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Synthesis

A Typology of Benefit Sharing Arrangements for the Governance of Social-Ecological Systems in Developing Countries

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ABSTRACT. This study explores and interprets relevant literature to construct a typology of benefit sharing arrangements for the governance of social-ecological systems in developing countries. The typology comprises three generic categories of benefit sharing arrangements: collaborative, market-oriented, and egalitarian. We contend that the three categories provide a useful basis for exploring and classifying the different societal arrangements required for governance of social-ecological systems. The typology we present is founded on a related set of explicit assumptions that can be used to explore and better understand the linkages among ecosystem services, benefit sharing, and governance. Issues that are strongly related to sustainability in developing countries form the core basis of our assumptions. Our aim is not to write a definitive exposition, but to spark debate and engage ongoing dialogue on governance and benefit sharing in the field of social-ecological systems.

Key Words: *benefit sharing; developing countries; ecosystem services; governance; social-ecological systems; typology*

INTRODUCTION

Benefit sharing approaches are increasingly being advanced as a means of addressing problems related to the governance of social-ecological systems in developing countries. These approaches seek to address fundamental issues around the complex interactions between nature and society. They can be considered as part of the growing trend to promote the notion of ecosystem services, broadly defined by the Millennium Ecosystem Assessment as the benefits of nature to society (MEA 2005). This trend is viewed as a way of exposing and highlighting the values of ecosystems to humans (Constanza et al. 1997, Boyd and Banzhaf 2007, Wallace 2007, Daily et al. 2009, Norgaard 2010). While the trend has at times been criticized as an attempt to commodify nature (McCauley 2006), it essentially derives from the acknowledgement that the services provided by ecosystems are socioeconomically and culturally valuable and lead to a range of benefits that support human well-being.

In most developing countries, the benefits that people obtain from ecosystem services, such as food, potable water, fiber, and flood regulation, are known to be a major contributor to local and national economic development. In sub-Saharan Africa, for example, ecosystem services are considered to be probably of greater importance to human well-being than anywhere else (Convention on Biological Diversity 2000). This is largely attributed to the relatively huge proportion of poor rural people whose livelihoods depend directly and heavily on ecosystem services. As such, the sharing of benefits derived from ecosystem services in developing countries is usually considered in contexts in which the majority of the people face the most serious and immediate risks from loss of those benefits (Díaz et al. 2006). In such contexts, achieving sustainable sharing of benefits and promoting improvements in the human well-being of the rural poor presents formidable challenges. The research challenge is thus how to improve understanding of benefit sharing policies by way of identifying the basic principles which underlie these policies.

We propose a typology of benefit sharing arrangements for the governance of social-ecological systems in developing countries. We view benefit sharing as embracing complex, interlinked notions of social and ecological processes that highlight the gains from ecosystem services that accrue to participants through multilevel governance processes. Basically, our typology comprises three generic categories of benefit sharing arrangements: collaborative, market-oriented, and egalitarian. While closely linked to similar conventional classification systems for institutions and governance (van der Leeuw and Aschan 2000, Kooiman 2003, Vatn 2010), our typology offers an extended view of governance arrangements for social-ecological systems by explicitly incorporating the dimension of benefit sharing. Although similar typologies offer a foundation for what can be considered in discussions concerning the governance of social-ecological systems, these classification systems do not provide a useful basis for exploring and classifying the different societal arrangements required for benefit sharing in developing countries. Arguably, we need a variety of typologies to explore and interpret the changing nature of the interactions between ecological and social systems.

