contribution to the construction of other and future forms of social capital. Indeed, recognizing the growing evidence that social capital contributes to development outcomes, the World Bank now recommends that member countries attempt to measure, protect and invest in their social capital (Serageldin 1996).

The weight and import of these claims and implications for policy calls for increased scrutiny of the multiple functions of collective action, and in particular, investigation of the social capital function of collective action. Ultimately, policy makers will want to know whether the benefits of these "other" functions of collective action regimes -- calculated in addition to the value of the objective output of action -- are sufficiently significant to merit

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[5] The term social capital refers to "features of social organization, such as networks, norms and trust, that facilitates coordination and cooperation for mutual benefits" (Putnam 1993).

particular government investment. Given the relative youth of this domain of research, these questions pose a quite formidable challenge requiring substantial advances in methodology and careful case analyses.[6]

Before getting started, it is important to note that Haiti is renowned for its history of predatory governments and its subsequently weak civil society, extreme poverty and environmental degradation (Fass 1988; Lundahl 1992; Trouillot 1990). On the other hand, Haiti is well known -- in the anthropological literature at least -- as a country with a strong and rich tradition of peasant associations, associations that assist peasants gain access to the factors of production, manage risk, and find meaning and conviviality in everyday life (cf. d'Ans 1987; Barthelemy 1989; Lundahl 1979,1983,1992; Moral 1978; SACAD and FAMV 1993). Haiti is richly endowed with social capital at the level above the family and below the community, but has substantial deficits in social capital at the middle and top levels of society. This paper reviews a case of concerted effort to extend existing fundamental forms of social capital to new forms that would address the challenge of natural resource conservation at the landscape level.

RESEARCH AND ANALYSES

The Case

Research was conducted in Maissade, Haiti where beginning in 1986, an international development organization conducted a pilot project to encourage resource conservation and economic development by building upon and strengthening traditional forms of peasant organizations.[7] The project encouraged peasants to organize producer groups (*groupman*)

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[6] This paper builds on, but does not review, the rich and extensive literature relative to the emergence of collective action, the management of common-pool resources, and common property - all literatures relevant to the issue of the multiple functions of collective action. For excellent general treatments of collective action theory and evidence see Ostrom 1990 and Bromley (Ed.) 1992. For reviews of the collective action literature from a public choice perspective see Olson 1965, Buchannan and Tullock 1962, Sandler 1992, and Ostrom, Gardner and Walker 1994.

[7] The project described here is the Local Resource Development Project II, financed by the United States Agency for International Development and implemented by the Save the Children Federation between 1986 and 1990.

in order to better achieve individual and collective goals.[8] In 1989 the project began an experimental program in 22 watersheds where extension agents encouraged all landholders to cooperate to manage the watersheds. No external incentives were given to peasants to encourage cooperation and members of producer groups were not specifically encouraged to cooperate. The rationale behind this effort was that by 1989 substantial progress had been made in identifying the technologies and mechanisms to increase agricultural production and resource conservation on individual plots - both in Maissade and in other areas of Haiti, but a substantial challenge remained in learning how to achieve coordinated use over geographic areas. The watershed experiment tested the logic of cooperation and the capacity of local peasants to create new organizations to manage land at the watershed level.

The research described in this paper explores the multiple functions of the watershed groups that emerged to control transboundary erosion in the small, multi-owner watersheds. Watershed groups were self-organized and directed. The collective action consisted of voluntary labor contributions to build checkdams in ravines that crossed private land holdings.[9] Research focused on understanding why individuals chose either to participate (or

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[8] "Underlying principles of *groupman* stress its independence as a social unit, its basis in pre-existing ties, i.e., exchange or kin ties, and its focus on investment. ...undifferentiated and non-hierarchical in its internal organization" (Locher, Smucker & Woodson 1983:49). The Maissade project was one of numerous organizations that promoted the *groupman* methodology during this period. These investments eventually produced the national-level *groupman* movement, which took on its own ideology, forms of expression and political direction (Maguire 1996, Noriac and Smucker 1996). Haiti has a long, and mostly unfortunate, history of explicit efforts to organize peasants into formal cooperatives and other community-level development organizations. For the history of cooperatives see Arbousse - Bastide (1967) and Lundahl (1993: Chapter 17). For the history and experience of community development organizations in Haiti see Smucker 1983 and Noriac and Smucker 1996.

