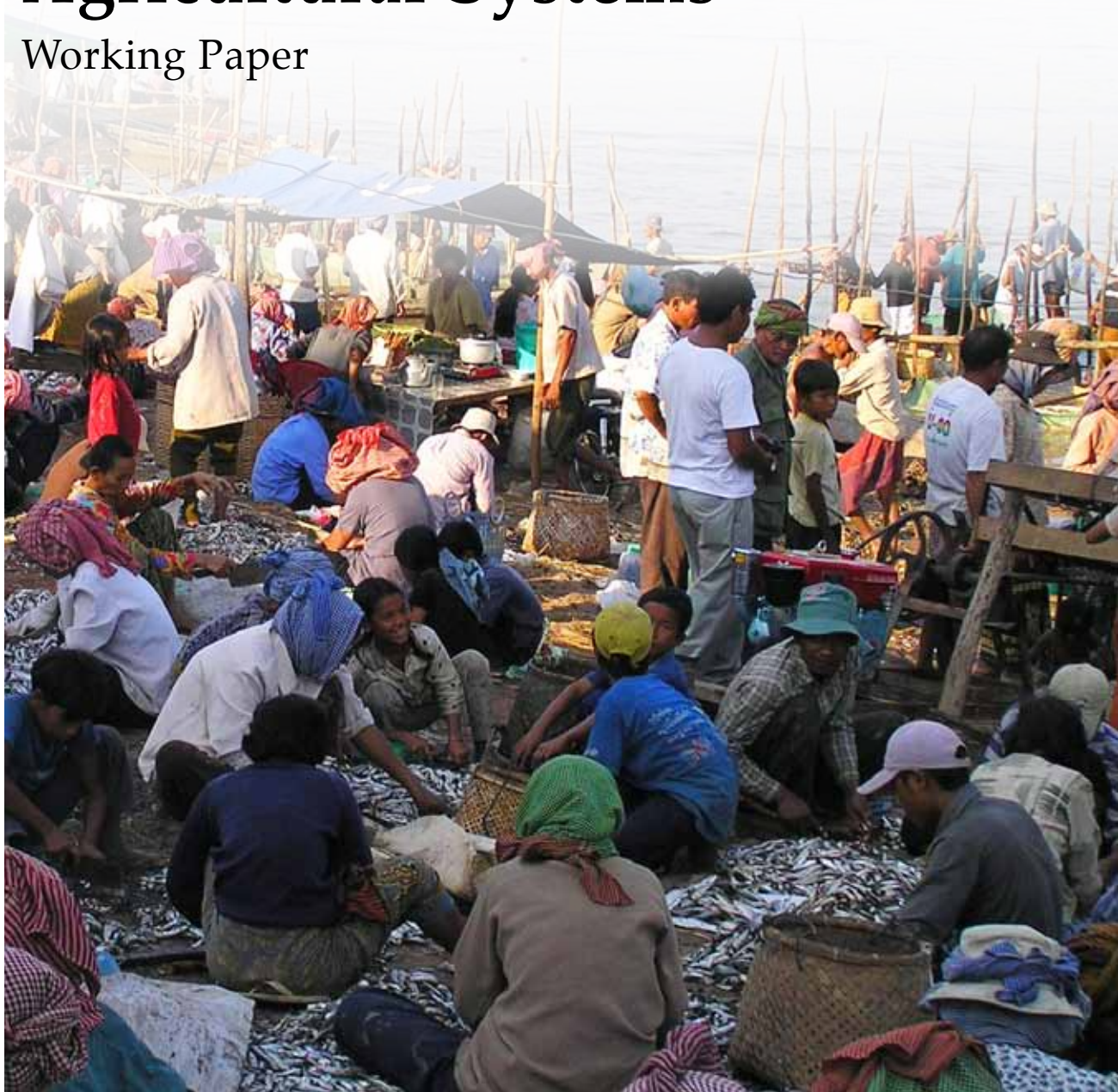


Strengthening Governance Across Scales in Aquatic Agricultural Systems

Working Paper

Making a difference in the lives of the poor



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**Research
Program on
Aquatic
Agricultural
Systems**

STRENGTHENING GOVERNANCE ACROSS SCALES IN AQUATIC AGRICULTURAL SYSTEMS

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SUMMARY

Aquatic agricultural systems in developing countries face increasing competition from multiple stakeholders operating from local to national and regional scales over rights to access and use natural resources—land, water, wetlands, and fisheries—essential to rural livelihoods. A key implication is the need to strengthen governance to enable equitable decision-making amidst such competition, building capacities for resilience and transformations that reduce poverty. This paper provides a simple framework to analyze the governance context for aquatic agricultural system development focused on three dimensions: stakeholder representation, distribution of power, and mechanisms of accountability. Case studies from Cambodia, Bangladesh, Malawi/Mozambique, and Solomon Islands illustrate the application of these concepts to fisheries and aquaculture livelihoods in the broader context of intersectoral and cross-scale governance interactions.

Keywords: environmental governance; social-ecological resilience; wetlands; coastal zone management; stakeholder representation; civil society; accountability.

1. INTRODUCTION

In assessing the factors that influence resilience, adaptability, and transformation in large social-ecological systems, governance characteristics are not sufficient in themselves to explain divergent outcomes. Yet, they play an influential role, interacting with characteristics of the user groups and the resource system (Ostrom 2009). Good governance can be considered a foundation for diverse user groups and other stakeholders to build capacities to manage resilience (Lebel et al. 2006). Learning how to make improvements in governance is especially important as the demands of managing resource competition across sectors and across geographic scales intensify (Dietz et al. 2003, Adger et al. 2005, Wilson 2006).

This paper presents and illustrates a framework to analyze the governance context for development of aquatic agricultural systems, intended as a tool to observe and compare differences across multiple cases and an aid to action research. We focus on developing country environments where aquatic resources play a critical role in rural livelihoods and poverty reduction. Occurring “along freshwater floodplains, coastal deltas, and inshore marine waters,” these aquatic agricultural systems (AAS) “are characterized by their dependence on seasonal changes in productivity, driven by seasonal variation in rainfall, river flow, and/or coastal and marine processes” (WorldFish 2011). By broadening the focus from individual production sectors (fisheries, crop agriculture, livestock, aquaculture) to integrated environmental, food production and livelihood systems, the AAS perspective aims to bring greater coherence to attempts to govern these systems for their contribution to food security and poverty reduction. The emphasis on resilience of livelihoods to multiple stresses and shocks demands a systems perspective in development planning and implementation. It recognizes that building social, political and economic rights is an integral element of poverty reduction, and a necessary foundation for efforts to build resilience and adaptive capacity (Allison et al. 2011). And it recognizes that in cases where current production systems are failing to meet the needs of local resource users, more fundamental transformations are needed (Walker et al. 2010).

The paper is organized as follows. In the next section, we summarize an approach to analyzing the governance context for AAS development.

Drawing insights from resilience thinking and the broader literature on environmental governance, the framework focuses on three dimensions: stakeholder representation, distribution of power, and mechanisms of accountability. To demonstrate the utility of such a framework, we then present four case studies, addressing protected riverine wetlands in northern Cambodia, seasonal floodplain systems in Bangladesh, transboundary management of Lake Chilwa in Malawi and Mozambique, and artisanal marine fisheries in Solomon Islands. In each case, the particular challenges of small-scale fisheries and aquaculture development are presented in the context of broader intersectoral and cross-scale governance interactions. These cases highlight the formal and informal mechanisms that hold decision makers accountable towards poor and marginalized groups, including the role of bridging organizations that improve communication across sectors and geographic scales, and the role of civil society advocacy. We then discuss the lessons and challenges of strengthening cross-scale governance in AAS in comparative perspective. In the concluding section, we reflect on the benefits and limitations of this analytical approach, and identify priorities for future research to understand and strengthen governance of AAS globally.