BENEFIT SHARING AND GOVERNANCE OF SOCIAL-ECOLOGICAL SYSTEMS

Governance in the context of social-ecological systems refers to multilevel socio-political and economic processes that enable society to define and accept or reject alternative environmental agendas (Boyle et al. 2001, Folke et al. 2005, Hall 2006, Duit et al. 2010, Nkhata and Breen 2010). These processes can be considered to provide the means of social

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coordination that engender collective action (Ostrom 1990), ordered rule (Stoker 1998), and allow members of society to share power and make collective decisions at multiple levels (Imperial 2005). Adaptive governance processes are designed to allow for learning about systemic feedbacks (Olsson et al. 2004, Armitage et al. 2008) and emphasize the nature of the social relationships among interest groups operating at multiple levels as nested quasi-autonomous decision making entities (Folke et al. 2005).

The complex social-ecological challenges faced by governance systems for ecosystem services are well documented (Farley and Costanza 2010, Norgaard 2010). These challenges have in the last two decades formed the core basis of international debates on the governance of ecosystem services in developing countries. Issues surrounding the sharing of the benefits of nature form the core basis of debates about the governance of access to and use of ecosystem services. There are usually widely differing opinions on how to respond to the complexity surrounding benefit sharing arrangements, particularly in developing countries. On the one hand, this is because ecosystem services are considered to play an important role in offering a wide range of benefits that directly support human well-being in developing countries (Brockhaus and Botoni 2009). On the other hand, it is because in most developing countries the sharing of benefits continues to be contentious and challenging (Philips et al. 2006, Turton 2008, Winickoff 2008).

It was not until 1992 that the Convention on Biological Diversity (CBD) formalized the concept of benefit sharing in international environmental law and governance (Convention on Biological Diversity 1992). The formalization of the concept culminated in 2005 in the Millennium Ecosystem Assessment, which has since generated massive policy enthusiasm in the role of ecosystem services in providing benefits that support human well-being. In terms of research, the concept of "benefit sharing" has mostly been addressed within the interdisciplinary field of natural resource policy analysis. For example, one major focus in the current works on genetic resources is related to the theme of "access and benefit sharing", particularly in the context of developing countries. Most studies around access and benefit sharing revolve around the need to take into account human rights and poverty issues. Over time, the concept of sharing benefits derived from ecosystem services has taken hold in a number of natural resource policy and management domains, from forestry, wildlife and water management through pharmaceutical, oil and mineral "prospecting" to human genetic research. Essentially, the concept denotes forms of social accountability and responsibility to direct returns from use of natural resources, be they monetary or nonmonetary, back to a range of designated participants within socially designed arrangements.

The case of benefit sharing in developing countries provides an excellent example of the inextricable relationship between governance and ecosystem services. There is a growing understanding in natural resource policy research that sustainability issues and concerns in developing countries cannot be explored or discussed in isolation, but need to be examined within the broader context of benefit sharing (Norgaard 2010). Research insights into sustainability problems demand a full appreciation and understanding of the underlying benefit sharing processes and patterns. Not surprisingly, perhaps, countries rich in natural resources have had higher incidences of conflict and have tended to underperform socioeconomically (World Bank 2007). Countries with relatively abundant natural resources have also tended to suffer from poor environmental governance processes including benefit sharing. We contend that the current sustainability dilemma in Africa has more to do with a crisis of sharing than a crisis of resources. To appreciate the research and policy relevance of benefit sharing one needs to deeply reflect on what is currently happening in developing countries that are heavily and directly dependent on natural resources for socioeconomic development and poverty alleviation (Suneetha and Pisupati 2009).

A TYPOLOGY OF BENEFIT SHARING

Over the years, a plethora of literature has been published on a range of topics related to ecosystem services and benefit sharing. These topics include the Millennium Ecosystem Assessment, Community-Based Natural Resource Management, Payment for Ecosystem Services (PES), and Access and Benefit Sharing (ABS), to mention a few. While such topics provide a useful frame for what can be discussed under the notion of ecosystem services, they account less for the content of benefit sharing. We explore and interpret these topics to construct a typology of benefit sharing arrangements within the context of the governance of ecosystem services (Table 1). We use the typology to examine the content of benefit sharing arrangements in developing countries through a comparison of selected case studies. It should be noted that the selected case studies are neither meant to be comprehensive nor exhaustive; rather they are only designed to be exploratory and illustrative.

