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Community-Based Conservation of Freshwater Resources: Learning from a Critical Review of the Literature and Case Studies

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ABSTRACT

Freshwater resources (FWRs) are under enormous stress due to human activities and climate change. Given the centrality of local communities in managing natural resources, community-based conservation (CBC) for FWRs (fCBC) offers a mechanism for addressing these challenges. A framework informing fCBC that incorporates unique features of FWRs (such as being fugitive resources, having increased risk of negative externalities, and sheer spatial coverage) is needed to unlock CBC's potential in achieving environmental and developmental impacts in freshwater contexts. We critically review and synthesize existing research adapting The Nature Conservancy's Voice, Choice and Action framework, organized around four pillars (Secure rights and fair externality consideration; Strong community capacity; Effective multi-stakeholder platforms; Sustainable livelihood and development opportunities) and two cross-cutting elements (Cultural connections; Equity and power balancing), and provide recommendations on ways to strengthen facilitation and support community empowerment in fCBC. We report on how applying the framework during a conservation planning process for fCBC projects in four geographies provides important insights for developing robust CBC programs.

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KEYWORDS

Community-based conservation; culture; equity; freshwater resources; multi-stakeholder platforms; rights

HIGHLIGHTS

- The unique features of freshwater resources require additional considerations as compared to terrestrial resources. Elevating thinking about how these unique features can exacerbate threats helps motivate more diverse ideas on holistic strategies for community-based conservation.
- The Voice, Choice and Action framework has been adapted to the freshwater resource context in this study, drawing on a critical literature review.
- The adapted framework provides a useful framework for conducting strategy selection processes and situation and stakeholder analyses to ensure that projects pay attention to creating critical

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enabling conditions for robust community-based conservation for freshwater resources capable of preserving cultural connections, achieving equity and water justice, and resolving power imbalance.

Introduction

Freshwater resources (FWRs), such as rivers, lakes, wetlands, and associated resources, including fish and aquatic plants, are under enormous stress from climate change, population growth, and infrastructure development (UNESCO and UN-Water 2020). Given the centrality of local communities in managing natural resources, community-based conservation (CBC) offers a mechanism for addressing these challenges (Berkes 2007; Mahajan et al. 2021). Trends toward government devolution of rights to communities further support CBC programming (Erbaugh et al. 2020; Garnett et al. 2018). But what are the conditions under which CBC can contribute to sustainable FWR management?

CBC for freshwater resources (*f*CBC) refers to the protection or conservation of freshwater species or ecosystems by local communities who depend on them for livelihood and development opportunities. Although there is extensive research including several frameworks examining the factors contributing to robust CBC programs (e.g., Agrawal and Gibson 1999; Berkus 2007; Mahajan et al. 2021), attention has largely focused on terrestrial resources, such as forests. Moreover, FWRs have unique characteristics that need to be considered when guiding the sustainable management and governance of these critical resources.

Water is essential to all life, and adequate access to clean drinking water and sanitation is recognized by the United Nations as a human right (Resolution 64/292). Yet FWRs tend to be fugitive resources with highly variable quality and quantity, making them challenging to monitor and measure, and creating information asymmetries among users (Meinzen-Dick and Pradhan 2002). FWRs can face higher extractive pressures because often multiple users draw on the same resources, and when the resource is “invisible” as in the case of groundwater, it takes longer to detect depletion than land-based resources. Unlike forests, the mobility of FWRs often means that consequences of extraction are felt by someone other than the beneficiaries of extraction. The heterogeneity of users and uses increases risks of negative externalities, with upstream users potentially reducing the quality and quantity of FWRs downstream, affecting humans, animals, land, and the environment (Meinzen-Dick and Nkonya 2007). The extensive spatial scale of freshwater systems (e.g., international rivers) means that there are often mismatches between the hydrologic and social or political governance boundaries, increasing the cost of developing and enforcing rules among communities, jurisdictions, and other stakeholders. Challenges are compounded by diverse cultural preferences and power differences among users, underscoring the equity implications of FWR management.