2. ANALYZING THE GOVERNANCE CONTEXT

Governance is often described in terms of positive attributes such as transparency or equity in decision-making, with relatively little attention to the underlying factors that constitute different governance arrangements or to the processes that help promote transitions in governance. Pursuing improvements in governance is not merely a technical process involving choice among design options, but a contested process of change, requiring deliberation over societal goals and underlying values (Armitage 2008). It is important, therefore, that the analytical framework used be critical rather than normative—in the sense that the description and assessment of how things are is distinct from the discussion of how things ought to be. It should also be suitable for use across a diversity of socio-political settings, simple enough to be understood

by the resource users and other stakeholders themselves, and therefore appropriate for use in action research settings where the goal is practical insights that can be applied. The accumulated experience of integrating governance objectives into development assistance over the last two decades confirms that many of the most promising opportunities exist at local levels, requiring deliberation over locally-determined “best-fit” options as opposed to “best practices” imported from other countries (Carothers and de Gramont 2011). Learning from such local innovations can also provide a foundation for policy reforms and institution-building at larger scales.

The governance context of AAS describes the domain in which people’s authority to use, manage, or otherwise influence natural resources is exercised. It concerns the formal legal and institutional framework as well as the informal sets of norms, traditions, social networks, and power relationships that guide and constrain the interactions of stakeholders with one another and with the natural environment. The simple analytical framework we present here is adapted from a version developed for small-scale fisheries development. (see Ratner and Allison 2012 for a more complete discussion of the framework and its roots). Integrating concepts from the broader literature on environmental governance (Agrawal and Ribot 1999, Ribot 2002), it focuses on three distinct dimensions of governance— stakeholder representation, distribution of authority, and mechanisms of accountability. These three dimensions provide the critical tools for assessing and describing the characteristics of different governance arrangements. They can be seen as the building blocks to determining what Lebel et al. (2006) term “positive attributes” of governance deemed essential to building the capacities of stakeholder groups to manage resilience and transformation (see Figure 1). In this perspective, the characteristics of stakeholder representation contribute to the goals of inclusive and deliberative decision-making; distribution of authority determines the degree to which there are polycentric and multi-layered institutional arrangements; while accountability mechanisms determine the strength of accountability in multiple directions and influence the just distribution of benefits.

In Figure 2, we provide key questions to help orient analysis of each of these three dimensions of governance, as well as points of guidance or clarification and issues of particular concern that often merit attention in developing-country AAS.

Foreachofthesedimensions,bothformalandinformal mechanisms typically function in parallel (see Figure 3 for illustrations). In each case, the emphasis is on how decision-making works in practice, which may differ significantly from how it is meant to work in principle (Carothers and de Gramont 2011). In assessing mechanisms of representation, for example, formal mechanisms such as community representation in management committees, or local or regional bodies of government, need to be considered alongside informal mechanisms such as the communication of stakeholder interests through social networks or civil society organizations. To evaluate distribution of authority, it is critical to consider both formally-allocated authority as well as powers assumed in practice. In some countries, for example, traditional civic or religious institutions may be involved in determining resource access or resolving environmental conflicts even if it is not their primary focus, and they may operate in parallel to the more formal bodies of village and district government.

Similarly, with regards to mechanisms of accountability, formal channels such as the court system need to be considered alongside informal mechanisms such as civil society advocacy and social movements. Compliance and enforcement of laws and local regulation may differ dramatically in practice, may be biased by the interests of government agencies, may be applied selectively to certain categories of resource users, or may be skewed according to class, ethnicity, gender, or religion. Historically, some informal enforcement mechanisms have functioned well at the community level, making enforcement by the state unnecessary (McCay and Acheson 1987, Ostrom 1990, Ruddle 1988). Most commonly, however, such informal mechanisms are incapable of handling the range of users competing for commercially valuable resources or the ecosystem threats that stem from other sectors of the economy (Berkes 2006, Dietz et al. 2003, Foale and Macintyre 2000, Thorburn 2000).

The framework summarized here is consistent with the more generic institutional analysis and development (IAD) model (Oakerson 1992, Ostrom 2005, 2009), focused on understanding the factors that influence opportunities for collective action in natural resources management and outcomes as measured by a variety of social and ecological criteria, including efficiency, equity, and resilience. It can be used as part of efforts to assess and promote cooperative, equitable resolution of resource competition, and capacity

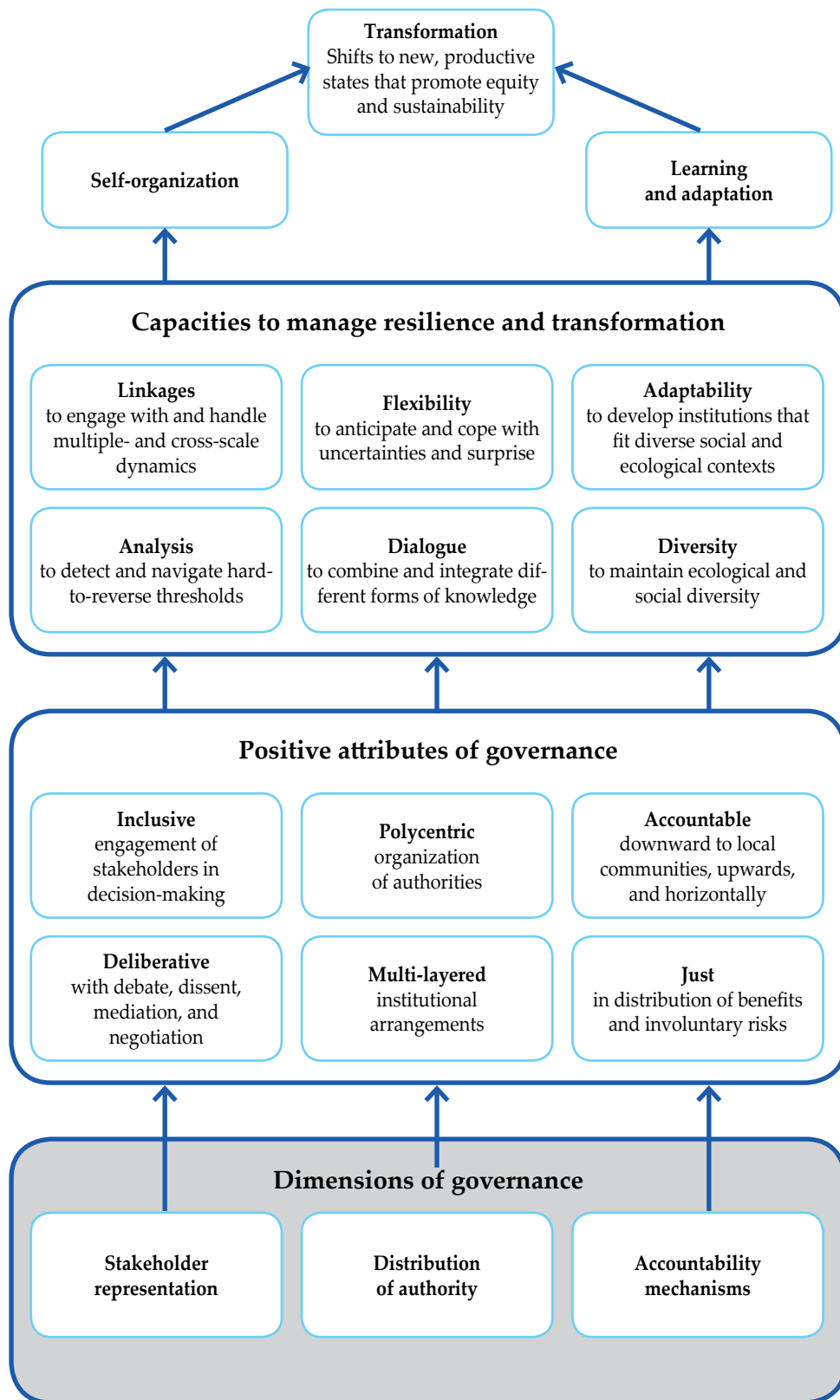


Figure 1. Governance and capacities to manage resilience, adaptation, and transformation. Adapted from Lebel et al. (2006).