Collaborative Benefit Sharing Arrangements

Collaborative arrangements refer to a benefit sharing system that is designed to regulate the relationships between state actors and local communities in the allocation of benefits from ecosystem services. Examples of natural resource management approaches that reflect elements of collaborative benefit sharing arrangements include Community-Based Natural Resource Management (CBNRM) initiatives, Integrated Conservation and Development Projects (ICDPs), Community Forest Management, Integrated Water Resource Management (IWRM), and Community-Based Wildlife

Table 1. A proposed typology of benefit sharing arrangements for the governance of social-ecological systems in developing countries

Category Examples of benefit sharing approaches	Governance arrangements	Benefit sharing outcomes (real and potential)	Related literature
Co-Management			
Community-based Natural Resource Management, Integrated Conservation and Development Projects, Community-based Wildlife Conservation, Joint Forest Management, Integrated Water Resource Management	Designed to provide the means for local communities to share power with governmental actors	- There is differential control over access to benefits - The flows of benefits are bureaucratically structured - Participating groups tend to be mixed (homogenous/ heterogeneous) - Monitoring and enforcement of agreements is usually difficult - Efficiency in delivery is dependent on the levels of bureaucracy - Main implementation weakness is how to curtail the unyielding power of state actors	Murphree 1996; Gibson 1999; Murombedzi 2000; Barrow and Murphree 2001; Dzingirai and Breen 2005; Nkhata et al. 2009; Nkhata and Breen 2010; Pomeroy et al. 2010; Tole 2010
Market-Oriented			
Payments for Ecosystem Services, Clean Development Mechanisms, Reducing Emissions from Deforestation and Degradation	Designed to address market failures where the value of benefits cannot be captured in monetary terms	- There is limited structured control over access to benefits - Multiple channels exist for flows of benefits - Delivery of benefits can be symmetrical (producers vs. suppliers) - Participating groups tend to be heterogeneous - Monitoring and enforcement of agreements is litigation driven - Efficiency in delivery is dependent on the structure of incentives - Main implementation weakness is to find willing buyers for ecosystem services	Wunder 2007; Brockhaus and Botoni 2009; Kosmus and Cordero 2009; Nelson et al. 2009
Egalitarian			
Access and Benefit Sharing	Designed to address social injustices related to equitable access to, and sharing of benefits from, ecosystem services	- Delivery of benefits is asymmetrical (local vs. national impacts) - There is no structured control over access to benefits - Flows of benefits do not follow specific channels - Delivery of benefits is perceived to be fair and equitable - Participating groups tend to be homogeneous - Monitoring and enforcement of agreements is based on social pressure - Efficiency in delivery is dependent on social cohesion - Main implementation weakness is to buffer the sharing schemes from external forces and shocks	CBD 1992; CBD 2000; Jayaraman 1996; Schuklenk and Kleinsmidt 2006; Suneetha and Pisupati 2009

Conservation (CBWC). Particularly in sub-Saharan Africa, most collaborative benefit sharing arrangements have largely been understood and associated with CBNRM initiatives. Principally, the term CBNRM represents a suite of benefit sharing arrangements that entail the involvement of rural communities in the allocation of ecosystem services and management of associated benefits (Barrow and Murphree 2001).

In the context of governance arrangements, we reckon that this type of arrangement provides the means for local communities to share power with governmental actors. This usually involves the delegation of government functions from the center to the periphery in the process of allocating ecosystem services. As a form of benefit sharing arrangements, collaborative initiatives are premised on the assumption that the human well-being of communities can be improved if and when communities are allowed to participate in natural resource management. These initiatives are usually driven by strong statutory mechanisms and can be viewed as the institutionalization of benefit sharing arrangements at local or community levels (Nkhata and Breen 2010). They mostly seek to devolve the authority and responsibilities for the governance of ecosystem services to rural communities, which are essentially not agents of the state. In this way, the need to understand the dynamics underlying the transfer of authority for benefit sharing from government to rural communities has great implications for the efforts aimed at assessing the performance of collaborative approaches to benefit sharing.