[9] Checkdams were the technical innovation that controlled the erosion externality by withholding water and soil. These checkdams were demanded by landholders because they reduced land degradation and enabled farmers to plant high valued crops in the trapped sediment. Cooperative management was the institutional innovation that allowed these gains to be realized. After two years of activity, a total of 590 checkdams had been constructed, 54% of all landholders had participated, 34% of all participants had checkdams constructed on their land; and 22% of all checkdams were built on non-participant land.

not to participate) in the activity, and why new cooperative groups formed in some watersheds and not in others. Both statistical and ethnographic methods were used. See White and Runge (1995) for comprehensive descriptions of the site, conceptual framework for collective action, the research methodology and statistical tests.

PREDICTORS OF INDIVIDUAL PARTICIPATION

Statistical analyses found that the strongest predictors of participation - for participants who held land in the watersheds - were: (1) membership in pre-existing producer groups (*groupman*); (2) prior adoption of soil conservation techniques on their own private parcel; and then (3) potential for checkdam construction on participant's land. Individuals who were members of producer groups and had previously adopted techniques were 12 times as likely to participate than other peasants. Notice that the variable indicating direct economic benefit from the collective action event was significant, but the weakest of the three significant variables. Data also indicated that participant's landholdings was disproportionately "insecure" in the conventional sense. That is, participants had a greater tendency to hold undivided inheritance land (*te indiviz)*, to rent (*fem)* or sharecrop (*demwatye*) than non-participants.

Almost one-half of all labor contributions came from individuals who did not own or work land in the watersheds. The strongest predictors of participation - for participants who did *not* hold land in the watersheds - were: (1) membership in pre-existing producer groups; (2) membership in reciprocating labor-exchange groups; and (3) youth. In terms of the odds of participation: producer group membership alone increased the odds four times, membership in labor exchange increased the odds two times and the odds decreased just over one time for each year of age. Individuals who were both members of producer groups and members of labor exchange were seven times more likely to participate than other peasants.

Observation and focus-group interviews revealed a moral dimension to the individual's participation calculus. This moral dimension was encouraged by project extension agents who used a normative argument to support participation. Peasant discourse associated with the activities indicated that all citizens were generally expected to participate, that is, the community felt that individuals *should* participate in the action as it was yielding public

benefits. Peer pressure was especially strong on producer group members, as the watershed activities were articulated as a concrete example of the duties and ideals of the *groupman* movement. It was also evident that conviviality was an important feature of the watershed groups. Many participants were friends and many individuals clearly enjoyed the experience of working together in the watersheds.

Because of the obvious importance of membership in producer groups and labor-exchange groups, we next sought to better understand the relationship between these fundamental social units.[10] The strongest predictors of membership in producer groups were: (1) membership in labor-exchange groups; and (2) affiliation with Protestant religions. Additional analyses indicated that membership in labor-exchange groups alone increased the odds of producer group membership by 11 times and Protestant affiliation alone increased the odds of membership three times. Membership in labor-exchange groups and, to a lesser extent affiliation with Protestant religions, is apparently an important precursor to membership in other forms of collective action. Participation in labor exchange apparently builds experience in the type of skills necessary for successful collective action, skills like: sharing information, leadership, building trust, constructing rules, monitoring relations and sanctioning.

