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Foreword

Fisheries and Aquaculture Department, Food and Agriculture Organization of the United Nations

The Food and Agriculture Organization of the United Nations (FAO) has a long tradition of promoting responsible fisheries throughout the world; 2015 marked the 20th anniversary of the FAO Code of Conduct for Responsible Fisheries. The code is a landmark of international cooperation and agreed set of guidelines and principles to help develop, manage, and conserve the world's fishery resources for the benefit of present and future generations. However, more is needed, especially for the world's inland fishery resources and the habitats that support them. The FAO and our global partners are facing numerous challenges in regards to inland aquatic ecosystems and their fishery resources.

Probably the most significant challenge is the competition for freshwater resources. Currently, about 9% of the freshwater from rivers, lakes, and groundwater is withdrawn for human use. Seventy percent of this water is abstracted or diverted for agriculture, industry takes another 20%, and domestic uses account for another 10%. These withdrawals have significantly degraded the aquatic habitat and fishery resources. However, agriculture is a key player in global efforts to reduce hunger and poverty. Fisheries and agriculture need to become closer partners. Fisheries are often called a "nonconsumptive" use of water. This is not exactly true. If you manage a river for fish, you may lose or reduce the use of that water for hydroelectricity or irrigation. The fishery sector needs to communicate win–win situations where people can have fish and irrigated agriculture and electricity. Happily, there are examples, and these need to be communicated more broadly.

Dealing with the multiple users of freshwater is essentially a governance issue. However, international and national efforts to fully integrate inland fisheries into the broader governance and development agenda have not been overly successful. Important publications and processes have given much more attention to domestic uses of water, to marine and coastal issues, or to agriculture production over inland fishery production. The FAO and partners are now striving to help bring all food producing sectors together in a synergistic manner.

A necessary component to support governance is adequate information. More than half of the catch from inland waters is not reported to species—we do not know how much and we do not know what is being captured. The FAO has a special strategy for improving information on status and trends of capture fisheries to increase the knowledge base.

However, inland fisheries are more than metric tons harvested; what this harvest contributes to nutrition and livelihoods is the important factor. Fish provide significant and affordable protein, minerals, and micronutrients to millions of people in developing areas. A small, freshwater fish from the Mekong River about the size of an index finger can provide a child's daily requirement of iron and zinc; similar small indigenous species of fish are a valuable component of people's diet and culture around the world.

The health of our planet, our own health, and future food security depend on how we treat aquatic ecosystems. To provide wider ecosystem stewardship and improved governance of the sector, FAO is advancing the Blue Growth Initiative as a coherent framework for the sustainable and socioeconomic management of our aquatic resources. Although there is a strong framework for fisheries and aquaculture already in place with the FAO Code of Conduct for Responsible Fisheries, the challenge is to provide incentives and adequate resources to adapt and implement this framework at local, national, and regional levels in order to secure political commitment and governance reform.

The proceedings and recommendation of the global conference, Freshwater, Fish and the Future, will contribute substantially to this global initiative and the core work of FAO and other United Nations agencies. The partnership between FAO and Michigan State University, formalized at the conference, will help to further promote the principles of responsible fisheries and blue growth. The Fisheries and Aquaculture Department of FAO is pleased to be a partner in this endeavor and offer the information in this book to those charged with developing, managing, and conserving the world's inland fishery resources.

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Foreword

Michigan State University

Inland fisheries have long been a quiet but vital component of food and economic security around the world. Yet the voices of those most dependent on inland fisheries often are drowned out by louder, more powerful interests competing for aquatic resources for use in agriculture, energy, and economic development.

We believe that inland fisheries and aquaculture have a great capacity not just to sustain poor and disadvantaged communities around the world, but to elevate them. That is why I was pleased to be in Rome in 2015 to help open the global conference on inland fisheries. This conference brought together experts from various sectors from more than 40 nations, including a large number of early career scientists and women (40% female speakers), because the challenges facing inland fisheries require new cross-sectoral approaches and the involvement of all stakeholders in freshwater resources.

We need to elevate the profile of inland fisheries and aquaculture in global discussions on food and economic security and on sustainable land development and water management. Based upon the thought-provoking presentations and discussions at the Rome conference, a set of recommendations—10 steps to responsible inland fisheries—were developed that we hope will provide the foundation for a new international approach to ensuring that the true value of inland fisheries is recognized in resource allocation decisions.