A case study of a CBNRM scheme in the Kafue Flats of Zambia provides useful lessons on the performance of collaborative benefit sharing arrangements in southern Africa (Nkhata and Breen 2010). One of the most important features of the Kafue Flats benefit sharing mechanism was its revenue sharing system. The government had authority to collect revenue from the legal use of wetland resources in the Kafue Flats. The revenues generated from hunting were shared among the central government, Department of National Parks (which was part of government), and local communities. The central government received the largest portion (50%) of the collected revenue. The remaining 50% was shared between the Department (65%) and local communities (35%). This benefit sharing arrangement was originally designed to devolve key components of a governance system to local communities, but resultant efforts were largely unsuccessful because of the poor social relationships between government actors and local communities. Although there were some marginal benefits for local communities, the CBNRM scheme could not support the construction and execution of an effective governance system. Despite the government's stated intentions, issues surrounding the uneven sharing of revenues, nontransfer of revenue generation powers to local communities and nonremittance of agreed funds by the Department of National Parks demonstrate the continued dominance of government officials in benefit sharing arrangements, contributing to the marginalization and as yet partial integration of local communities in benefit sharing arrangements.

Drawing on lessons from the Kafue Flats benefit sharing arrangement (Nkhata and Breen 2010) and several other collaborative arrangements in southern Africa (Dzingirai and Breen 2005), we discovered that it is not uncommon to find that most collaborative initiatives provide for differential control over access to the benefits from ecosystems services. Several other studies have highlighted a range of issues and concerns related to differential control, which include state dominance (Gibson 1999), ineffective property rights (Murphree 1996), inadequate devolution of authority and responsibility for nature resources (Murombedzi 2000), and inadequate genuine participation by local communities in the distribution of benefits. Differential control over access in turn affects the flows and delivery of benefits, which tend to be bureaucratic and asymmetric.

Overall, we observed that the groups that participate in collaborative arrangements tend to have mixed interests and profiles. In other words, the participating groups can either be homogenous or heterogeneous in terms of their cultural identity, geographic origins, and economic status. Depending on specific contexts, group profiles can have profound effects on the nature of monitoring and enforcement that take place under collaborative initiatives. For example, while the monitoring and enforcement of benefit sharing agreements in most CBNRM initiatives is usually difficult, there are claims that efficiency in delivery of benefits is largely dependent on the structure of levels of bureaucracy. It is perhaps for this reason that the main implementation weakness of this category of benefit sharing arrangement has a lot to do with how to curtail the unyielding power of state actors.

It is important to note that the performance of collaborative arrangements has been constantly brought in the limelight in terms of their significance in contributing to the maintenance of ecosystem services (Sen and Raakjaer-Nielson 1996). Although the literature in general provides several examples of successful collaborative arrangements (Dietz et al. 2003, Pomeroy et al. 2010), there are studies that reveal many examples of failure (Meizen-Dick et al. 2004). In southern Africa, for example, while some authors have claimed high incidences of failure (Dzingirai and Breen 2005), others have suggested that because CBNRM has the attributes of a complex system, emergent forces continually challenge stability such that phases of success, collapse, and reconstruction have defined the hallmarks of CBNRM (Nkhata et al. 2009). These debates in the literature have focused on factors that either constrain or enable collaborative arrangements (Tole 2010). Although some arguments have emphasized the operational characteristics of collaborative arrangements such as financial accountability, efficient operations, and establishment of community infrastructure, others have stressed the importance of the characteristics of governance such as equity, power, democracy, public accountability, human rights, and effective community participation. There is general agreement that both types of factors are relevant to the enhancement of collaborative arrangements.

