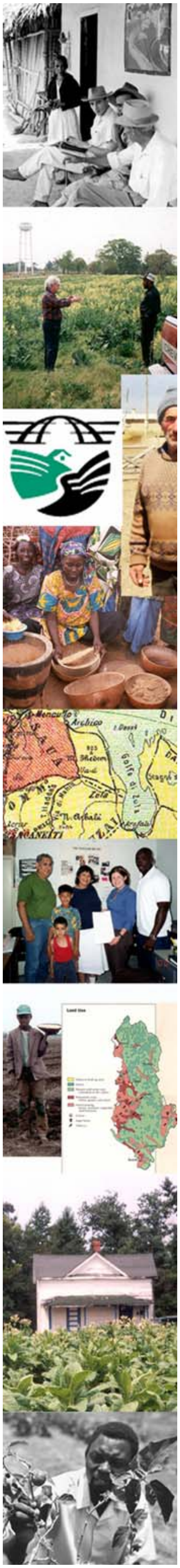

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TENURE BRIEF

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Ecological Complexity and the Management of Common Property Resources

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Many community-based conservation programs are designed without carefully considering goals, community capacities, and the ecology of the common property resource. This *LTC Brief* outlines factors that can improve common property management.

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Nature of the resource

TO PROTECT AND CONSERVE natural communities—such as forests, grasslands, and wildlife—management approaches in international conservation and development increasingly treat animal and plant communities as commonly-held resources with economic value. The approaches include community-based conservation, payments for environmental services, and revenue-sharing schemes associated with wildlife protection. In this way, village woodlots, pastoral clan pastures, extractive reserves, buffer zones, or even endangered wildlife populations are treated as resources that generate economic benefits and are held in common by different social groups. Rights of individuals to these resources derive from their membership in the social group, which can be achieved through kinship, place of residence, or investments of time, labor or capital.

Community-based conservation is largely concerned with the functioning of governance systems that regulate and monitor extraction and distribution of benefits of these common property resources (CPRs). A multidisciplinary body of literature, commonly referred to as "common property theory," provides important insights into the design of appropriate management institutions. A major focus of this work has been to address the collective action problem inherent in situations where individual benefits are derived from commonly-held resources.

The "tragedy" of the commons is when commonly-held resources are "overused" as unregulated individuals seek to maximize their individual gains to the resource. Four features of more successful CPR management are:

- well-defined social group with rights to a clearly-defined resource

- ability to exclude others from using the resource
- set of use rules that limit the seasonality, extent, or ways in which the resource is extracted by individuals
- capacity to monitor use and enforce rules.

The fact that realities are often more complex than common property conceptual models (see box) does not negate the insights derived from these models but does point to the need for frameworks that allow practitioners to identify characteristics of the resource(s) and social group(s) that may require additional management costs, institutional features, and community capacities for successful management.

community-based conservation. This brief does not ignore these politics but focuses on how the biophysical aspects of the resource affects management and the politics that necessarily surround management of CPRs.

Goals of governance

The often stated goals guiding the management of commonly-held natural resources include:

- conservation and/or preservation
- economically profitable utilization
- widespread participation by group members
- equitable distribution to group members of the benefits of the resource.

Simple models and complex realities

Conservation and development practitioners often find that “on the ground realities” deviate from the heuristic models widely invoked by common property theory. “On the ground realities” reflect:

- biophysical nature of the commonly-held resource
- communication and transportation infrastructures
- differential technical capacities of local communities, governments, and NGOs
- local systems of governance and the distribution of power
- outside extractive interests and their relationships with local and national interests.

This brief focuses on a neglected feature of the on-the-ground realities faced by conservation and development practitioners: How does the biophysical nature of the resource itself affect the appropriate form of governance, level of governance (local, district, national), and design of effective extraction rules? This fills a void in the common property literature that generally focuses on CPR management as a collective action problem.

An additional body of literature recognizes the intensely political nature of common property management by highlighting the importance that power differentials both within and between local communities have on

In practice, these goals may not be consistent with one another. Participation, for example, does not necessarily lead to profits, conservation, or equitable distribution of benefits.

It is important that those involved in CPR management be clear about the priorities regarding the goals. For example, is equitable distribution the main goal, or is it conservation of the resource? By establishing priorities and recognizing that it may not be possible to achieve all goals, the management plan will have greater chance to succeed in reaching the priority goals.

