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Institutions for Managing Ecosystem Services

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Two decades of research into the management of what economists call common-pool resources suggests that, under the right conditions, local communities can manage shared resources sustainably and successfully. These revolutionary findings challenge the long-held belief in the "tragedy of the commons." Instead, we have found that tragedy is not inevitable when a shared resource is at stake, provided that people communicate. In many places—from Swiss pastures to Japanese forests—communities have come together for the sake of the environment and their own long-term well-being.

Common-pool resources have two features: first, they are shared resources whose use by one person makes them less available for use by another; second, it is typically very difficult to limit the public's access to them (through laws or physical barriers). Many, but not all, ecosystem services can be categorized as common-pool resources. Consider, for instance, the clean water provided by an intact watershed, the pollination provided by a community of bees, or the carbon sequestration provided by a healthy forest. These are public goods, but individual use can degrade a watershed or strip a forest, compromising these benefits for all. As we look to develop institutions to better manage ecosystem services, and ensure their resilience over time, we can benefit from the lessons learned in the management of common-pool resources.

The principles below, gleaned from research into the successful stewardship of common-pool resources, can guide the establishment and evolution of institutions to manage many ecosystem services.

Understanding People and Place

One of the most important lessons to be learned from common-pool resource management is that no one solution is appropriate in all circumstances. While certain ecological and social principles can guide us in understanding how watersheds work and how humans interact with them, these principles will never tell us all we need to know about every basin—this understanding must come from a place-based assessment of the specific physical, ecological, climatic, societal, and economic factors shaping that particular place and people. General principles can guide us in determining the appropriate institutions and organizations needed to manage a complex natural system, but we must also take into account the cultural, social, and economic attributes of the community at hand.

Using Forest Carbon Credits to Improve Health Care in Vernonia, Oregon

by Catherine Mater and Brian Kittler

Vernonia is a small, historic timber town in Oregon's Coast Range. Like many other rural, forest-dependent communities, near double-digit unemployment and poverty plagued Vernonia long before the "Great Recession" of 2008. Vernonia had the even greater misfortune of experiencing two 500-year floods in an 11-year period, one in 1996 and another in 2007. In response, the Vernonia community has come together to create a unique management solution that addresses the particular needs and assets of the local people and environment.

The Forest Health–Human Health (FH-HH) Initiative uses the community's forest resources to invest in community health care. Health-care costs are a primary reason landowners have had to liquidate their timber assets or even sell their land. The FH-HH Initiative is the nation's first program to exchange forest carbon credits for direct payments for health care to both participating forest landowners and the communities in which they live.

Landowners participating in the FH-HH Initiative pilot in Vernonia agree to increase carbon stocks by sustainably managing their forests to promote robust growth, often shifting the timing of harvests or extending the length of rotations. Participating landowners donate a tax-deductible portion of the carbon revenue generated from their lands to support the local community health-care clinic, which was strapped for funding and unable to meet local needs. By tailoring its approach to the economic and health needs of the local community, this project has developed a creative solution that is good for both people and the environment.

Diagnose and Embrace Complexity

While acknowledging the complexity of human and natural systems is a critical first step, we also need to move toward a deeper understanding of these complex systems and their interactions. The approach taken in medical diagnoses may offer a useful analogy. While guided by a broad understanding of the subsystems that make up the human body, physicians must also seek to understand a specific patient's condition to decide what treatment is most appropriate for that patient.

By developing a similar body of knowledge around ecosystem services in different physical and cultural contexts, we can better analyze the specific attributes of particular cases. We can assess how different factors, such as geography and community structures, influence different common-pool resource management schemes across different resource sectors, from forestry to fisheries to land management.[1,2] This will lead to a broader understanding of linked ecosystem and human health.

Our bodies require regular checkups to ensure that they are functioning well. In a similar fashion, our ecosystems also need periodic checkups so we can gather sufficient information about the resources we seek to manage and whether that management is headed in the right direction. Given the scale of the system and limitations on gathering data, it is important to develop metrics to assess whether management efforts are creating desired outcomes. In this case the general direction of the trajectory is more important than precision—we don't need to measure everything to the "nth decimal point" in order to assess whether we are moving in the right direction.

Action and Integration at All Scales

Identifying the appropriate scale or scales on which to act is an important step toward successful management of ecosystem services. For example, it is necessary to act on a local scale when managing a water basin that provides drinking water for a community. This will allow for meaningful participation by the community and ensure that the specific characteristics of that watershed are considered. In contrast, to effectively address the challenges of climate change, action is needed at all levels—from household-level energy conservation to international agreements to generate improved outcomes at the global level.

Even when action is primarily at the local level, actions at other scales may protect against parochial self-interest and encourage shared learning across space and time. The systems that support the provision of ecosystem services range from a neighborhood, to a watershed, to a country, to a continent, to the globe. Managing them effectively therefore requires a set of nested institutions that can encompass these multiple scales and interact and communicate with each other to create cross-scale management.