Environmental and water justice are fundamental for FWR conservation and equity, and the CBC approach is firmly grounded in water justice, with widespread community

actions and efforts taking place globally to address injustice issues that they often face (Martinez-Alier et al. 2016; American Rivers 2020). Vulnerable communities often bear the burdens of water-related inequities and injustice including lack of access and poor quality (American Rivers 2020). It is argued that water justice will only be achieved through enabling inclusive, community-based, water management. This includes recognizing Indigenous water rights through legislation, empowering Indigenous communities and listening to their perspectives, recognizing and including communities in (state) water governance, and strengthening their capacity to self-govern water resources (Grafton et al. 2022).

A framework for designing robust *f*CBC programs must incorporate these unique challenges to unlock the considerable potential of CBC in achieving long-term impacts for the environment and development in freshwater contexts. We fill this gap by critically reviewing and synthesizing existing research on both key design elements of *f*CBC programs and ways for practitioners to strengthen their support of the empowerment of communities in *f*CBC, using and adapting The Nature Conservancy's (TNC) Voice, Choice and Action (VCA) framework (TNC 2017).

Further, we report on an application of insights drawn from our review to a conservation planning process for *f*CBC projects conducted in four contexts, highlighting how conservation plans were strengthened through its application.

Methods

We conduct a critical review (Grant and Booth 2009) of the literature on FWRs to identify key factors for robust *f*CBC. Several conceptual frameworks relate explicitly to the connections between natural resources and governance systems (Grafton et al. 2019), including Integrated Water Resources Management (GWP 2000), Institutional Analysis and Development (Ostrom 1990), Socio-Ecological Systems (Ostrom 2007), and TNC's VCA frameworks (TNC 2017). Each framework provides important insights; however, we organized our review around the VCA framework. "Voice, Choice, and Action" is a vision for Indigenous Peoples and Local Communities (IPLC) to shape and manage their waters and lands in ways that improve lives and drive conservation (TNC 2017). A stronger **voice** leads to the inclusion of traditional knowledge, identity, local priorities, and values in plans and solutions; the ability to exercise and influence **choice** builds leadership and engagement in decision-making; and greater **action** provides the opportunity for communities to initiate and participate in the implementation of programs and the management of resources that impact their well-being both now and in the future (Table S1 in Supplemental Material). Developed through extensive literature review and evidence from TNC projects,¹ the VCA framework, comprised of four pillars as the enabling conditions necessary to achieve the vision, is well-grounded in CBC practices, with clear implications for actions by practitioners and links to theoretical elements from the other frameworks.

Like other critical reviews, we employ a conceptual framework to identify relevant literature, and we conduct a critical assessment to generate insights and hypotheses for further study (Grant and Booth 2009). Note that critical reviews are expert assessments that identify primary themes, often utilizing a conceptual framework to guide reviews,

conducting backward and forward reference exploration, as well as a purposeful sampling of the literature. Critical reviews do not rely on comprehensive or a systematic search of the literature, and as a result differ from systematic reviews, evidence maps, and meta-analyses. Instead, they are more similar to scoping reviews, overviews, rapid reviews, and umbrella reviews (Grant and Booth 2009). The critical review approach is well-suited for our study because of its holistic approach in bringing perspectives from multiple disciplines judiciously together to assess whether the adapted VCA pillars actually capture elements important for CBC of FWRs. For recent systematic reviews assessing the quality and distribution of evidence on CBC and its potential efficacy within freshwater contexts see Fariss et al. (2023) and Karres et al. (2022).

We employ an adapted VCA framework to structure our review. We do so because FWRs differ in distinct ways from terrestrial resources, and as a result require accounting for the unique biophysical, cultural, and governance features of FWRs, such as the mobility of FWRs, which makes it more difficult to monitor FWRs' quantity and quality compared to most terrestrial resources. Importantly, our hypothesis is that these unique features have implications for how *f*CBC should be designed, especially related to rights to FWRs and the scale of governance. Our adapted framework refines the VCA framework to the FWRs by refining the four pillars (Figure 1): Secure rights and fair external-ity consideration, Strong community capacity, Effective multi-stakeholder platforms,



Figure 1. Adapted VCA framework for community-based conservation for freshwater resources (Source: Authors, adapted from TNC (2017)).

and Sustainable livelihood and development opportunities. The two cross-cutting elements are Cultural connections and Equity and power, for a total of six themes.