Whether taking the form of "participatory conservation/development," "community-based conservation," or "natural resource co-management," all common property management involves multiple individuals and groups beyond the social group that holds the resource in common. Stakeholders may include national government ministries, district government officials, commercial extraction interests, local communities, or international NGOs. These groups have different powers and interests with respect to the CPR.

The authority that the social group actually holds over the resource it manages is contingent on its relations with these outside stakeholders, who may wield significant control over management decisions. Claims of political neutrality or scientific expertise may increase outsider control. Also, taxation, regulation or market power may allow outside groups to control a significant portion of the benefits generated by the resource.

As a result, a major area of contestation and negotiation lies between the local community with nominal control over the resource and outside interests. The degree to which the local community retains decision-making authority and control over the benefits of resource extraction will shape its relationship to the resource and the prospects for its conservation.

There has been a tendency for development and conservation groups to treat local communities as homogeneous, with a coherent political vision and governance system, yet local communities often are fractured politically, with multiple subgroups holding rights to the common resource. Existing governance structures may not incorporate all those who hold some rights to the resource. Moreover, local authorities making decisions about CPRs may not be accountable to the group(s) they represent.

While building from existing governance systems is preferable, local communities may need to modify or transform existing systems to address resource management needs. Such institutional change produces winners and losers even when compromises are made. As outsiders, conservation and development agencies must work through local elites but also should seek, though an infusion of outside resources, to widen access to resource-derived benefits for the less powerful—especially where equitable resource access is a priority goal. If outsiders enter into this political process naively, the financial and technical assistance they provide will likely be used to serve purposes inconsistent with their goals.

Successful community-based development programs often rely on a selection process by which communities must demonstrate a capacity to self-organize in response to opportunity. Community-based conservation programs may be more constrained since the choice of communities with whom to work is not solely defined by their governance capacity but also by their control or access to a natural resource of conservation concern.

It is vital to understand the existing governance structure of those who hold rights and its relationship to those who directly utilize the resource and to those who benefit from the resource. It is important that governance systems are recognized by members of these groups and can therefore effectively regulate extraction activities.

Successful governance systems in community-based conservation are most likely to develop from prior community institutions. There is therefore no simple recipe for institutional structures and use rules. Instead, there are governance principles that can be addressed through a range of different systems. This brief is concerned with identifying how characteristics of the natural resource itself affect these principles.

Managing CPRs is not without costs—political, financial, time, etc. As these costs rise in relationship to the benefits enjoyed from extraction, the prospects for community participation and successful management decline. Certain characteristics of CPR management systems are associated with increased costs (see table). Designing effective CPR management systems often involves seeking to reduce these costs relative to the benefits enjoyed by the social group managing the resource. Cases where the management costs exceed the benefits enjoyed by the managing group will likely not produce a sustainable CPR management system.

Resource characteristics

Effective common property institutions can only be developed if conservation goals are clearly specified. An obvious point (so much so as to be often overlooked) is that conservation goals strongly influence how the commonly-held resource is defined. Take a forest area managed in common by a local community. Goals of the community, local NGO, or government may be focused on conserving the standing stock of wood, a particular species of tree, a wildlife population utilizing the forest as habitat, or the biodiversity of the forest patch. All these goals are valid but each defines the commonly-held resource differently. In so doing, there are different implications for appropriate institutional design. A major cause of confusion and failure is when the resources to be managed are defined differently by different stakeholders.

This is particularly common when international NGOs define a goal around "biodiversity," a concept likely not captured by local communities' ecological concepts.

Moreover, maintaining biodiversity is difficult to implement given that it implicates a wider ecological web, lacks clear rules for successful implementation, and requires significant monitoring effort. Typically, biodiversity projects are located in areas of high endemic biodiversity but are implemented to address less ambitious goals than the conservation of biodiversity: for example, the maintenance of biological productivity, wildlife habitat, or a particular endangered wildlife population. It is important for these "biodiversity" projects to understand how their implementing goals relate to biodiversity conservation and to the visions held by different stakeholders associated with the project.

In short, it is important that conservation *and* development goals are clearly specified and understood by all.