We need to develop more integrated institutional frameworks and find ways to enhance effective participation across institutions. Our current approach is fragmented: the ecological systems that we are interested in are governed by different agencies that don't always communicate, with diverse and sometimes conflicting regulatory structures and overlapping jurisdictions. What we need are efforts to bridge these gaps, efforts like Oregon Solutions, an initiative of the Oregon Governor's Office that brings representatives from diverse state agencies together in regional centers to tackle specific community-based problems. Through Oregon Solutions, local business leaders and NGOs have also been brought in to work with government officials—sustainability experts as well as the governor's Economic Revitalization Team—and, together, they have initiated more than 60 projects around the state.

Design for Resilience

Change happens. Actors and circumstances change, and the social values that inform a community's priorities can shift. Increasingly, climatic and demographic changes pose fundamental and potentially seismic shifts in many communities.

Not surprisingly, our strategies, frameworks, and institutions must also evolve. Though it goes against our nature, humans need to "anticipate obsolescence" of our own creations, building in mechanisms to periodically evaluate and ensure that lessons learned are understood, that plans are adapted accordingly, that trajectories toward goals have not become antiquated, and that societal goals have not changed. Nothing can or should last forever.

Recognizing that adaptation must occur and building in periodic review and renegotiation of agreements are essential elements of any long-term strategy. In addition to contributing to the resilience of a system by ensuring ongoing responsiveness to emerging issues, this approach also recognizes the need for civic engagement and active democratic participation.

Successful Comanagement in the Amazon

by Carol Franco and Leandro Castello

In two reserves in the Brazilian Amazon, a local conservation organization, the Mamirauá Institute, has worked with fishers to develop a comanagement model for the pirarucu (*Arapaima* sp.).[1] The pirarucu is one of the Amazon's most historically important and overexploited fish resources, growing up to three meters in length and 200 kg in weight. The Mamirauá Institute provides fishers with a broad range of institutional support services, and it facilitates negotiations between the fishers and governmental agencies. For example, the institute works with the fishers to facilitate vigilance of lakes to prevent violators from illegally harvesting the fish. Fishers also earn exclusive rights of use over the pirarucu with the condition that they obey fish size, season, and quota regulations. Fishers use their traditional knowledge to assess pirarucu stocks by counting the fish at the moment when they surface to breathe air.[2] Fishers then use the data to set fishing quotas in collaboration with partner institutions.

Since the implementation of this comanagement model within the reserves, overexploited pirarucu populations have rapidly recovered and fishers' economic returns have increased. Involving fishers in the comanagement scheme also has improved compliance with management policies. Due to demand from fishers from other regions, NGOs, and governments, this comanagement model has now been incorporated in legislation covering a fourth of the Amazon Basin area.

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Experimentation and Storytelling

Another key to successful management of ecosystem services is to acknowledge that all of our actions are experiments from which we can learn. One of the most effective ways that societies process and share knowledge is through storytelling.

Again, while there is no one-size-fits-all solution to managing ecosystem services, much can be learned by sharing our approaches, strategies, and experiences. Telling the stories of both successes and failed efforts can provide a rich source of data with which to generate new solutions. Case studies provide an opportunity to acknowledge both the qualities that make particular places and efforts unique as well as the elements that may be generalizable across contexts. Just as data collection and assessment are necessary at multiple scales, so too are storytellers to ensure that learning can be shared among key actors.[3] One possible forum for this kind of knowledge sharing is the recently

launched Ecosystem Services Partnership, which is creating a worldwide network of best-practices case studies for the assessment and management of ecosystem services.

Participation Is Key

When designing management institutions for common-pool resources, the participation of relevant stakeholders is vital. And the first step to a successful cooperative management approach is communication.[4] Possessing multiple ways to communicate about the resources or services being managed—to allow "movement beyond anonymity"—has proven an essential element in successful comanagement of shared resources.

In many communities, voting is seen as the primary mechanism for participation in democratic systems. But the use of participatory geographic information system (GIS) technology,[5] mediated modeling,[6] town meetings, or other approaches can also help participants develop shared learning about a resource and shape a unique place-based approach.

Mediated Modeling of the South African Fynbos

by Robert Costanza

Mediated modeling is the process of involving stakeholders (parties interested in or affected by the decisions the model addresses) as active participants in all stages of the modeling process, from initial problem scoping to model development, implementation, and use.[1,2] Mediated modeling can build mutual understanding, solicit input from a broad range of stakeholder groups, and maintain a substantive dialogue between members of these groups. Mediated modeling and consensus building are also essential components of adaptive management.

One example of how mediated modeling has been used effectively comes from the South African "fynbos" shrubland ecoregion, one of the world's "hot spots" for biodiversity. In order to adequately manage the species-rich fynbos ecosystems, information about what services they provide and what their value is to society was needed. In 1995, a two-week workshop was held at the University of Cape Town with a group of faculty and students from different disciplines, along with park managers, business people, and environmentalists.