We also found that membership in producer groups was the strongest predictor of soil conservation adoption. This suggests that such forms of social capital also facilitate the acquisition of knowledge, diminish the risk of innovative behavior, and thus decrease the cost of adopting new technologies. Labor exchange groups, in particular, reduce the cost of labor by reducing the opportunity costs, the transactions costs of acquisition and supervision, and thereby reducing the costs of labor-intensive land improvements. Numerous tests found that

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[10] Labor exchange institutions (e.g. *asosye, esquad, ron*) are pervasive and exist in diverse forms throughout rural Haiti. Other, related forms of social capital include rotating credit groups (*sang, sol, sabotay, komble*) and other, non-economic, forms including those of a ceremonial character (e.g. *bann rara, kontradans*). Because these groups are self-initiated and governed, they are perhaps the most common and fundamental form of democratic governance in Haiti. For additional information on peasant organizations see d'Ans 1987, Barthelemy 1989, Horowitz 1971, Lundahl 1979 and 1983, Moral 1978, Smucker 1983, Bastien 1985, SACAD-FAMV 1993, Metraux 1951 and 1971, Murray 1977.

no variables predicted membership in labor exchange groups.[11] Viewing the varied ramifications of labor exchange in the rural economy, identifying the determinants and dynamics of this fundamental form of social capital remains a valuable line of further inquiry.

PREDICTORS OF EMERGENCE OF COLLECTIVE ACTION

The level of collective action ranged from high in some watersheds to low in others. Statistical analyses were conducted to identify the variables associated with collective action. Strong action was significantly predicted by: (1) the proportion of watershed parcels that were in the mid-stream position (indicating the aggregate potential for economic gain); (2) the proportion of watershed landholders who had adopted soil conservation techniques; (3) the proportion of landholders who were members of labor exchange groups; and (4) the proportion of landholders who were members of producer groups. Note that at this aggregate level of analysis, the potential for direct economic gain from the collective action was the most important predictor. Groups formed to manage watersheds where there was sufficient private economic logic. In economic terms, a "critical mass" of narrow self-interest was required for action.[12] High levels of practical knowledge concerning the benefits of the techniques themselves, and high levels of social capital - in the form of producer and labor-exchange groups, were apparently necessary, but not sufficient, conditions for successful emergence.

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[11] Here it is important to note that neither kinship (real or fictive - such as godparenting) nor patron-client relations were tested. Other research in Haiti and elsewhere has suggested that kin and patron-client relations often play a substantial role in an individual's access to land, labor and capital as well as social security in all its forms (c.f. Murray 1977, Smucker 1983 and Bloch 1973).

[12] This finding supports the assertion of public choice economists, articulated most simply by Todd Sandler that "individual rationality is not sufficient for collective rationality" (Sandler 1992).

DISCUSSION

Multiple Functions of Watershed Management Regimes

Individual level. The watershed management regimes served as "bundles of opportunities", performing different functions for different individuals. Here, these functions will be separated into two somewhat artificial categories, those associated with the direct *output*, and those associated with the *process* of action. As stated previously, the concrete *output* of action was a series of checkdams established on private land while the *process* of action was a series of labor contributions. As the reader will see, the output/process distinction could also be described as direct/indirect, immediate/deferred, or short/long-term benefits. Clearly, at the individual level, process-related functions were more important than output-related functions. That being said, as illustrated by the social-level analysis, groups did not form unless there was sufficient economic logic at the aggregate-level to form.

Output-related. The management regime appeared to perform at least three output-related functions for individuals: (1) provided direct economic gains to those who benefitted from establishment of checkdams on their land; (2) decreased land degradation on-site, providing farmers with more assured expectations over production; and (3) minimized risk of land degradation downstream, providing downstream farmers more assured expectations over production.

Peasant discourse regarding the activity indicated that the function of reducing the uncertainty and enabling more secure expectations over production was especially important. This is easily understandable. Weather, and its varied impacts, is a constant source of uncertainty in Haiti. Rainfall is frequently torrential and because soil conservation is uncommon, overland flow can ruin a planted field overnight. Evidently, in constructing the regimes farmers sought to coordinate the behavior of upstream farmers to reduce their own insecurity. More secure expectations would, in turn, enable better investment decisions and more efficient production.