Back home in Michigan, we are acutely aware of the fragility of freshwater fisheries. Our waters have suffered greatly from pollution, overfishing, and the introduction of invasive species. Our experience in restoring the Great Lakes across boundaries and borders provides a great example of the power of international partnerships and cooperation.

Beyond the conference, Michigan State University (MSU) and the Food and Agriculture Organization of the United Nations (FAO) are strengthening our relationship through joint studies linking societal well-being and food security to the quality and quantity of freshwater habitats and local fish populations. On behalf of FAO and MSU, Árni Mathiesen and I signed a memorandum of understanding to collaborate on inland fisheries educational programs. This includes resource mobilization, capacity building and training, new faculty, internships, fellowships, visiting scholars, and sharing and disseminating information while advocating for our common goals.

Inland fisheries represent an important component of a growing, global blue growth economy. This conference proceedings serves as a roadmap demonstrating how to assess the world's inland fisheries and freshwater resources and how to optimize and protect them.

Lou Anna K. Simon, Ph.D.
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Fisheries Governance in the 21st Century: Barriers and Opportunities in South American Large Rivers

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Abstract.—South American large-river fisheries are experiencing a growing pressure due to mining activity, construction of dams, water diversion, dredging, commercial overfishing, pollution, floodplain deterioration, agriculture, and development. Despite the fact that artisanal fisheries represent a valuable resource for many riverine communities and play a critical role in assuring food security and poverty alleviation, managers are challenged to develop sound governance processes that ensure the sustainability of resources and fishing communities. The lack of effective governance processes in artisanal fluvial fisheries is rooted in several social, economic, institutional, and ecological/environmental constraints. Most large-river fisheries are managed under a conventional approach, applying centralized government control policies that minimize stakeholders' participation in management decision making. River-fisheries governance is dependent on institutions, policies, and economic and political scenarios that are outside the fishery sector. Market demands and construction of dams and river fragmentation, mining, pollution, cattle agriculture, deforestation, and recreational fishing pressure are all factors that have the potential to alter fisheries sustainability. Governance mechanisms in South American large rivers can be developed at three levels but need to prioritize economic growth, food security, employment, equitable access to resources, and poverty alleviation and promote and integrate the sustainable use of fluvial resources through stakeholders´ involvement in decision-making processes. To achieve such goals, new institutional and legal arrangements should be promoted envisioning small-scale fisheries as ecosystem services and implementing an ecosystem-based approach that integrates ecological and human components to support better governance processes.

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Introduction

Management of South American large-river fisheries is challenging for managers due to increasing fishing pressure, construction and operation of dams, water diversion, dredging, pollution, floodplain deterioration, and agricultural and cattle development (Barletta et al. 2010). River fisheries play a critical role in the livelihoods of artisanal fishing communities by providing food security, nutrition, employment, and poverty alleviation (Berkes et al. 2001; Béné et al. 2007). The number of people employed in the inland fishery sector has increased during the past 50–60 years (Welcomme 2011). In the Amazon basin, for instance, around 100,000 fishers produce gross revenues of about US$200 million (Almeida et al. 2001, 2003), contributing 33% of the local economy (Almeida et al. 2004). However, despite the importance of river fisheries in South America (Carolsfeld et al. 2003; Barletta et al. 2016), conflicts and related resolving mechanisms have not received proper attention.

Basic governance theory and practice have grown and received increasing attention during the past decades (Gray 2005; Kooiman et al. 2005, 2008; Bavinck et al. 2013), but these have been barely applied to South American river fisheries. Although fishery agreements and comanagement initiatives have been successfully implemented in several areas of the Amazon basin (Almeida et al. 2000, 2001), governance and its application to address fishers´ demands and interests and fish conservation still remain poorly developed for most of South American large rivers.

This study reviews some of the main issues faced by artisanal fisheries in South American large rivers, highlighting those factors that hinder the ability to enable more effective governance processes and also discussing the needs and opportunities for governance improvements.

Main Factors Affecting Fisheries Governance in South American Fluvial Systems

Large-river fisheries of South America are all small-scale and considered multifaceted socio-ecological systems (Berkes et al. 2001). They involve diverse full- and part-time fishers, middlemen, transporters, local markets and processors, retailers, and management agencies. All these sectors are connected through variable spatial and temporal relationships that are modified according to fishing trends regulated in turn by the hydrological regime. South American fisheries are almost all based on open-access management policies and mostly supported by lateral and long-distance migratory species.