One product of the workshop was the creation of a general dynamic model that integrated ecological and economic processes in fynbos ecosystems.[3] This model incorporated a broad range of research by workshop participants. Benefits and costs of different management scenarios were addressed by estimating values for harvested products, tourism, water yield, and biodiversity. Costs included direct management costs, such as clearing invasive trees, and indirect costs, such as personnel and infrastructure. The model showed that the ecosystem services derived from the Western Cape mountains were far more valuable when the mountains were vegetated by fynbos plant communities than by alien trees. The difference in water production alone was sufficient to favor spending significant amounts of money to clear invasive pine trees and maintain fynbos in mountain catchments.

The model was designed to be user-friendly and interactive, allowing the user to adjust for different areas of alien-plant clearing, fire-management strategies, levels of wildflower harvesting, and park visitation rates. The model has been valuable in demonstrating to decision makers the benefits of investing now to stop the spread of alien plant species, since delays have serious social costs. Park managers have implemented many of the recommendations from the Cape Town workshop and have invested in alien-plant and fire management to enhance ecosystem services.

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Information Is Important, but Problems Are Solved by People

In recent years, much research effort has been devoted to developing ways to put a value on ecosystem services to help ensure that they are given adequate weight in decision making and resource management efforts.[7] While some aspects of these services are easier to assign a monetary value to than others, a variety of approaches has been developed to better capture ecosystem services' value to society.

While incorporating such values into cost-benefit analyses will help make these services more visible to policymakers, such analyses do not, in and of themselves, determine how such resources will be managed. A cost-benefit analysis cannot serve as a neutral arbiter of value, because even the best, most comprehensive cost-benefit analysis will come down to a social decision about a community's shared ideals. Similarly, while a mediated modeling exercise can help people come to some agreement about managing their resource systems, there may still be conflicting beliefs and values regarding the use of these resources.

By making all of the values and ethical considerations that influence decision making more explicit, we can better design institutions to mediate when values conflict. This information will help communities balance trade-offs between managing for the delivery of ecosystem services and other types of outcomes that may be of value to society. Once again, ensuring that there are multiple channels for the participation and deliberation of affected stakeholders will be important to increasing the range of values represented and making sure that the priorities assigned through any management decisions are vetted as comprehensively as possible.

Mangrove Ecosystems and the Tragedy of Private Property Rights

by Joshua Farley, David Batker, and Isabel de la Torre

Mangrove ecosystems provide many goods and services that are of critical importance to humans and other species, including protection against storms and tsunamis, filtration of sediments and pollutants that could harm coral reefs and other marine ecosystems, critical habitat for commercially and ecologically important species, and carbon sequestration. In collaboration with academics, NGOs, local government, and local communities in Puerto Princesa, Palawan, Philippines, we conducted a scientific atelier (a transdisciplinary workshop/field course) on the conversion of mangrove ecosystems to shrimp aquaculture in the region—currently the leading cause of mangrove deforestation.

We focused on a site that was actively being deforested as we worked. Facts were uncertain, decisions were urgent, stakes were high, and people's values mattered, so detailed, time-consuming scientific research was not an option. We instead conducted a transdisciplinary synthesis across the natural and social sciences, relying heavily on local knowledge, anecdotal evidence, the values of affected communities, and scientific studies conducted elsewhere.

We found that aquaculture yields high returns on investment for shrimp farmers for an average of three to five years before succumbing to disease and waste buildup, leaving behind a degraded ecosystem and grossly diminished ecosystem services. The economic, social, and ecological benefits of intact mangroves significantly outweighed the returns to aquaculture. In fact, because intact mangroves serve as a nursery for commercial fisheries, they provide more seafood than shrimp aquaculture. The benefits of conservation are shared by neighboring communities, while the benefits of conversion accrue to private owners of the aquaculture ponds. Private property rights to mangrove ecosystems favor inefficient, unjust, and unsustainable allocation of the resource—a tragedy of the noncommons.

We presented the workshop results to the press and local government, the latter of which shut down the aquaculture ponds to conserve the threatened ecosystem, effectively restoring common property rights.

Summary

Policymakers often gravitate toward one-size-fits-all solutions and static institutions. However, when it comes to the

complexity of managing human-natural systems, a more adaptive approach is required. A key to success is understanding each unique place and the people who depend on its ecosystem services. Clear communication and storytelling at all scales not only will engage necessary participation but will help determine which successful strategies can be translated across cases and which are not translatable. Cost-benefit analyses are helpful but limited in describing how social values will ultimately result in a particular decision.

Just as natural systems evolve, so must our strategies and institutions. Like a durable good that reaches the end of its life and is then recycled, so too must we periodically evaluate and anticipate obsolescence of our management structures and tactics.

As we explore ways to ensure that we are maintaining the integrity of the natural systems on which we depend, these concepts can guide us in managing natural systems in a more integrated and resilient manner.

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