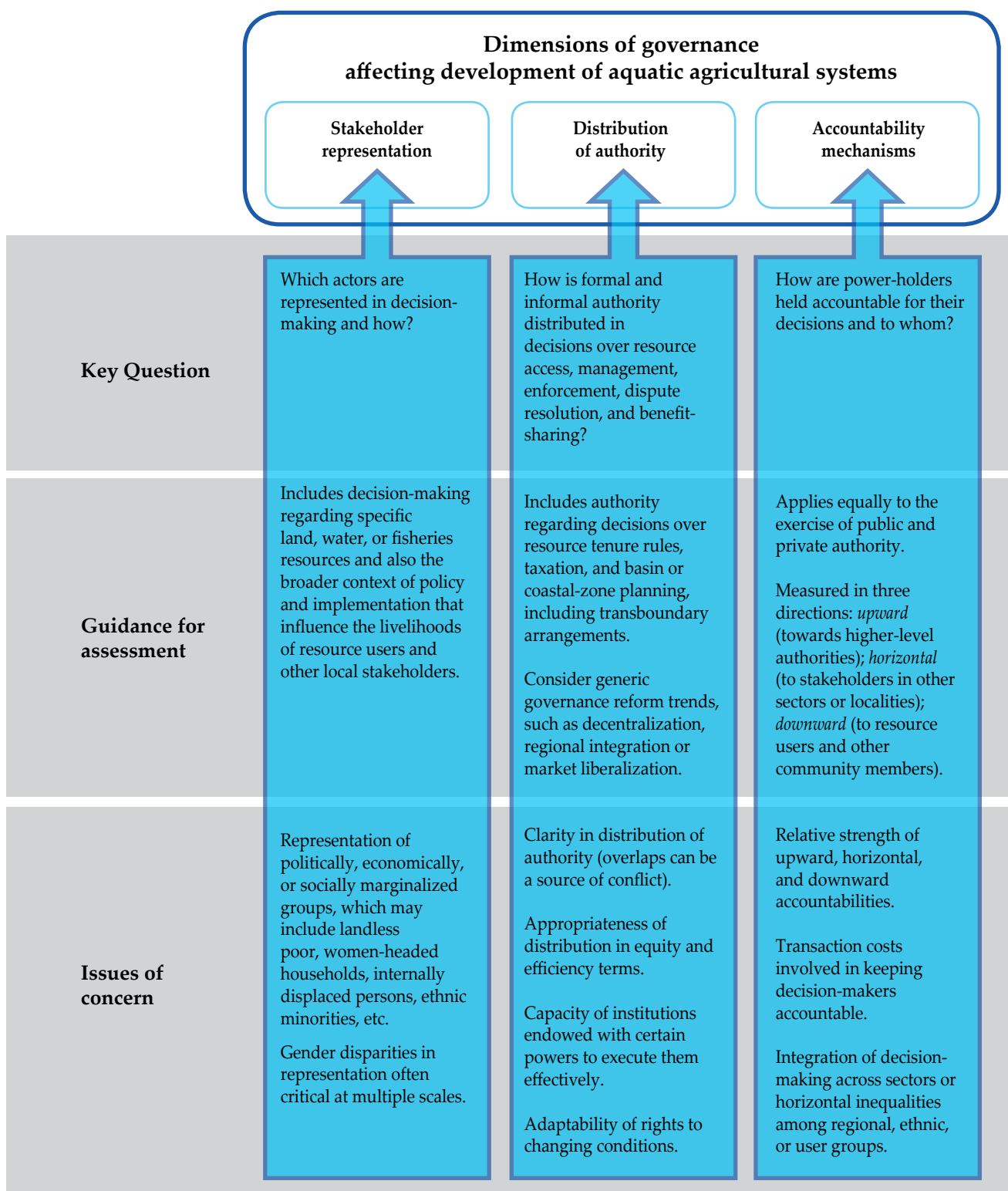


Figure 2. Key questions and considerations in analyzing the governance context for development of aquatic agricultural systems. Adapted from Ratner and Allison (2012).

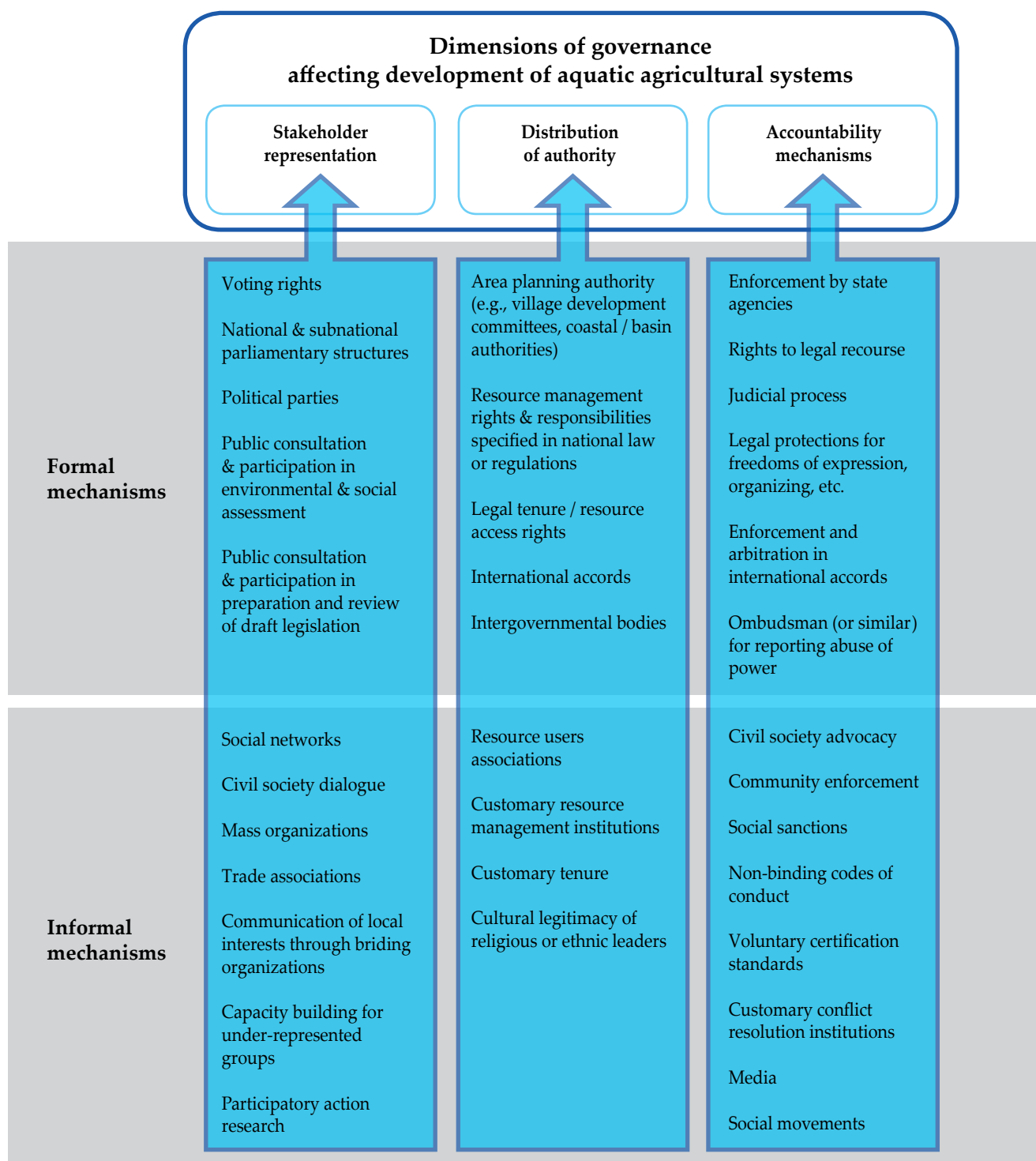


Figure 3. Examples of formal and informal mechanisms for three dimensions characterizing the governance context for development of aquatic agricultural systems. Adapted from Ratner and Allison (2012).

to manage such competition (Ratner et al. 2010), as well as diagnosis of the institutional challenges affecting options for small-scale fisheries development (Andrew et al. 2007). As such, assessments using this analytical framework can contribute to broader, comparative analyses.

The advantage of this framework, as compared for example to more elaborate models of interactive governance (e.g. Kooiman et al. 2008), is its practical intent and relative conceptual simplicity, making it more easily applied by local stakeholders as part of participatory action research and learning. Without prescribing answers, the framework aims to help structure assessments involving local stakeholders by posing questions about the present, the possible future, and the routes of influence to bridge that gap: How does the governance context affect local livelihood options now? What are the relevant institutions and relationships, including those we may not have considered before? What factors are unlikely to change, to which we'll need to effectively adapt? Where are the opportunities for improvement? What groups might have influence in pursuing such progress?