The Amazon basin is by far South America's most developed fishery in terms of harvest and target-species diversity (Ruffino 2004; Barletta et al. 2016). These fisheries provide well-being and mobilize local market economies, representing a valuable resource for many riverine communities (Bartley et al. 2016) and also for rural people inhabiting surrounding forest landscapes (Coomes et al. 2010). Riverine fishers often use economic strategies that combine fishing with farming and cattle ranching, particularly in those large rivers with alternating dry and wet phases.

River fisheries governance depends on institutions, policies, economic and political scenarios, and patterns of decision making that often are outside the fishery sector (Jentoft 2007; Mahon et al. 2008). Such problems exhibit the difficulties to put in practice effective governance process at local, regional, and basin scales. Lack of effective governance processes in artisanal fluvial fisheries is rooted in several barriers such as deficient or null statistical information, fisheries managed and enforced only at stock levels, and lack of policy responses despite signs of overfishing in several basins (Bayley and Petrere 1989; Tello and Bayley 2001; Agostinho et al. 2007; Galvis and Mojica 2007; Rodríguez et al. 2007; Baigún et al. 2013). Also, increasing recreational fisheries in the major developed areas of the upper Paraguay, the Orinoco, the San Francisco and the Paraná rivers has led to stakeholder conflicts that impact artisanal fisheries (Carolsfeld et al. 2003; Freire et al. 2016). This conflict is worsened when migratory fish species need to be managed under different legal frameworks across basins (Valbo-Jørgensen et al. 2008).

There is an institutional mismatch between the size of the fisheries and the capacity for surveillance, enforcement, and acquisition of harvest data, coupled with the absence of adequate management plans. The high dispersion of fisheries and open-access characteristics in most basins represents a major obstacle for assessment and regulations enforcement, particularly when the regulations are neither agreed nor accepted by fishers. Centralized government control policies with limited stakeholder's engagement (Barletta et al. 2010) have limited fishers´ participation, which is only an instructive or consultative relationship according to the continuum proposed by Sen and Nielsen (1996). Fishers´ participation and their knowledge have been historically rejected or ignored (Baigún 2015), even denying fishers the legitimate right to participate in management decisions. This problem has been exacerbated in those fisheries mostly exploited by indigenous people. Also, most fisheries exhibit outdated or incomplete legal frameworks focused on only fisheries issues. The main socioeconomic barriers relate to the underestimation of recreational fisheries impacts, weak inclusion of fishers in formal economic circuits, poverty and social marginalization of fishers, and poor economic profits and inequality in marketing chains. As inland fisheries lack economic visibility and remain poorly valuated, their local relevance has not been properly addressed (Benetti and Thorpe 2008). At the ecological and environmental level, landscape and waterscape degradation mainly produced by deforestation, construction of dams, and agriculture are all factors having the potential to alter fisheries sustainability and therefore to promote governance conflicts.

What Governance Should Mean in South American Large-River Systems

Governance priorities in large rivers should address the body of rules, traditions, norms, social networks, and regulations that allow key stakeholder involvement, participation, and interaction in the decision-making and implementation process. Ultimately, fisheries governance needs to assure economic growth, food security, employment, equitable access to resources, and poverty alleviation and to promote and integrate the sustainable use of fluvial resources and fishery resilience mechanisms.

According to Kooiman et al. (2005), governance could be envisioned as three interactive level processes that can be well identified and adapted to large-river fisheries. First-order governance relates to solving daily local conflicts and societal problems, which in fluvial systems involve making decisions about fishing areas, fishing satisfaction, conflicts between recreational and artisanal fishers, landing sites, market chains, and access and rules enforcement. Second-level governance corresponds to institutions and organizations that provide the framework within which first-order governance takes place by framing norms, laws, and agreements; solving problems; and creating opportunities. In South American large rivers, this level is often filled by government offices or institutions that lack the required expertise and are not well suited to accomplish this task. Moreover, fishers´ organizations are scarce and poorly developed. The third order or metagovernance is about the constitutive values, norms, and principles upon which governing activities and institutions are founded. Metagovernance reflects norms, ideas, and principles to improve governance at the first- and second-order levels and can also promote new directions and goals. At this level, fisheries governors need to make explicit their ideas and initiatives for discussion and evaluation and decide how, in practical terms, the ideas should inform collective decision-making and managing practices (Bavinck et al. 2005). This level is usually weak in fluvial fisheries, particularly when top-down conventional management is, in practice, lacking strong stakeholders' involvement and public. All these governance orders, however, should integrate a multiple-scale perspective. At the local scale, for instance, fishery systems are shaped by internal components and external stressors, but as the spatial scale increases, a broader array of actors, institutions, and stressors acting along the basin influence and increase governance complexity.