While this study focuses on FWR management, it recognizes the interdependence of land and water systems. For example, freshwater ecosystems are often impacted by upstream land-use effluent. Adapting the terrestrial resources-focused VCA framework² to be inclusive of *f*CBC considerations demonstrates the robustness of the VCA framework. Throughout the discussion, we highlight the implications of distinctions between terrestrial and freshwater resources and the associated unique challenges for *f*CBC.

We complement the review by reporting on the application of lessons from the adapted VCA framework and critical review to TNC's conservation planning process for *f*CBC projects in Ecuador, Gabon, Angola, and Tanzania. These conservation plans were developed between 2019 and 2021 and utilized TNC's Conservation by Design (CbD) 2.0 guidance (TNC 2016) which was developed for all types of TNC conservation projects (Masuda et al. 2018). CbD 2.0 emphasizes a five-phase method, employing processes such as situation and stakeholder analyses, articulation of results chains and theories of change, identification of candidate strategies and explicit goals, and monitoring and evaluating plans for conservation and human well-being goals. Authors AA and YJM worked with in-country conservation practitioners in applying the adapted framework to conservation planning processes.

Toward Robust CBC for FWRs: Adapting the VCA Framework

Secure Rights and Fair Externality Consideration

The first pillar of the framework focuses on resource rights, which are defined as individual or collective claims to use or control natural resources and may derive from multiple sources—not only statutory law, but also customary and religious law (legal pluralism); however, state-backed rights are often argued to be superior to customary rights (Molle 2004). It focuses on securing these rights by local communities and the degree of confidence that their claims are respected by others depends on community capacity (see below).

Much of the added complexity of FWR rights compared to land rights is driven by FWR variability, mobility, vulnerability to exogenous factors such as climate and other communities' actions, and sheer spatial scale (Meinzen-Dick and Pradhan 2002). Establishing rights to FWRs is not straightforward because of their dynamic and mobile characteristics. Their high costs of monitoring and enforcing can challenge communities' capacity to defend FWR rights and regulate use in ways that are consistent with community values regarding cultural connections with FWRs and equity among users.

The formalization process itself can undermine its potential benefits or even create conflict, particularly when statutory rights are inconsistent with customary or religious principles that consider water as a basic or human right (Meinzen-Dick and Nkonya 2007; ElDidi and Corbera 2017). Particularly for small-scale water users, the costs and challenges of registering formal water rights are often prohibitive (Van Koppen and Schreiner 2018).

In the multi-use, multi-user context of FWRs, rather than starting from the assumption of a formal water rights system, especially one akin to land “ownership,” it is more

useful to begin with the perspective from the ground, wherein multiple people may claim different and overlapping “bundles of rights” (i.e., access, withdrawal, management, exclusion, and alienation rights) (Schlager and Ostrom 1992), and a multiplicity of bases for their claims. This allows recognition of multiple property right regimes and the political and economic power relations that constantly influence them (Meinzen-Dick and Pradhan 2002). The relative strength of different legal authorities can change with geography and distance from urban centers (Meinzen-Dick and Nkonya 2007) and over time (Sikor and Lund 2009). For example, irrigation systems in the Ecuadorian Andes often operate under customary law, and outside of or against state law (Boelens and Doornbos 2001). All of these factors can affect the security of rights, and hence incentives for natural resource management.

For *f*CBC, it is necessary to consider not only rights to FWRs, but also associated land needed to access the FWRs or physical capital such as irrigation infrastructure (Hodgson 2004). When people have difficulties in accessing land, water can be difficult to reach even if water rights have been accorded (Meinzen-Dick and Nkonya 2007).

Holding Rights Is Not Enough

Ribot and Peluso (2003) definition of access emphasizes the **ability**, as opposed to just the **right**, to benefit from things. For example, many rivers or aquifers are over-allocated, meaning water rights that have been given out exceed the water available, especially in drought years. Similarly, water may be available but of poor quality, unsuitable for the intended use. Three components of tenure security are especially important for practitioners to consider: (1) completeness (whether the various rights are held by one water user group or distributed among different stakeholders), (2) robustness (whether rights and responsibilities are known by the holders, accepted by other water user groups, and enforceable in the face of challenges at reasonable costs), and (3) duration (whether the rights are long term to allow capturing the benefits of conservation; whether they change by season or between regular and drought years) (adapted from Place, Roth, and Hazell 1994).