Market-Oriented Benefit Sharing Arrangements

Market-oriented benefit sharing arrangements denote benefit sharing approaches that involve voluntary exchanges established to support what Ostrom (2005) refers to as quid pro quo relationships. These relationships are essentially reciprocal in that a party offers a favor or advantage in return for something (Nkhata et al. 2008). Examples of approaches that reflect elements of market-oriented arrangements include Payments for Ecosystem Services (PES) initiatives, Clean Development Mechanisms (CDMs), voluntary carbon market projects, and Reducing Emissions from Deforestation and Degradation (REDD) initiatives.

In the context of governance arrangements, market-oriented approaches are designed to address market failures where the value of benefits cannot be captured in monetary terms. Although market-oriented arrangements are also driven by conservation goals, they are largely designed to enhance the economic status of participating groups. The economic rationale behind most of such arrangements is viewed as different from the traditional natural resource management approaches that focus on natural resources that are solely

controlled by the state and managed by state functionaries. For example, in most developing countries, PES initiatives represent a suite of voluntary benefit sharing arrangements that provide positive economic incentives to sustainably manage ecosystems and to produce ecosystem services. While one might argue that PES initiatives do not necessarily involve sharing per se, more especially that they involve situations where one pays another for a service, for the purposes of this study we contend that such payments can justifiably be categorized as sharing mechanisms, particularly in the context of the pervasive enormous social differentials in the levels of economic, political, and information power that prevail in most developing countries. We take this position because such payments are usually made in contexts where traditional markets are underdeveloped and decisions to change land use types fail to take into account the total costs of loss of ecosystem services.

Accordingly, market-oriented arrangements provide incentives to manage ecosystems and to produce the services that promote human well-being (Sommerville et al. 2009). In other words, they are basically designed to create nontraditional economic incentives for the maintenance of ecosystems services. It is partly because of this reason that market-oriented arrangements are increasingly being promoted as a major benefit sharing approach to conservation by way of rewarding the people who are responsible for the provision of ecosystem services (Nelson et al. 2009). For example, according to Wunder (2007), PES initiatives consist of voluntary and conditional transactions whereby an ecosystem service is purchased by at least one service buyer from at least one service provider. As such, market-oriented arrangements are usually considered to be based on economic incentives put in place to compensate providers of ecosystem services, on condition that the provider secures the provision of services.

Kosmus and Cordero (2009) provide an instructive case study of the Costa Rican Payments for Ecosystem Services Program, which offers useful lessons on the performance of market-oriented arrangements in Latin America. This Program was created in 1996 in an effort to set up special markets and payments to ensure the provision of services that ecosystems provide to society. The National Forestry Law was established through this Program to provide a framework for the development of policies that promote the economic values of ecosystem services. According to Kosmus and Cordero (2009), the enforcement of the National Forestry Law enabled the creation of the National Forestry Financing Fund (FONAFIFO), which is an intermediary mechanism for buying ecosystem services from landowners and selling them to interested buyers. This mechanism pays landowners to enforce specific land uses that guarantee the provision of ecosystem services. At the beginning, the central government committed itself to finance this fund with five percent of the revenue from the tax on fossil fuel, but later on a diversification of funding sources took place to cover the vast requests from landholders to join the Program. New sources of funding include the private sector and the international community. Kosmus and Cordero (2009) argue that the stability of the PES program in Costa Rica depends on financial sustainability, the legal framework, the capacity of institutions to administer the program, political support from the highest to the lowest levels, participation of civil society, transparency, and credibility of institutions and actors regarding the administration and implementation of the scheme.