Good governance examples, however, are found in the Amazon basin where fishing agreements nested in comanagement were installed to limit commercial exploitation and to protect subsistence-oriented local fishers (Almeida et al. 2001, 2009; Silvano et al. 2009). As a result, overfishing trends were reduced, fish yields were increased, and stakeholder conflicts were minimized. Active fishers´ participation helped in recovering the iconic Paiche (also known as Arapaima) *Arapaima gigas* fishery (Castello et al. 2009). In the upper basin in Peru, territorial use rights for fisheries (TURFs), coupled with comanagement and community-based management, were successfully applied to protect main target species and, ultimately, local fishers' livelihoods (Anderson et al. 2009). Such cases demonstrate the critical relevance of strengthened local capacities based on incorporating traditional ecological knowledge, promoting rights of access to the resources, and protecting critical habitats for fish life cycles. Improvement of control and surveillance provided fishers with a general awareness of ecological and resource management concepts under a comanagement regime (Castello et al. 2009; A. Oliveira and L. Cunha, paper presented at the 8th biennial conference of the International Association for the Study of Common Property, 2000).

The Need for Adopting an Ecosystem-Based Governance Perspective

As large-river fisheries are strongly embedded within a watershed, including man-made and natural processes, governance should be visualized at multiple dimensions and scales, considering ecosystem and social factors as main interacting drivers. Preserving ecosystem health in large rivers emerges as one of the most critical outcomes of the governance processes for supporting long-term livelihoods and welfare conditions and maintaining the capacity to cope with external stressors from outside the fishery sector (Pasqual-Fernandez and Chuenpagdee 2013). In this context, the three-level governance systems should retain the ecological integrity of fluvial systems as the main basis for providing goods and services for a diverse spectrum of stakeholders and riverine communities. In the Amazon and the Orinoco basins, for example, interactions between people and the natural environmental vary spatially and temporally, usually involving complex governance processes (McGrath et al. 2008), and agriculture plays an important role during the dry season. Expansion of agriculture, however, could affect the forests as critical habitats for many valuable fish during the flooding season (McGrath et al. 2008). In the Magdalena River, floodplains occupation by ranchers have reduced fishing areas (Junk 2007), whereas in the lower Parana River, inner lagoons that are important rearing and fishing habitats have been isolated and converted to agriculture and cattle areas (Baigún et al. 2008).

River fragmentation by dams is probably the most pervasive factor that disrupts fluvial ecological integrity and affects fluvial fisheries. In the upper Parana basin, reservoir formation has reduced fish yield and decreased stocks of large migratory species having high commercial and sporting value, thus impacting fishers´ socioeconomic conditions (Agostinho et al. 2003; Hoeinghaus et al. 2009). Similar patterns were noted in the San Francisco River (Sato and Godinho 2003). The loss of ecosystem health in fluvial systems could have direct impact on rural fisheries where fishing strongly contributes to food security. The deterioration of human, natural, financial, social, and human capital as part of livelihood assets could compromise the resilience of communities to cope with severe or irreversible impacts. The above examples point out the need to balance cost and benefits for different stakeholders in large rivers, integrating man-made infrastructure with fishers' needs, demands, and rights as part of main governance outcomes.

Ecosystem-based governance in fluvial systems should be strongly related to the application of an ecosystem-based approach for fisheries management (EAF). The EAF recognizes the human component as one of the main pillars for governance (De Young et al. 2008), giving stakeholders´ participation a central role. An ecosystem approach oriented

to fisheries thus provides a powerful framework to assess and recognize main gaps and limitations in solving social, economic, fishery, environmental, and institutional problems that shape fishery governance. In addition, it requires and promotes the interaction across different sectors that use and could impact water resources. Unfortunately, the EAF concept is still poorly developed in South American large rivers and is not being yet considered by management agencies as a desirable goal to achieve better governance (Barletta et al. 2016).