3. CASE STUDIES

In this section, we present four developing country case studies to illustrate how the framework can be applied to analyze the governance context for AAS development in diverse ecological and socio-political settings. Each case study draws on the direct experience of one or more of the authors, supplemented by published research and project documentation. Each case also represents an ongoing, long-term collaboration between the WorldFish Center and partners in a multi-faceted program of action research and capacity building (WorldFish Center 2011). As such, the set of cases offers a useful basis for comparison and identification of common lessons and challenges that are helping inform future development efforts. Focused on fisheries and aquaculture as an entry point, these brief case descriptions highlight practical implications of efforts to analyze and improve stakeholder representation, distribution of authority, and mechanisms for accountability.

Strengthening community voices for conservation in the wetlands of Stung Treng, Cambodia

The Stung Treng Ramsar site, a protected wetland along some 40 km of the Mekong River mainstream in northeastern Cambodia, is recognized internationally for its unique biodiversity value, featuring important habitat for migratory birds and deep pools that serve as spawning grounds for as many as 100 fish species. It is also a source of livelihood for 20 villages, which depend on the floodplain and riverbanks to cultivate rice and other crops such as watermelon, tobacco, cucumber, tomato, chili, potato, bean and eggplant. Subsistence fishing is the second major livelihood activity, and in the dry season attracts villagers from distant areas who establish makeshift tents on the sandbars. The river also provides a navigational route for transboundary trade between Stung Treng province and Champassac in neighboring Laos.

Since 2005, a village-based action research initiative has worked to build local commitment to resource protection, as well as better advocacy of local interests, by engaging local government and the media. The initiative, known locally as Salaphoum, addresses a deficit in local stakeholder representation in decision making by supporting community members in four villages to document local knowledge of environmental resources—such as fish species, their habitats and migration patterns, medicinal plants and their uses – improving their ability to take part in planning exercises (Salaphoum 2009). Community-produced media, using video footage taken by members within the research network, is developed as a tool for their advocacy work. Villagers have influenced the designation of fish habitats such as deep pools for protection, documented fishing gears and practices, and formed a network among neighboring villages to protect fisheries resources. An outcome evaluation shows that villages in the area now share information much more effectively, dialogue to trouble-shoot shared problems such as deterring illegal fishers, and engage in collective action such as joint patrols between neighboring community fisheries (Halpern et al. 2010).

Legal and administrative reforms have also increased the scope for community-based resource management in recent years, but overlapping

authority and limited government capacity pose serious constraints. The Fisheries Administration and non-governmental organisations (NGOs) have supported development of 21 community fisheries in this section of the river, with authority to manage fisheries resources in public fishing grounds as authorized under a sub-decree on community fisheries (2007). Local fisheries and environment offices are both poorly staffed and financed however and, in addition, under the protected areas law (2008) management of the Ramsar site falls under the authority of the Ministry of Environment. Rangers and fisheries officers have difficulty monitoring the area because of high travel costs, while low wages and limited downward accountability encourage both to seek informal income, which is justified as supporting the cost of their operations.

One of the most significant obstacles to improving enforcement is distribution of authority—in particular, the misfit between resource use rights and responsibility for protection. According to the fisheries law (2006), outsiders enjoy the same use rights as local community members, provided they follow local management rules. Yet, when outsiders violate these rules, there are few avenues of recourse for community fishery leaders, who do not have the authority to apprehend offenders (only to report them). Outsiders are not subject to the same social sanctions that act as deterrents for community members, and in many cases they employ large scale and sophisticated fishing gear, sometimes financed by powerful interests (Halpern et al. 2010).

Meanwhile, decentralization reforms outlined in the organic law on sub-national administration (2008) are introducing new opportunities to improve accountability. Local government units have typically been more responsive to local needs than fisheries and environment officers accountable to the central line ministries; however, they typically lack the resources to provide much support. By allocating fiscal resources to local planning committees at commune, district, and provincial levels, the decentralization reforms should in principle help address this gap. So far, however, natural resource management has received low priority in participatory commune planning processes, due to the immediate need for physical infrastructure, limited resource management capacity of local service providers, and lack of clear guidance on how to measure outcomes. Improving the ability of sectoral agencies to respond to local planning priorities is a key policy goal. Mechanisms to

achieve this include strengthening capacity of local technical staff, developing young professionals to assume responsibilities of retirees, and delegating functions to appropriate sub-national levels (RGC 2010). A final priority is improving the capacity of elected commune councils and their accountability to local constituencies (Mam 2009).

Building accountability through community-based fish culture in seasonal floodplains, Bangladesh

Bangladesh has one of the largest inland fisheries in the world, with nearly 4.6 million ha of inland waters, 62% of which are floodplains (FRSS 2007). Intensive harvesting and land use change have reduced yields from natural floodplain fisheries. Augmenting natural productivity through fish culture is an important tool for strengthening the rural economy (Dey and Prein 2006). Although past fish culture interventions increased production, they have also resulted in fishers losing access rights (Barman et al. 2010, 2011), with negative effects on income of poor households and biodiversity (Toufique and Gregory 2008). In some cases, public floodplains leased to fisher groups are appropriated by influential people, with the benefits from fish culture accruing only to a few members.

While there are various initiatives to introduce fish culture in privately owned floodplains through contracts between landowners and individual entrepreneurs, initiatives to bring public and privately-owned floodplains under community-based systems with multiple beneficiaries are less common. In part this is because the approach is more demanding in its requirement for equitable institutions to balance the interests of fishers, landless and landowners (Collis et al. 2011). During 2005-2010, an initiative supported by the CGIAR Challenge Program on Water and Food experimented with such an approach, working both in publicly-owned floodplains surrounded by private lands, as well as privately-owned floodplains (Joffre and Sheriff 2011).

The case of Beel Mail in Mohanpur at Rajshahi, a seasonal waterbody formed on public lands surrounded by private lands, illustrates the sharp divergence between distribution of authority in

law and in practice. Local communities organized under the Melandi Fishers Society (MFS) gained legal access rights to the waterbody for a three-year period by participating in an auction. But in practice they were often excluded, as the resource was captured by economically and politically influential local people. MFS members lacked representation in decisions regarding production management, conflict resolution, and benefit sharing. Elite capture of the Beel Mail floodplains stemmed from a serious lack of accountability in several respects: MFS was a weak institution, with little internal commitment among its members; its leaders were influenced by local elites who captured the floodplains with token payments; local government authorities, along with the department of fisheries, also had weak lines of accountability to local communities.

Project support led to a significant improvement in representation within the MFS, plus improvements in downward accountability of local authorities and support agencies. As more MFS members became actively involved in floodplain management, its leaders gradually became more accountable to members in distributing roles, assuring distribution of benefits, as well as working to maintain active linkages with other local agencies to improve delivery of services. Elite capture was effectively stopped, with many withdrawing their claims on the resource, while those local elites who remained involved became active members of the MFS, providing support to fish culture management, ensuring security, and influencing formal institutions to support the community efforts when needed. Incursion by outsiders in illegal fishing has ceased, and local landless households have benefited by harvesting small, non-stocked species. Harvests of both stocked and non-stocked fish have more than doubled (from 282 to 691 kg/ha), with a similar rise in income (from US\$192 to US\$470/ha) (Joffre and Sheriff 2011).

This experience is notable for its success in addressing the problems of weak downward accountability and elite capture. Researchers engaged in the project were able to build on many years of prior collaboration with the Department of Fisheries and local government institutions to diagnose the stakeholder relationships and institutional dynamics, and learn from the outcomes of prior efforts. Key insights included the importance of supporting marginalized households to assert their rights to resource use, as well as engaging relatively better-off fishers to invest in

community-based efforts. These people then helped finance activities such as fish fencing, stocking, and management, which generated economic gains and encouraged others to participate (Barman et al. 2010, 2011). Where there was strong stakeholder representation, effective institutional linkages with local government, and accountability mechanisms to ensure equitable distribution of benefits, similar results were achieved on privately-owned floodplain lands as well. Where these governance features were lacking, outcomes were far less successful. At the Angarar Beel floodplain at Pirgonj in Ranpur, for example, participation of members was far less consistent, leaders lacked an orientation towards consensus building, had less extensive networks with local institutions, and were less able to negotiate with local authorities and fisheries officers. Complaints over lack of transparency on the use of investment funds and disputes over distribution of benefits stymied the initiative (Barman et al. 2011, Joffre and Sheriff 2011).