Process-related. The regime appeared to perform at least four process-related functions for individuals: (1) provided a mechanism to invest effort (and good will) in reciprocal relations and social solidarity; (2) enabled individuals the opportunity to express their beliefs regarding how one should manage land, and how society could limit degradation

by cooperating across landscapes; (3) provided an opportunity for conviviality; and (4) provided an opportunity for poorer individuals to form relationships where they might be able to sell their labor in the future.

We have no idea how much of the process-associated participation was a function of expectations of reciprocity; social, cultural or religious norms; or conviviality. The fact that participation was most strongly correlated with membership in producer groups, which in turn is predicted by membership in labor exchange groups and Protestant religions, rather than potential for direct economic gain, indicates that social norms played a strong role in the individual's decision calculus. Apparently, the watershed activity reflected the ethical values of these different - and overlapping - social systems. The participants appeared to share a common sense of responsibility toward each other, at least in terms of cooperation for landscape management (cf. Uphoff 1996:367). This deeper sense of individual, and subsequently collective, sense of moral responsibility seemed to provide the social rationale and justification for the action. The fact that producer-group participants were disproportionately Protestant appears to support Max Weber's (1930) famous thesis, that Protestant ethics contribute to the accumulation of capital, and subsequently to economic and social development.

Conviviality is highly valued in rural Haiti for its own sake, but also because conviviality serves to sustain group life (Smucker 1983). In short, the more lively and more entertaining a group, the greater the probability the group will continue to function and continue to supply mutual benefits. Individuals thus seek groups that are entertaining and "fun". To the extent that the watershed groups were determined to supply this function, the watershed groups contributed both to individual enjoyment and group solidarity. At a deeper level, the watershed groups would also have assisted in fulfilling the fundamental human need for belonging, validation and dignity (c.f. Durkheim 1933; Fukuyama 1995). Anthropologists have reported this individual and collective norm to belong in rural Haiti, where some stigma is attached to individuals who prefer to avoid participation in social groups (Smucker 1983).

Because of the importance of labor-exchange membership, it appeared that participants, at least to some degree, were "banking favors", or "building debts", and therefore reducing uncertainty over ability to muster labor in the future. It was also apparent that these debts

were fungible, and that a labor contribution to build a checkdam on an individual's land might be repaid in other types of assistance at a later date. Because land and capital are scarce in rural Haiti, and labor relatively plentiful, labor is the currency used to gain access to other factors of production, as well as all aspects of social security. For these reasons a labor contribution could in fact be a maneuver to acquire almost anything.[13] These reciprocal labor relationships functioned, at least in part, because of the low opportunity costs of acquiring labor from an assured source, and because contributions were both fungible and redeemable over longer periods of time.

The function of providing an opportunity to bank favors cannot be underestimated in rural Haiti where rural poverty is extreme, and steadily worsening, and social services almost nonexistent. All peasants are mutually vulnerable to contingencies arising from uncertain climatic, political, and economic conditions, in addition to those affecting individual health. This vicious combination of vulnerability, poverty and uncertainty drives peasants to develop a wide range of maneuvers and institutions to increase social security, as well as constituting a strong logic and motivation for positive relations within the community and diverse forms of collective action (on Haiti cf. Lundahl 1992; Smucker 1983; Barthelemy 1989; d'Ans 1987, and in general cf. Mearns 1996; Singleton and Taylor 1992). These manuevers and institutions include patron-client relations, fictive-kin relations, financing emigration, extended families (i.e., *lakou*) (Lundahl 1992). It is instructive that participants appeared more economically insecure than non-participants: watershed landholders who participated had disproportionately weaker claims to land and non-watershed participants were younger, and thus inherently poorer.