Drawing on lessons from the Costa Rican Payments for Ecosystem Services Program (Kosmus and Cordero 2009) and other market-oriented arrangements in Latin America (Wunder 2007, Brockhaus and Botoni 2009), we were able to establish that, in contrast with collaborative arrangements, there is usually limited structured control over access to benefits from ecosystem services under market-oriented arrangements. While multiple channels exist for the flows of benefits, the delivery of these benefits can be symmetrical whereby the exchanges between the so-called "producers" and "suppliers" tend to be balanced. In many instances the participating groups tend to be largely heterogeneous. This affects the monitoring and enforcement of benefit sharing agreements, which tend to be litigation driven. Given that efficiency in delivery under this category of benefit sharing arrangement is dependent on the structure of economic incentives, the main implementation weakness is how to find willing buyers for ecosystem services.

It is important to acknowledge that there are two main reasons advanced for sharing financial returns under this category of benefit sharing arrangement. Firstly, the need to create resource management incentives is considered to be an important means of rewarding individuals, communities, organizations, and businesses for actions that change resource use patterns. This reason entails offering benefits in excess of the costs incurred in the process of changing "resource-degrading behaviors". The second reason is to build sustained legitimacy for benefit sharing initiatives. It is argued that if too many people benefit from something they have not actively contributed to or have no legitimate claims to, the associated incentives may be diluted. This would lead to weaker incentives and lower overall benefits to share. Alternatively, if the benefits are given only to certain groups, actions, or geographical areas, people may feel unfairly treated and turn against the initiative as they define it as illegitimate. Thus, market-oriented benefit sharing arrangements seek to garner legitimacy by way of focusing on those people who are directly affected by the benefits.

Egalitarian Benefit Sharing Arrangements

Egalitarian arrangements denote a benefit sharing approach based on the principle that all people are equal and deserve equal rights and opportunities. For the purposes of this study,

we focus on one typical example of these arrangements: Access and Benefit sharing (ABS) initiatives under the Convention on Biological Diversity (CBD). The CBD is an international treaty that seeks to advance three interrelated goals: the conservation of biological diversity, the sustainable use of the components of biological diversity, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources (Convention on Biological Diversity 1992). Essentially, the treaty provides a multilateral framework for harnessing the values of biodiversity and ecosystem services. One major way in which the treaty provides for such harnessing is by establishing mechanisms for ensuring that some of the benefits of industrial exploitation of genetic resources are allocated to producer nations and communities in the form of royalty sharing, technology transfer, and scientific capacity building. The ABS initiatives are commonly discussed and implemented under the rubric of three themes: appropriate access to genetic resources, appropriate transfer of relevant technologies, as well as appropriate funding.

In terms of governance arrangements, ABS initiatives tends to focus on the need to address the social injustices related to equitable access to and sharing of benefits from ecosystem services. Benefit sharing under the ABS initiatives is usually framed as a matter of social justice. According to the Secretariat of the CBD (Convention on Biological Diversity 2000:4), "an important part of the biodiversity debate involves access to and sharing of the benefits arising out of the commercial and other utilization of genetic material, such as pharmaceutical products". The CBD requires that the benefits of nonhuman genetic resources be shared among stakeholders. It emphasizes the desirability of sharing equitably benefits arising from the use of traditional knowledge (TK), innovations, and practices relevant to the conservation of biological diversity and the sustainable use of its components. The CBD thus institutionalizes the call for equitable returns to producer countries and communities as a multilateral principle of social justice in conservation. In this context, benefit sharing revolves around trade-offs between access to genetic resources and fair and equitable sharing of the associated benefits. Such sharing also includes the use of a wide variety of monetary and nonmonetary mechanisms, ranging from profit sharing or equitable stakes in the bioprospecting business, as well as technology transfer, training, and collaborative research. In this context, bioprospecting is the systematic search of new sources of chemical compounds, genes, proteins, microorganisms, and other products that have economic potential and can be found in biodiversity. The process of getting resources from the use of biodiversity-related commercial products includes the negotiations and contracting that goes on between industrialized enterprises and local communities.