Parallel authorities and transboundary governance in the Lake Chilwa basin, Malawi and Mozambique

Lake Chilwa lies in southeastern Malawi, spanning the border with Mozambique. A shallow, enclosed lake with a surrounding reed belt and a seasonally-flooded plain, it is one of Africa's most productive lake fisheries (Njaya et al. 2011). The basin provides fertile land for over 1.6 million people in Malawi growing mostly rice in the wetlands and maize in upland areas. The relatively high population density of 321 people per sq km (NSO 2008) is driving the expansion of cropland to marshes, forests and other marginal areas. The lake's fish production is directly influenced by deforestation, upland agriculture and soil erosion within the catchment that deposits phosphorous and other pollutants, as well as urban waste runoff from Zomba City (Government of Malawi 2000). The lake is also highly sensitive to climatic variation. It dried out eight times in the last century, with resilient fish species surviving in the swamps and streams and re-establishing in the lake three to four years after (Njaya et al. 2011). The fishery is predominantly artisanal, with fishers' gear varying by season, water level and species targeted. The lake and its marshes form an

internationally significant ecosystem, designated a protected Ramsar site in 1997.

An important feature of local governance is parallel systems of authority aligned with local chiefdoms and national government. Traditional management strategies can be traced to the time when Lomwe, Yao and Nyanja ethnic groups settled around the lake, forming networks that cross today's international border. The local chiefs appointed beach chairpersons, who developed a fishing calendar based on taboos and myths respected by each group. These traditional management systems, although modified, are still being practiced in small, cohesive communities as found in the islands of Lake Chilwa (Chisi and Njalo) as well as Lake Malawi (Mbenji). In parallel, the Malawian government instituted a centralized system, with Department of Fisheries as the sole fishery management authority. But in 1995, after the lake dried out and the fishery was depleted, government authorities initiated a co-management approach. While some of the regulations formulated under centralized management were retained, others were changed to reflect management and monitoring roles assigned to the newly-introduced Beach Village Committees. In some cases, these committees and traditional local leaders have come into conflict over authority to set and enforce rules (Kayambazinthu 1999, Njaya 2009).

Recently, the Lake Chilwa Climate Change Adaptation Program has introduced participatory monitoring, which serves to increase accountability of government and private sector actors. Fishers use logbooks to record catch, sales and incomes, providing more detailed information than previously available from government statistics. A preliminary assessment of these records revealed that fishing effort on Lake Chilwa had been underestimated by a factor of three to four, and suggested the number of people directly involved in fishing is also far greater than indicated by official data. With this information in hand, fishers have become more proactive in calling on government to improve enforcement and to adjust management approaches in response to the shifting resource status. By tracking financial records that demonstrate how much cash fishing can yield each month and year, fishers have also begun to promote a savings culture, which may open new options for local microenterprise development. To facilitate the savings and access to credit, fishers recently requested mobile banking services at the fish landing beaches.

If such efforts succeed in strengthening fisheries co-management systems in Malawi, and if the competition with traditional authorities is resolved, significant challenges will still remain at the lake basin scale. One dimension involves the interface between land, water, agriculture and fisheries management. Agriculture authorities, for example, have promoted manual treadle pumps for irrigation to expand cropping on the lakeshore and riverbanks, inadvertently competing with efforts to protect critical aquatic habitats. So far, few institutions have developed to manage trade-offs and competition across sectors, such that poor users in particular are left to seek strategies to cope and adapt as livelihood opportunities shift. At the international scale, conflicts among fishers and between fisheries authorities in the two countries are frequent (Njaya 2007). Fishing restrictions in Mozambique are less developed than in Malawi, so seine fishers, for example, migrate to the Mozambican side of the lake during their closed season when they are not allowed to fish in Malawian waters. Yet there is no joint committee or other institutional arrangement to handle such disputes, much less to undertake joint planning and management efforts – a significant gap in distribution of authority.

Networking and advocacy among coastal communities in Solomon Islands

The population of Solomon Islands resides predominantly in rural and coastal areas, and is highly dependent on subsistence and small-scale agriculture and fisheries for food security and livelihoods. Nationally, up to 80% of households participate in fishing activities, and in many rural areas alternative protein sources and income opportunities are limited (Bell et al. 2009). Although current population density is relatively low, Solomon Islands has one of the world's fastest growing populations. The projected demand for fishery resources, alongside increasing pressures from global markets and climate change, threaten sustainability of marine biodiversity and the benefits it provides. The nation is situated within the coral triangle region of exceptionally high marine biodiversity, and therefore attracts global interest in the management and conservation of its marine resources (Coral Triangle Initiative 2009).

Most land and near-shore marine areas are traditionally owned, and customary systems allow clans with tenure to control resource access and use. These customary tenure rights are constitutionally protected. National environmental and fisheries legislation also regulate near-shore marine resource use; however, lack of capacity and difficulties resolving state and traditional controls have limited the application of centralized measures for non-export fishing activities in rural areas. Over the last 15 years, communities and their partner agencies (predominantly international NGOs) have established over 130 locally managed marine areas (LMMAs) in Solomon Islands. The Solomon Islands locally managed marine area network (SILMMA) was established in 2003 by the Ministry of Fisheries and Marine Resources and NGOs as a national branch of the Asia-Pacific LMMA network. SILMMA's objective is to promote information exchange, collaboration and coordination across the numerous government ministries, NGOs and communities involved in managing Solomon Islands' marine resources (Cohen et al., in press).

The SILMMA approach is notable for clarifying local resource management authority by supporting state institutions to complement rather than compete with customary management regimes. NGOs typically facilitate the development of management arrangements and resource use rules, approved through consultation with reef-owning clans and the broader community. Rules are designed to combine local and traditional governance practices and ecological knowledge with contemporary scientific knowledge and management practice. Compliance is promoted by strengthening local and traditional leadership, enforcement, and dispute resolution systems. SILMMA NGO and government members are engaged in dialogue to develop legal reforms to support co-management, including measures to increase mutual accountability between provincial and community levels. Current draft legislation would, for example, decentralize authority to provincial government agencies and formally recognize community management plans in provincial ordinances, as well as provide new formal avenues for local representation and participation in the governance of near-shore fisheries and marine resources (Govan et al. 2011).

Despite such efforts by SILMMA network members to facilitate representation of community interests in higher levels of governance, significant obstacles remain to enhance stakeholder representation and downward accountability. Community groups

are often very reliant on financial, technical and logistical support received via their international or national NGO partners for management activities, and for engagement in the SILMMA network. Without appropriate mechanisms to ensure autonomy, community interests may be subordinated to partner, donor and government agendas, particularly where community representatives lack confidence to voice their concerns. Community representatives in the SILMMA network are selected at the local level, generally from a local resource management committee. This selection may be arbitrary (for example, where people in positions of power become representatives by default), and as a result, representatives may not be answerable to all sectors of the community. In particular, women's representation on local committees, and their formal role in decision-making processes, is often lacking.

While the SILMMA network has had some success in bridging fisheries and environment sectors, engagement with other sectors such as health, agriculture and education has been minimal to date. Therefore, improving sector-spanning representation in decision-making fora and horizontal accountability among sectoral institutions remain serious challenges. Bridging organizations like SILMMA have a role to play in dialogue to highlight, for example, how improvements in health and education services to remote communities can contribute to improvements in capacity for resource management, or how international trade policies affect domestic food security and potential for climate change adaptation. Playing such a role effectively, however, requires significant organizational capacity to bring together the sometimes competing agendas of different donors, initiatives, agencies and local communities. It also requires communication channels to introduce local perspectives in regional and global debates that will directly influence the livelihoods of coastal communities in Solomon Islands.