The most important dimension to reciprocal assistance relationships is assurance. Peasants must know if, when and how their requests for assistance will be answered, and conversely, when and if they will be called upon to return a favor. For example, because of the high labor demands of preparing fields, the unpredictable rainfall, and the poor water retention capacity of the soil, when peasants call for labor, they must know that their call will

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[13] Cf. Marcel Mauss's classic work *The Gift* (1967) in which he concludes: "A gift is never freely given."

be answered, and answered appropriately. This implies that in order to produce, peasants not only strategically bank favors with a large number of individuals and respect their own debt commitments, but also regularly investigate the opportunity for new favors.[14]

In order to assure their expectations over the status of reciprocal assistance, and keep the relationship from lapsing, peasants regularly monitor all relationships, keep track of favor and debt balances, and subsequently adjust the level of assurance over the expected behavior of their colleagues. It is this sum of strategic and moral motivations that would lead peasants who are otherwise not interested in the watershed protection itself to assist in the effort.[15] It is clear from this case that understanding peasant behavior, including the multiple functions of collective action, requires understanding peasants' radical dependence on the labor and assistance of others (Murray 1977) and their constant search for assured expectations over the supply of that labor.

Social level. As in the individual-level analysis, functions performed by the regime at the social-level again can be separated into two broad categories; those functions associated with the *output*, and those associated with the *process* of action.

Output-related functions include: (1) increased agricultural production and economic wealth in the watersheds; and (2) decreased land degradation and risk of crop damage due to storm events. The wealth generated by the action, and the more secure environment for production enhanced, even if slightly, social welfare. Because of cultural pressures for redistribution in rural Haiti, the wealth generated by the action was undoubtedly redistributed to some degree, and its effects multiplied.

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[14] This search for assurance over labor closely parallels that of the search for assurance over market exchanges between individuals. See Mintz (1961) for an excellent description of *pratik* the Haitian practice of forming relationships between buyer and seller to diminish market uncertainty and increase the predictability of future exchanges. See Fass (1988) and Barthelemy (1989) for more recent descriptions of peasant and urban maneuvers to gain assurance in the marketplace.

[15] This discussion glosses over the extensive and rich literature on reciprocity and the morality of exchange in the fields of anthropology, political science and economics. For an introduction to the anthropology literature see Durkheim (1933), Maas (1967), Bloch (1973) and Parry and Bloch (1989). In political science see Scott (1976) and Fukuyama (1995). In economics see Sugden (1984) and Fafchamps (1992).

Process-related functions include: (1) stimulating the labor market, with more opportunities for building debts and favors and monitoring commitments; (2) providing a medium for testing, reinforcing or discarding social, cultural or ideological norms and institutions, and in particular, enabled producer group members to reinforce and add influence and prestige to the *groupman* movement; and (3) creating new forms of social capital. It appears that the watershed regime functioned as a mechanism by which peasants addressed their labor demands and ensured solidarity. By increasing the opportunity for exchange, i.e., the market for labor and other maneuvers, the watershed regime -- perhaps only slightly -- contributed to social and economic development in the areas. As each group established its own internal governance rules, the regimes contributed in a general way to the creation, maintenance and evolution of rules and norms. Perhaps ironically, from a purely self-interested perspective, participation in collective action is both advantageous and disadvantageous, as participation both enhances the individual's social security in the short-term, and creates obligations - binding individual behavior in the long-term. This *quid pro quo* nature of social relations is reflected in the Haitian proverb: *zami loin se lajan sere, zami pre se kouto de bo* (distant friends are money in the bank, close friends are double-edged knives).

In addition to the watershed management regime-specific functions cited above, it is probable that the regimes themselves in some, and perhaps only a modest, way will contribute to forming new, and more ambitious social, economic and/or political actions. In the case of producer organizations (far more numerous than watershed groups in Maissade), their contribution to more ambitious organizations and economic development are proving real. As of early 1997 -- 10 years after producer groups were encouraged to form -- groups had a total asset value of over US $40,000 and were providing local farmers unprecedented access to credit, low-cost agricultural inputs and opportunities to store grains (SCF 1997).

By identifying issues, organizing social debate and supplying leaders, producer organizations have had a large influence on recent political process in Maissade as well. For example, the new mayor of Maissade was an extension agent who provided technical assistance to the watershed management regimes and other peasant groups before his election. This trend was repeated across Haiti in the municipal and parliamentary elections of 1995

where the majority of municipal officials elected had been leaders of peasant groups and civic activists who campaigned on their proven ability to promote rural development (Maguire 1996; Noriac and Smucker 1996).