CPR management characteristics and their costs

Management characteristic		Cost
Size and social heterogeneity of social group managing resource	→	Increased time and organizational resources devoted to political organization of managing group.
Magnitude of interest in the resource by outside groups	→	More resources required to exclude outsiders from resource.
Spatial expansiveness (and local sparseness) of the CPR	→	Increased costs (relative to benefits) to protect resource from outsiders
Degree of difficulty to monitor the state of the CPR	→	Greater resources required to monitor changes in resource availability and to adjust extraction pressures
Degree of difficulty to monitor extraction by group members	→	Increased investments in monitoring and surveillance required and greater equity in distribution of benefits needed

Standard designs of community-based conservation projects rely on assumptions of the natural resource as fixed in place, with the standing stock primarily determined by the amount of extraction by the controlling group and unaffected by outside influences or nonlinear responses to community extraction.

Take a village woodlot. Establishing effective community management is relatively straightforward. The community must be able to exclude others from the woodlot and establish rules for harvesting wood in a sustainable fashion. Developing extraction rules also is relatively straightforward. Given the slow growth rates of trees compared to the rapidity of extraction, a 30% increase in the rate of extraction results in a 30% reduction of the availability of the resource.

The goal for sustainable extraction would be to balance extraction rates with the growth rates of the standing stock and replanted trees. The major management issue is political; that is, how to ensure that access to the shared resource is equitable and that village members abide by extraction rules.

However, what are the management implications for those resources with characteristics that deviate from that of the woodlot? Even an introductory understanding of the ecology of many resources calls into question assumptions of a fixed resource. The effect of extraction of a resource may depend on what season the extraction takes place, how extraction is performed, and the rate or density of the resource.

Therefore, two key features are relevant for the effective design of common property institutions:

- the inherent variability of the resource’s availability across space and time
- the nonlinear ecological response of resource availability to extraction pressure.

Resource availability

Community-based approaches to conservation often are organized around a territorial model in which control over a resource is tied to control over a geographical area. Moreover, resource availability within a managed territory is seen to be controllable through the regulation of resource extraction by the management group. However, the availability of some CPRs may vary significantly across time and space independently of the extraction decisions by the management group. Common examples include the following.

Forage production of common pastures in semi-arid or mountainous environments. Independent of extraction pressures, this resource often will vary significantly over time and space due to climatic fluctuations. Without flexible access to forage over a wide area, local pasture shortages may lead to overgrazing.

Mobile wildlife populations that move across an area larger than the managed area. The local availability of a wildlife population can be affected by the changing distribution of the wildlife population across a broader territory beyond the managed areas and by extraction pressures from outside that area.

Plant and animal populations of low spatial density whose genetic viability is dependent on gene flow from outside the managed area. Population viability may be strongly affected by barriers to the gene flow as well as changes in extraction pressures or habitat quality outside the managed area.

Such conditions make strict adherence to territorial forms of CPR management problematic. When the location of resources to be managed varies significantly over time, then adequately capturing the resource requires very large territories, which drastically increases the costs of exclusion, monitoring, and enforcement. Under these conditions effective governance may need to consider the following strategies.

- Protect smaller circumscribed areas that serve as key habitats/sources/resources to the resource in question.
- Find leverage points for regulating the magnitude of extraction in venues distant from the point of extraction; for example, regulation of resource product markets.
- Outside the managed area, reduce efforts to exclude use and focus instead on regulating use. Restrictions or quotas on the amount of resource extracted over broad areas can be difficult to regulate or monitor. Restrictions on *how* the resource is extracted and used may be more easily monitored and enforced. Examples include regulating the technology, seasonality, or morphological/demographic composition (plant part, age cohort of wildlife population, etc.) of extraction rather than attempting to monitor absolute quantities of resources being extracted.
- Replace a single governance system by a combination of institutions that together work to manage the resource at different spatial scales. These institutions could have