4. LESSONS AND CHALLENGES

These four case studies represent a diverse set of AAS in riverine wetland, seasonal floodplain, lakeshore, and marine environments. They illustrate a range of governance challenges, from local to international scales, and a spectrum of

socio-political contexts. Yet, the cases also share some common characteristics that provide a basis for comparison. Each case demonstrates important linkages between local livelihoods dependent on aquatic resources and broader ecological, economic, and institutional trends. They illustrate increasing competition over environmental resources, and suggest the importance of improvements in stakeholder representation, distribution of authority, and mechanisms of accountability to address this competition equitably, in ways that support resilient livelihoods. In this section we discuss these three dimensions of governance in turn.

Strengthening stakeholder representation

Strengthening representation of groups typically marginalized from decision-making is critical, considering the complexity of livelihood systems and the diversity of stakeholders involved in AAS. In the Bangladesh case, coalitions of community-based organizations played a key role in helping to lobby government for community access to seasonal waterbodies, and the Bangladesh Environmental Lawyers Association provided legal and administrative support. More recently, some 250 community-based organizations in the floodplain have established a federation, known as the Society for Water Resources Management, which continues to advocate for community tenure and management rights, along with improvements in the distribution of benefits derived from these waterbodies (Sultana and Thompson 2009, Thompson et al. 2010). The example of village-led research networks in Cambodia's Stung Treng wetlands illustrates an earlier stage of supporting community capacity to articulate local interests. Downstream in Cambodia's Tonle Sap Lake, where civil society groups are more densely represented, efforts to strengthen a national network of grassroots fisherfolk and increase their capacity to collaborate and negotiate with government authorities have recently helped to secure a formal transfer of access rights to fishing communities and to resolve access disputes spanning provincial boundaries (Ratner et al. 2011). Follow-on efforts are now addressing competing uses of water and seasonal crop agriculture in the flooded forest zone, and assessing management options that balance interests in conservation and economic development.

Bridging organizations (Berkes 2002) that sustain representation of poor resource users in development decision-making and that help mediate interests across sectors and geographic scales are especially important. In the Solomon Islands example, a key challenge is increasing the influence of local resource users in national and regional policy formulation. The SILMMA network aids in this goal by providing a channel for information from communities, including community co-management experiences, to be considered in national and international policy arenas. The network also facilitates forums for dialogue with national government agencies and international NGOs, and provides logistical and financial support to enable community members to participate (Cohen et al. in press). In recent interviews of SILMMA members, two thirds of respondents felt that information provided by their organizations had already influenced national or regional policies concerning local marine area management. Mandates of SILMMA member organizations vary, however, between conservation of biodiversity or fisheries management for livelihood and food security, and longer or shorter planning horizons. While network heterogeneity is a valuable characteristic for responding to change and uncertainty (Folke et al. 2005), in practice these differences also present challenges to network-wide information exchange, learning and collective action (Cohen et al., in press). It is a sign of progress that network members are grappling with these challenges, in contrast to a case like Lake Chilwa, where organizations to mediate transboundary management issues remain absent. In the case of Cambodia, there is an intergovernmental institution in place to mediate transboundary riverbasin management, the Mekong River Commission. Yet its very makeup means that local stakeholders such as riverside villagers in Stung Treng rely primarily on national government to represent their interests on matters such as construction of mainstream dams upriver in Laos. This illustrates the need for cross-scale interactions that empower local user groups rather than extend control by central government or large-scale economic actors (Adger et al. 2005).

Redistributing authority

Measures that redistribute rights to access, manage, and retain benefits from AAS are especially important in areas where marginalized groups have seen those rights eroded in the face of

increased competition. In Bangladesh, for example, community-based fish culture has enabled improvements in income and nutrition for the landless poor and women-headed households, two groups largely excluded from participation in the prior system that enabled capture of resource rights by local elites (Barman et al. 2010). In Stung Treng, Cambodia, village members of the Salaphoum research network face increasing pressure to balance longer-term conservation demands with improvements in access rights for local users to meet more immediate food production needs. Navigating these tensions is essential, as livelihood security and respect for basic human rights should be understood as a precondition for participation in longer-term resource management efforts (Allison et al. 2012).

In some instances, clarifying tenure arrangements for resource management can undermine cooperation between groups or act as a catalyst for conflict within communities. This has been documented in Solomons Islands, for example, following establishment of management areas or conservation zones (McDougall 2005). The objectives of customary and state resource management institutions also may not be aligned, and these differences can present difficulties in forming hybrid institutions for coastal management (Foale et al. 2011). Traditional systems may also be inequitable and lack effective mechanisms of downward and horizontal accountability, as research in inland AAS in Sub-Saharan Africa has shown (Béné et al. 2009).

In building capacity to resolve disputes over tenure and resource management authority, it is often useful to support parallel institutions. Comparative research on co-management institutions in Malawi, for example, suggests that where formal, local representative management institutions collaborate with the traditional chiefs, fisherfolk are able to access multiple avenues of recourse in clarifying resource claims and resolving disputes (Russell & Dobson 2011). In the Pacific, many initiatives to establish marine protected areas have ignored or sidelined local tenure and dispute resolution systems, while the most successful efforts have instead acknowledged the legitimacy of these local institutions, strengthening their capacity in areas such as monitoring and enforcement (Ferse et al. 2010).

Building accountability of decision-makers

Robust mechanisms of accountability are especially important at times when rights to access, use, and derive benefits from natural resources are being re-allocated or negotiated. In the case of floodplain waterbodies in Bangladesh, as community-based organizations became more active in advocating for community rights, and more effective in communicating with local government, they were able to avert elite capture in many locales. Similarly, in Cambodia a recent wave of mobilization in response to tensions between large-scale and small-scale users of fisheries and agricultural land in the Tonle Sap floodplain culminated in a three-year suspension of commercial fishing concessions. As national authorities launch a period of review and analysis of future management options, continued engagement by civil society groups, close monitoring by the media, and independent research are important mechanisms to promote public understanding and deliberation over the likely consequences of various policy options (Ratner 2011).

Even where traditional management systems may be absent, informal mechanisms of accountability are typically critical alongside more formal mechanisms. In each of the four cases summarized in this paper, the courts are inadequate to handle the number and range of disputes at play among competing users of land, fisheries, water, and wetlands. Even assuming expanded capacity, however, courts represent a costly and inappropriate mechanism to settle many disputes, which often hinge more on establishing effective dialogue and negotiation than on interpreting existing law. In the Lake Chilwa case, for example, support for participatory monitoring and analysis of fisheries production trends at the lake scale is influencing local stakeholders' understanding of policy and management options, bringing new voices into the policy debate, and increasing public scrutiny of management decisions. In the Cambodia case, decentralization reforms have provided an opening for local communities to take part in resource management planning alongside provincial and local authorities. Yet, injecting concerns over food security and livelihoods in broader development policy decision-making such as plans for hydropower dams remains exceptionally difficult, despite increasing evidence of the risks (Ziv et al. 2012). Such challenges accentuate the need for independent

research and media, and civil society engagement to draw attention to the linkages between sectors such as energy, fisheries, and agriculture, between human rights and the environment, and between gender equity and economic development. This is essential to hold decision makers accountable for the exercise of their authority, moving beyond the “rhetoric of participation” (Evans et al. 2011) and expanding demand for good governance more generally (Carothers and de Gramont 2011).

5. CONCLUSION

In many aquatic agricultural systems, local resource users are witnessing increased competition from multiple stakeholders at local to national and regional scales over rights to access and use natural resources—land, water, wetlands, and fisheries—essential to rural livelihoods. A key implication is the need to strengthen governance to enable equitable decision-making amidst such competition. The simple analytical framework developed in this paper aims to facilitate action research to diagnose obstacles and opportunities for improving governance in developing-country AAS. It can also aid comparison of the governance context for development of AAS, within and across countries.

The cases presented here illustrate the sorts of questions that researchers and local actors can explore using the concepts of representation, authority, and accountability, and the practical insights this yields. In these cases, we have used fisheries and aquaculture as an entry point, but livestock production, agricultural cropping systems, water management, biodiversity conservation, or more integrated approaches in coastal or inland systems are equally suitable entry points. Whatever focus one chooses at the outset, governance analysis encourages analysts to explore linkages in the form of stakeholder interests, power relations, and institutional relationships that span sectors and scales. In this respect, governance analysis can complement analysis of ecosystem linkages, and indeed the two should go hand in hand. By identifying critical obstacles and opportunities that build on an understanding of the full social-ecological system, researchers and development practitioners can better support efforts to strengthen livelihood resilience.