In sum, the watershed regimes were new threads in the web of local social relationships and institutions, incremental social adaptations built by peasants on the foundation of pre-existing institutions. This capacity to reformulate to address newly identified opportunities and needs, termed "conservation and mutation of social energy" by Albert Hirschman (1974), and "spontaneous sociability" by Francis Fukuyama (1995), contributed to local economic and political development.

CONCLUSIONS AND IMPLICATIONS

Haiti

It is clear that, in this case, collective action regimes performed a wide variety of functions, including the ostensible purpose of the action - to manage the watershed. It is also evident that labor exchange groups and producer groups, and other reciprocity-based social units, contributed to a social foundation for natural resource management and rural development. In short, project investment in strengthening peasant organizations, as an indirect means to accomplish resource conservation and economic development, worked. This investment reinforced an ideology of development action and decreased the transactions costs of addressing collective dilemmas, thereby increasing the likelihood that collective dilemmas could be addressed. It is also evident that - at least in the short-term - the presence of such forms of social capital are a necessary but not sufficient condition for the emergence of new institutions to address new collective dilemmas. That is, collective action in an economic domain - such as watershed management - requires a critical mass of private economic logic.

Labor exchange groupings are generally transitional, informal and small, but they are one of Haiti's most fundamental and pervasive forms of democratic governance. They are the fundamental antecessors of more complex forms of public-goods producing groups such as producer groups. In economic terms, in rural Haiti, social capital is a positive externality of

private labor exchange. This means that all forms of acquiring labor are not equal and how an individual chooses to acquire labor (exchange or purchase) matters to society.

Policy makers should be aware that policies that (directly or indirectly) weaken reciprocity-based institutions will affect the potential for voluntary supply of public goods and local governance capacity. The tools and data necessary to measure the social and economic benefits of rural social capital do not yet exist. In the case of labor exchange, for example, one cannot say whether governments should pursue policies that encourage labor exchange or allow the market to run unhindered. There are undoubtedly tradeoffs between financial efficiency and social adhesion, both at the individual and social levels. These tradeoffs should be explored.

Given the importance and vulnerability of Haiti's rural social capital, and the current state of knowledge, it would be prudent to recommend that policy makers: (1) not pursue policies that discourage labor exchange and other fundamental forms of social capital; i.e., do no harm; (2) carefully consider the effects of all programs and policies on social capital, especially reciprocity-based forms, and carefully weigh all tradeoffs before embarking on particular courses of action; (3) evaluate the feasibility of undertaking major policy directives and public investments in development approaches explicitly oriented to maintaining and reinforcing rural social capital, especially at the levels of labor exchange and community; (4) establish a legal and fiscal framework that encourages the formation of social capital and the free expression of civil society; and (5) promote new research that improves understanding of the role and functions of collective action and its linkages to economic and political development. Research in this last domain should begin with a careful assessment of the determinants and dynamics of labor exchange.

General

As illustrated by this case from Haiti, collective action arrangements are completely enmeshed within existing social, economic, cultural/religious and political systems where interdependent individuals have multiple relations with multiple social actors at multiple layers for multiple reasons. For this reason, assessments limited to the narrow incentives for action, or focused simply on the output of action, will underestimate both the potential for groups

to organize and the full role of collective action in society. Attempting to understand the motivations and functions of action is daunting, especially for outsiders. Nonetheless, researchers, practitioners and policy makers should consider paying greater attention to the "other" functions of collective actions, especially to the social capital function of collective action. Advances in methodology and additional rigorous analyses will be required to more fully understand the role of collective action in society and enable more appropriate policy interventions.

Research along the following lines of inquiry would be fruitful: (1) the role of morality and ideology in the creation and maintenance of collective action; (2) the source and maintenance of trust; (3) the social and economic tradeoffs of employing state, market, or collective action options of supplying public goods; and (4) the linkages between collective action and economic and political development. Progress on this last issue will be especially difficult but will yield important contributions to social science and public policy.

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