Jayaraman (1996) provides an instructive case study of the Kani Access and Benefit Sharing Program, which offers useful lessons on the performance of egalitarian arrangements in India. This case study relates to access and benefit sharing arrangements arrived at between Tropical Botanical Garden and Research Institute (TBGRI) and the Kani tribals of Kerala for the development of a drug called "Jeevani" based on the knowledge of the Kani tribe. Jeevani is a restorative, immune-enhancing, antistress and antifatigue agent, based on the herbal medicinal plant "arogyapaacha" (*Trichopus zeylanicus*), used by the Kani tribals in their traditional medicine. Within the Kani tribe, argues Jayaraman (1996), the customary rights to transfer and practice certain traditional medicinal knowledge are held by tribal healers, known as Plathis. The knowledge was divulged by three Kani tribal members to the scientists of TBGRI, who isolated 12 active compounds from arogyappacha, and developed the drug Jeevani. The technology was then licensed to Arya Vaidya Pharmacy Ltd., an Indian pharmaceutical manufacturer pursuing the commercialization of Ayurvedic herbal formulations. A Trust Fund was established to share the benefits arising from the commercialization of the TK-based drug Jeevani. According to Jayaraman (1996), this case study brings to light the need for a multistakeholder framework for discussing the scope of access and benefit sharing. The case illustrates that while intellectual property rights play a crucial role in generating benefits from biological resources and traditional knowledge, their role should be balanced with the conservation as well as institutional objectives.

We analyzed the lessons drawn from the Kani ABS case study (Jayaraman 1996) as well as similar initiatives in other developing countries that focus on the involvement of indigenous people in bioprospecting and genetic research (Schuklenk and Kleinsmidt 2006). Our analysis suggested that, in contrast with the other two types of arrangements, there is usually no structured control over access to benefits and the flows of benefits do not follow specific channels. While obviously debatable, the delivery of benefits under ABS initiatives is in most instances perceived to be fair and equitable by participating groups, which tend to be homogeneous. It is instructive to note that the monitoring and enforcement of agreements under this form of arrangement is usually based on peer social pressure. As such, efficiency in delivery of benefits is dependent on social cohesion. However, it has been observed that the main challenge in implementation usually has to do with how to buffer the sharing schemes from external forces and shocks.

CONCLUSION

The above discourse has provided a preliminary review of the major categories of benefit sharing arrangements for the governance of social-ecological systems insofar as ecosystem services in developing countries are concerned. Although simplified, these categories represent a set of important strategies that can used to promote sustainable natural resource management as well as efficient, effective, and equitable governance of social-ecological systems. Perhaps surprisingly,

these categories have in practice been more often than not narrowly employed as a way of soliciting support from participants who have been associated with "resource-degrading behaviors". Although both collaborative and market-oriented arrangements will be critical and indispensable in specific social-ecological contexts, egalitarian arrangements are of particular importance to this study given the relatively inadequate scholarly attention paid to this type of arrangement. Except in the case of genetic resources, most research has not given explicit and focused attention to egalitarian arrangements as they relate to other equally important ecosystem services.

We envisaged that sharing issues will continue to form the core basis of debates about the governance of social-ecological systems in developing countries. Given that the supply of, and demand for, ecosystem services are so variable in time and space (Koch et al. 2009), there are widely differing opinions on how to respond to the complexity surrounding benefit sharing arrangements. Complexity in turn is fuelled by heightened uncertainty about the likely consequences of both collective and individual choices. As demands for access to and use of ecosystem services become more diverse and grow, relative scarcity will increase, fostering competitive rather than cooperative behaviors necessary for sustainable allocation of benefits, particularly from common property resources. In such complex contexts, governing access and use is not simply a matter of setting a utility function and selecting the alternative leading to the preferred set of consequences. On the contrary, it requires a systemic framing of key determinant variables, which define the effectiveness, efficiency, equity, and sustainability of benefit sharing arrangements. Knowledge about benefit sharing arrangements must be scientifically reliable and evolve to remain contextually relevant.

Responses to this article can be read online at:
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