This overview also highlights important gaps and priorities for the future. Integrated approaches to agricultural production systems are rare, and have been largely absent from aquatic systems. In consequence, researchers lack systematic analyses of governance across multiple cases with a multidimensional view of food and livelihood systems. We need improved tools and better evidence to assess the role of gender equity in governance of AAS, as gender relations often strongly influence all three dimensions of governance yet are frequently under-appreciated. This should reveal, for example, how improvements in women’s representation and decision-making authority affect the leadership capacity and accountability of community-based organizations, government agencies, and NGOs. We need more refined tools to assess private sector roles in governance, addressing challenges such as how to manage risks and opportunities from commercial investment in AAS, and how to secure more benefits for poor households.

There is also an overarching need for better monitoring and evaluation of governance change in aquatic agricultural systems to trace the contributions towards livelihood improvements such as household income and child nutrition. These efforts should measure reductions in vulnerability through improvements, for example, in women’s rights or the participation of indigenous minorities in policy decision-making. As a part of participatory action research initiatives, local actors can monitor and assess change in such outcomes in parallel with community-based monitoring of ecosystem status, and identify priorities for future action to influence institutional and governance reforms. The framework can also be applied in assessments that aim to identify opportunities for investment in governance strengthening. When such assessments involve local stakeholders in ways that influence future programming priorities of official aid agencies, NGOs, and other development partners, this can help improve downward accountability of aid agencies to the communities they aim to serve (Blagescu et al. 2005).

When used for cross-country comparative analyses, assessments of institutional change in aquatic agricultural systems can improve understanding of the links between governance attributes, capacities for managing resilience and transformation, and ultimate outcomes in terms of equity, resources sustainability, and reduction in multiple dimensions of poverty. Such comparative analysis is critical in order to test and refine hypotheses about the causal pathways posited by Lebel et al. (2006), probing, for example, how different arrangements of distribution of authority and accountability influence the capacity to manage cross-scale dynamics. Most urgently, it can provide lessons about how development initiatives addressing natural resource management and livelihoods can empower local actors to work towards governance improvements in challenging developing-country environments.

Finally, greater awareness of the limitations of short-term top down solutions to the dynamic and unpredictable challenges faced by farmers and other rural resource users is highlighting the central importance of building the capacity of these communities to adapt in the face of future change. Improved governance, and improved capacity of communities to shape their governance, are key elements of this more effective development environment. Development investments to support improved resource governance, and research to inform this, will be critically important elements of efforts to reduce poverty and improve food security in aquatic agricultural systems.

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LITERATURE CITED

- Adger, W. N., K. Brown, and E. L. Tompkins. 2005. The political economy of cross-scale networks in resource co-management. *Ecology and Society* 10(2):9. [online] URL: <http://www.ecologyandsociety.org/vol10/iss2/art9/>
- Agrawal, A. and Ribot, J. 1999. Accountability in decentralization: a framework with South Asian and West African cases. *Journal of Developing Areas* 33(4):473-502.
- Allison, E. H., C. Béné, and N. L. Andrew. 2011. Poverty reduction as a means to enhance resilience in small-scale fisheries. Pages 216-237 in R. Pomeroy and N. L. Andrew, editors. *Managing small scale fisheries: frameworks and approaches*. CABI, UK.
- Allison, E. H., B. D. Ratner, B. Åsgård, R. Willmann, R. Pomeroy, and J. Kurien. 2012. Rights-based fisheries governance: from fishing rights to human rights. *Fish and Fisheries* 13(1):14-29.
- Andrew, N., C. Béne, S. J. Hall, E. H. Allison, S. Heck, and B. D. Ratner. 2007. Diagnosis and management of small-scale fisheries in developing countries. *Fish and Fisheries* 8:227-240.
- Armitage, D. 2008. Governance of the commons in a multi-level world. *International Journal of the Commons* 2(1):7-32. <http://www.thecommonsjournal.org/index.php/ijc/article/view/28/16>
- Barman B. K., N. Sheriff, F. Rahman, and M. Haque. 2010. *Community-based fish culture in seasonal floodplains in Bangladesh: lessons learnt*. Paper presented in the ISDA Conference held at Montpellier, France.
- Barman, B. K., F. Rahman, and M. Haque. 2011. *Community-based fish culture approach in Bangladesh*. Paper presented in the IFWF3 Conference held on 14-18 November 2011, South Africa.
- Bell J. D., M. Kronen, A. Vunisea, W. J. Nash, G. Keeble, D. Demmke, A. Pontifex, and S. Andrefouet. 2009. Planning the use of fish for food security in the Pacific. *Marine Policy* 33:64-76.
- Béné, C., E. Belal, M. O. Baba, S. Ovie, A. Raji, I. Malasha, F. Njaya, M. Na Andi, A. Russell, and A. Neiland. 2009. Power, struggle, dispute and alliance over local resources: analyzing democratic decentralization of natural resources through the lens of Africa inland fisheries. *World Development* 37:1935-1950.
- Berkes, F. 2002. Cross-scale institutional linkages: perspectives from the bottom up. Pages 293-322 in E. Ostrom, T. Dietz, N. Dolšak, P. C. Stern, S. Stonich and E. U. Weber, editors. *The drama of the commons*. National Academy Press, Washington, D.C. USA.
- Berkes, F. 2006. From community-based resource management to complex systems. *Ecology and Society* 11(1): 45. [online] URL: <http://www.ecologyandsociety.org/vol11/iss1/art45/>
- Blagescu, M., L. de Las Casas, R. Lloyd. 2005. *Pathways to Accountability: a short guide to the GAP framework*. One World Trust, London, UK.
- Carothers, T. and D. de Gramont. 2011. *Aiding governance in developing countries: progress and uncertainties*. Carnegie Endowment for International Peace, Washington, D.C., USA.
- Cohen, P., L. Evans, and M. Mills. Social networks supporting governance of coastal ecosystems in Solomon Islands. *Conservation Letters*, in press.
- Collis, W. J., S. Parvin, B. K. Barman, and T. Paul. 2011. *Scaling out enhanced floodplain productivity by poor communities – aquaculture and fisheries in Bangladesh and eastern India*. Paper presented in the IFWF3 Conference held on 14-18 November 2011, South Africa.
- Coral Triangle Initiative. (2009) *Regional plan of action, Coral Triangle Initiative on coral reefs, fisheries and food security* (CTI-CFF), Coral Triangle Initiative, Manado. [online] URL: <http://www.worldwildlife.org/what/wherework/coraltriangle/WWFBinaryitem12638.pdf>
- Dey, M. M. and M. Prein. 2006. Community-based fish culture in seasonal floodplains. *NAGA* 29 (1 & 2): 21-27. [online] URL: http://www.worldfishcenter.org/resource_centre/community.pdf
- Dietz, T., E. Ostrom, and P. C. Stern. 2003. The Struggle to Govern the Commons. *Science* 302 (5652): 1907-1912.
- Evans, L. S., K. Brown, and E. H. Allison. 2011. Factors influencing adaptive marine governance in a developing country context: a case study of southern Kenya. *Ecology and Society* 16(2):21. [online] URL: <http://www.ecologyandsociety.org/vol16/iss2/art21/>
- Ferse, S. C., M. M. Costa, K. S. Máñez, D. S. Adhuri, and M. Glaser. 2010. Allies, not aliens: increasing the role of local communities in marine protected area implementation. *Environmental Conservation* 37(1):23-34.