Conclusions and Future Directions

Installing better governance processes in South American large rivers is challenging managers and other main stakeholders. Suitable governance practices in South American rivers have not yet been underpinned by the application of strong social, economic, institutional, and environmental criteria and practices. Poor governance results can be attributed to visible problems associated with increasing basin fragmentation, pollution, and overfishing, but social, economic, and institutional problems have remained less detectable or even not well perceived by government and other stakeholders. The importance of the social dimension for small-scale fisheries governance cannot be emphasized enough (Arthur et al. 2016). Most tropical small-scale fishers are comprised of poor and marginalized people (Pauly 1997), and in several South American basins, large populations suffer from inadequate nutrition and exclusion of their lands and lack the most basic health services, social rights, and education (Chapman 2008). Exclusion of the people that depend on fisheries from political decisions weakens the governance process (Friend 2009) and reduces collective efforts to participate in sustainable resource management (Ratner and Allison 2012). Management approaches that are centrally controlled with little or no stakeholder involvement still remain a main obstacle to improving the governance processes by reducing the possibility of sharing responsibilities and decisions with management agencies. This is due to their inability to cope with the complexity of fluvial fisheries, which are driven by environmental features, the interaction with fishing activity, and the lack of support from the people dependent on the fishery.

Accelerated development of artisanal fisheries in South American rivers, increasing man-made impacts, and climate change all could impact rivers' ecological integrity and necessitate improving governance conditions in river fisheries. Moving to an ecosystem-based perspective to promote better governance processes, however, will require a long effort in recognizing different stakeholders' visions and problems as the basis to start discussing actions and potential solutions for new governance paradigms (Chuenpagdee and Jentoft 2013). Several general measures inherent to small-scale fisheries can be applied to reduce governance barriers in South American floodplain river fisheries (Table 1). For example, envisioning fluvial fisheries as providing highly valuable ecosystem services and not as commodities and understanding their irreplaceable social benefits represent a seminal concept to improve fisheries governance and maintain feedbacks between fisheries, ecosystem productivity, and aquatic biodiversity (Beard et al. 2011). In turn, comanagement concepts and participative management policies need to be considered as a critical part for improving an ecosystem-based governance approach. However, rural fisher communities still have difficulties in self-organization and achieving collective actions, which are strong limitations to their participation in governance processes (Béné 2008). In this context, management agencies need to stimulate consensus, collective action, and recognition of fishers´ rights and demands. Clearly, new institutional and legal arrangements involving experts in planning, adaptive management, and social skills are needed to foster not only stakeholder participation in policy making, but also addressing learning, inclusiveness, and partnership as part of new interactive management agendas (Bavinck et al. 2005). Recognition of users´ tenure and rights-based approaches and co-

Table 1.—General measures for improving fisheries governance in South American large rivers.

Dimension	Measures
Fishery/ management	Develop reliable fishery information systems to aquire basic data. Identify indicators of fishery sustainability and related reference point system based on scientific and fishers' ecological knowledge. Develop and apply a community-based approach expanding benefits at social and environmental levels. Develop management agreements for common regulations, research, and monitoring programs for main target species in transboundary basins. Develop an ecosystem approach to fisheries management to promote fishery, environmental and social sustainability. Envision large-river fisheries as a long-term valuable ecosystem service strongly dependent on fluvial ecological integrity.
Social/ economic	Aquisition of informatimon oriented to capture social and economic trends. Develop appropriate mechanisms for partnership, empowerment, and inclusion of stakeholders in management plans. Work with governmental and nongovernmental institutions to improve social and economic conditions and recognition of fishers' rights. Develop and promote fishers´ organizations to achieve better and fairer trade conditions.
Institutional	Promote capacity building and training and reinforce management agencies. Promote stakeholders' participation, consultation, and comanagement practices for the formulation and implementation of fisheries management plans. Develop participative and adaptive management plans integrating the needs, interests, and demands of a broad spectrum of stakeholders related to fisheries sustainability. Promote a sound revision and update of legal frameworks stimulating the inclusion of norms associated to an ecosystem-based approach. Develop appropriate management policies to account for different fishing activities of the most highly vulnerable fishers groups.
Ecological/ environmental	Integrate fisheries in multipurpose land and water use management and raise awareness about fluvial ecological processes and factors that govern fish production and biodiversity conservation. Develop research programs oriented to identify and preserves critical migratory corridors, spawning and rearing habitats that require specific management, and conservation measures. Preserve functional processes based on flood high-low water pulses and related to floodplains and channels connectivity as key factors to support fisheries sustainability.

management and empowerment of the poor and more vulnerable stakeholders will also play a critical role in promoting new governance scenarios (Franz et al. 2016). How new institutional, legal, and socioeconomic frameworks can be accommodated to shape better processes based on considering environmental and social sustainability will be main goals and challenges for future scenarios in large South American river basins.

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