Implications of land-use ecology on the regulation of resource extraction

Characteristics of land-use ecology	Implications for extraction rules
Costs/difficulty of extraction do not increase dramatically with increased scarcity	Rules need to be enforceable at low levels of resource extraction/availability. With all else equal, full protection of the resource becomes preferable at higher resource availabilities.
Sensitivity of resource is strongly affected by relatively regular temporal or ecological cycles	When feasible, regulations should vary in relation to these cycles.*
Sensitivity of resource is strongly affected by irregular, unpredictable climatic or ecological fluctuations	Regulations need to be adaptable to changing conditions.* To reduce demands on institutions, adaptation of extraction pressures could occur by making extraction pressures dependent on the same climatic/ecological cycles (often through limits on infrastructure development). For example, grazing pressures are limited in areas of drought by the availability of surface water for livestock; building boreholes will lead to greater imbalances of extraction pressures to resource availabilities.
Extraction's impact on resource availability is affected by the part of the resource extracted (part of individual or population of plants/animal)	The impacts of grazing, firewood collection through lopping, or nontimber forest production extraction are affected by the parts of the plant being harvested. Impacts of fishing and hunting are affected by the age/sex profile of the harvested animals. Therefore regulations should seek to influence which resources are extracted and how. This can be achieved indirectly through regulations on the timing and technology of extraction or through greater participation/education of extractors.
Extraction's impact on resource availability is nonlinearly related to extraction pressures	Requires significant monitoring and adaptive extractive response reflecting knowledge thresholds of resource response. Extraction pressures should be kept below those that lead to disproportionate declines in resource availability.
Extraction does not leave a clear human signature	This increases the monitoring costs associated with regulation, which if too high would favor regulatory strategies focused on the way resources are extracted rather than how much is extracted.

*Such adaptive regulation places greater demands on political institutions and requires greater understanding and acceptance by regulated resource extractors.

different jurisdictions and work in parallel in a coordinated fashion or have overlapping jurisdictions of different spatial extents and holding different responsibilities. Much resource management authority is devolving to the local level, yet national and district level agencies have an important role to play in cases of highly mobile resources.

- Given that resource availability may be more influenced by factors outside of the managing group's control, use regulations need to inherently reduce extraction rates as resource availability declines or be flexibly changed by governance systems as resource availability fluctuate.
- Consider replacing hard and fast rules of resource access with rules that define the political/judicial/negotiation process through which groups and individuals can gain access to resource. Such rules demand significant organizational resources and are most common in indigenous tenure systems where social networks are well-developed and the resource availability varies radically over time and space.

Extraction pressures

The ecological impact of resource extraction may depend on many factors other than the amount of the resource extracted. In real ecological systems, governance systems that focus solely on the amount of the resource extracted (for example, through definition of extraction quotas) may not prove effective. Not only might the resource vary independent of local extraction pressures but also the impact of extraction on resource availability may not be linear. In other words, a 30% increase in extraction may not lead to a 30% reduction in resource stock.

Commonly-held resources may be wildlife, plant fruits, fodder, or fiber. The ecologies that surround the extraction of such resources is often more complex than depicted in depletable/renewable stock models. A 30% increase in resource extraction may actually exceed an ecological threshold leading to a drastic reduction in the future availability of the resource. The seasonality, spatial density, or morphological characteristics of the resource extraction may strongly affect how resource availability is affected in the future.

Herding livestock in West Africa
(Photo: Matthew Turner)

Understanding the extraction ecologies of managed resources is very important. In some cases, threshold effects and the importance of "how" (rather than "how much") a resource is extracted may not be very important. In these cases, conventional resource stock models will continue to be helpful. In other cases, however, there will be a need for greater investments into monitoring the state of the resource and the development of regulations concerning how the resource is extracted. The more standard rules of monitoring can be incorporated directly into extraction decisions, the better. For example, regulations that directly tie extraction rates to the state of the resource through restrictions on technology, search times, extraction periods, and minimal standing stocks are useful. These regulations would in turn provide information about the state of the resource.

Effective management

Both the resource and the goals for its management need to be well defined. Existing governance systems need to be evaluated with particular attention to how these systems incorporate, as constituents, the owners, implementers, and beneficiaries of resource extraction. The ecology of the resource also affects the management of the resource.

The complexity of the resource dynamics over time and space make additional demands on management. Given the variable capacities of local communities, governments, and NGOs to regulate resource uses, effective management of resource dynamics may require deviations from classic common property management prescriptions. Given the spatiotemporal variability of many commonly-managed resources, the costs of exclusion may exceed capacities and resource benefits. In these situations, efforts to regulate how resources are extracted may prove to be more successful.

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