- Foale, S., P. Cohen, S. Januchowski-Hartley, A. Wenger, and M. Macintyre. 2011. Tenure and taboos: origins and implications for fisheries in the Pacific. *Fish and Fisheries* 12:357-369.
- Foale, S. J., and M. Macintyre. 2000. Dynamic and flexible aspects of property tenure at West Nggela, Solomon Islands: implications for marine resource management. *Oceania* 71:30-45.
- Folke, C., T. Hahn, P. Olsson, and J. Norberg. 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* 30: 441-473.
- FRSS, 2007. *Fisheries resource survey system report*. Department of Fisheries, Government of Bangladesh, Matshya Bhaban, Dhaka, Bangladesh.
- Govan, H. 2009. Achieving the potential of locally managed marine areas in the South Pacific. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin* 25:16-25.
- Govan, H., A. M. Schwarz, and D. Boso. 2011. *Towards integrated island management: lessons from Lau, Malaita, for the implementation of a national approach to resource management in Solomon Islands*. WorldFish Center Report to SPREP, Honiara. [online] URL: http://www.worldfishcenter.org/resource_centre/WF_2898.pdf
- Government of Malawi (2000). *Lake Chilwa State of Environment Report*, Environmental Affairs Department, Ministry of Natural Resources and Environmental Affairs, Malawi.
- Halpern, G., K. Mam, and M. Dubois. 2010. *The Salaphoum process in Stung Treng and Kratie: an impact assessment*. WorldFish Center, Phnom Penh, Cambodia.
- Haque, A.B.M.M., Barman, B. K. and M.M. Dey. 2008. Institutional Issues on management of seasonal floodplains under community-based aquaculture to benefit the poor in Bangladesh: Volume II. Pages 250-253 in *Proceedings of the CGIAR Challenge Program on Water and Food 2nd International Forum on Water and Food*, 10-14 November 2008, Addis Ababa, Ethiopia.
- Joffre, O. and N. Sheriff. 2011. Conditions for collective action: understanding factors supporting and constraining community-based fish culture in Bangladesh, Cambodia and Vietnam. *WorldFish Center Studies and Reviews* 2011-21. The WorldFish Center, Penang, Malaysia. [online] URL: http://www.worldfishcenter.org/resource_centre/WF_2816.pdf
- Kayambazinthu, D. 1999. Synthesis of Institutional Arrangements for Local-Level Management of Natural Resources: the case of Chimaliro. Pages 30-42 in *Community-Based Management of Miombo Woodlands in Malawi*. Forest Research Institute of Malawi, Proceedings of a National Workshop, Mangochi, Malawi.
- Kooiman, J., M. Bavinck, R. Chuenpagdee, R. Mahon, and R. Pullin. 2008. Interactive governance and governability: an introduction. *Journal of Transdisciplinary Environmental Science* 7(1): 1-17. [online] URL: http://www.journal-tes.dk/vol_7_no_1/no_2_Jan.pdf
- Lebel, L., J. M. Anderies, B. Campbell, C. Folke, S. Hatfield-Dodds, T.P. Hughes, and J. Wilson. 2006. Governance and the capacity to manage resilience in regional social-ecological systems. *Ecology and Society* 11(1):19. [online] URL: <http://www.ecologyandsociety.org/vol11/iss1/art19/>
- Mam, K. 2009. Fisheries sector policy, legal, and institutional framework in Cambodia: is there a place for strengthening decentralization? In *CBNRM Learning Institute. Emerging trends, challenges and innovations for CBNRM in Cambodia* (2nded). CBNRM Learning Institute, Phnom Penh, Cambodia. [online] URL: http://www.boell-cambodia.org/downloads/CBNRM_full_document.pdf
- McCay, B. J., and J. M. Acheson. 1987. *The question of the commons: the culture and ecology of communal resources*. University of Arizona Press, Tucson, USA.
- McDougall, D. 2005. The unintended consequences of clarification: development, disputing, and the dynamics of community in Ranongga, Solomon Islands. *Ethnohistory* 52(1): 81-109.
- National Statistics Office (NSO). 2008. *Malawi population and housing census*. National Statistical Office, Zomba, Malawi.
- Njaya, F. 2007. Governance challenges for the implementation of fisheries co-management: experiences from Malawi. *International Journal of the Commons* 1(1):137-153.
- Njaya, F. J. 2009. Governance of Lake Chilwa common pool resources: evolution and conflicts'. *Development Southern Africa*, 26:4, 663-676.
- Njaya, F., K.A. Snyder, D. Jamu, J. Wilson, C. Howard-Williams, E.H. Allison, and N.L. Andrew. 2011. The natural history and fisheries ecology of Lake Chilwa, southern Malawi. *Journal of Great Lakes Research* 37(1): 15-25.

- Oakerson, R. J. 1992. Analyzing the commons: a framework. Pages 41-62 in D. W. Bromley, editor. *Making the Commons Work*. ICS Press, San Francisco, USA.
- Ostrom, E. 1990. *Governing the commons*. Cambridge University Press, Cambridge, UK.
- Ostrom, E. 2005. *Understanding institutional diversity*. Princeton University Press, Princeton, USA.
- Ostrom, E. 2009. A general framework for analyzing sustainability of social-ecological systems. *Science* 325:419-422.
- Ratner, B.D., R. Meinzen-Dick, E. Haglund, and C. May. 2010. Resource conflict, collective action, and resilience: An analytical framework. *Collective Action and Property Rights Working Paper Series*. Washington, DC: International Food Policy Research Institute.
- Ratner, B. D., G. Halpern, and K. Mam. 2011. Catalyzing collective action to address natural resource conflict: Lessons from Cambodia's Tonle Sap Lake', *Collective Action and Property Rights Working Paper Series*. No. 103. International Food Policy Research Institute, Washington, D.C., USA.
- Ratner, B. D. 2011. Common-pool resources, livelihoods, and resilience: critical challenges for governance in Cambodia. *IFPRI Discussion Paper Series* no. 1149. Washington, DC: International Food Policy Research Institute, Washington D.C., USA.
- Ratner, B. D., and E. H. Allison. 2012. Wealth, rights, and resilience: An agenda for governance reform in small-scale fisheries. *Development Policy Review*, in press.
- RGC 2010. *National program for sub-national democratic development (NP-SNDD)2010-2019*. Phnom Penh, Cambodia.
- Ribot, J. C. 2002. *Democratic decentralization of natural resources: institutionalizing popular participation*. World Resources Institute, Washington, D.C., USA.
- Ruddle, K. 1988. Social principles underlying traditional inshore fishery management systems in the Pacific Basin. *Marine Resource Economics* 5:351-363.
- Russell, A. J.M., and T. Dobson. 2011. Chiefs as critical partners for decentralized governance of fisheries: an analysis of co-management case studies in Malawi. *Society & Natural Resources* 24(7):734-750.
- Salaphoum. 2009. *Learning from Experiences: reflection on the Salaphoum-villager led research process*. A documentation by Salaphoum Researchers, Research Assistants, CEPA and produced by villagers through a collaborative writing process and facilitated by The WorldFish Center, Phnom Penh, Cambodia.
- Sultana, P. and P. Thompson. 2009. *Scaling up integrated floodplain management through adaptive learning networks*. Paper presented at Innovation Asia-Pacific Symposium, 4-7 May 2009, Kathmandu, Nepal.
- Thompson, P., P. Sultana, and R. Arthur. 2010. Integrating biological conservation into management: community adaptive learning in the wetlands of Bangladesh. *Biodiversity* 11(1 & 2):21-30.
- Thorburn, C. C. 2000. Changing customary marine resource management practice and institutions: the case of Sasi Lola in the Kei Islands, Indonesia. *World Development* 28:1461-1479.
- Toufique, K. A., and R. Gregory. 2008. Common waters and private lands: distributional impacts of floodplain aquaculture in Bangladesh. *Food Policy* 33:587-594.
- Walker, B., J. Sayer, N. L. Andrew, and B. Campbell. 2010. Should enhanced resilience be an objective of natural resource management research for developing countries? *Crop Science* 50: 10-19.
- Wilson, J. A. 2006. Matching social and ecological systems in complex ocean fisheries. *Ecology and Society* 11(1):9. [online] URL: <http://www.ecologyandsociety.org/vol11/iss1/art9/>
- WorldFish Center. 2011. *CGIAR Research Program: Aquatic Agricultural Systems*. Program Brief. WorldFish Center, Penang, Malaysia. [online] URL: http://www.worldfishcenter.org/resource_centre/WF_2934.pdf
- Ziv, G., E. Baran, So Nam, I. Rodríguez-Iturbe, and S. A. Levin. 2012. Trading-off fish biodiversity, food security, and hydropower in the Mekong River Basin. *Proceedings of the National Academy of Sciences*.



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