Externality Considerations

Rights come with responsibilities for how resources are used. Most water users not only withdraw water and other FWRs, but also return used water, thus affecting other users, especially downstream. Both withdrawals and return flows can impose costs and benefits—externalities—on others. The externalities that water users impose on each other, in terms of changes in the quantity and quality of water, combined with the vital nature of reliable and clean water, means that equity concerns are inherent in FWRs.

Many local communities have strong norms of sustainable resource use as well as cooperation and reciprocity that promote cultural connections with FWRs and social cohesion among users (ElDidi and Corbera 2017; Molle 2004). In such communities, internalized values and community monitoring and enforcement help reduce externalities. But many FWR users do not consider the costs and benefits to others, and high monitoring costs make it difficult to enforce rules to protect others, especially over large areas.

Externalities are inherently linked to how rights and responsibilities are defined and enforced, and therefore how costs and benefits are allocated across actors, over varying temporal and spatial scales. As hard as it is to define rights to the varying quantities of water, defining rights to water quality is even harder because of the lack of low-cost indicators of pollution and limited or asymmetric user understanding of pollution dynamics (Schlager 2005). Therefore, both state and local institutions are needed for sustainable management of FWRs; institutions must go hand-in-hand with technological improvements that lower the costs of monitoring.

Effective Multi-Stakeholder Platforms

Multi-stakeholder platforms (MSPs) are formal or informal roundtables or forums that bring together different stakeholders in resource management to discuss and agree on actions for solving problems. As such, they are platforms for conflict resolution, adaptive management, democratization and inclusion (Warner 2006). Compared to terrestrial resources, FWR governance often involves a greater number and diversity of stakeholders because of its essential nature, multiple overlapping claims, and expansive spatial coverage, making inclusive and participatory decision-making platforms even more important and challenging than for many terrestrial CBC programs.

In the case of *f*CBC, the spatial connectivity and spatio-temporal variability of FWRs often confer inherent inequity among stakeholders in MSPs. This includes inequity in levels of vulnerability to negative externalities, such as between upstream and downstream stakeholders, as well as inequity in the power to influence MSP principles and decision-making processes. To strengthen *f*CBC through effective MSPs, it is critical to consider these inequities and power differentials. We highlight two key issues: identifying the time-space scale appropriate for governance, and ensuring inclusive stakeholder membership and participation (Seufert 2017).

Identifying the Time-Space Scale Appropriate for Governance

A key challenge in managing FWRs is the sheer scale of the resources involved, which often transcend local community boundaries. MSPs can vary in scale, from international to local levels (administratively), and from whole basins to smaller ecosystems (ecologically). Establishing the appropriate scale of FWR governance depends on the “problem-shed”—the particular water use or challenge to be addressed (Mollinga, Meinzen-Dick, and Merrey 2007).

Governance of FWRs at the watershed scale can help conserve larger ecological landscapes but achieving collective action at that scale is challenging because macro-watersheds are often not at the scale under which social organizations operate (Kerr 2007). Attributes for successful FWR governance, including having well-defined boundaries, ability to trace benefits, accountability, and monitoring, are difficult to achieve at the macro-scale, including large transboundary rivers (*ibid.*). One solution is to work at multiple, connected scales (Robinson et al. 2017) by nesting village-level micro-watershed platforms into larger-scale macro-watershed management platforms to bridge sectoral and institutional boundaries. This would allow local communities to operate at their scale of social organization, embedded in district- or other, higher-level MSPs

(Kerr 2007). State recognition and support of various MSPs is key in this case to ensure that governance decisions of one MSP feed into the higher-scale ones.

MSPs for FWRs formed at the river basin or wider catchment scale will likely link a wider spectrum of issues relevant to the basin, such as land use, fisheries, or navigation. Given the inseparability of freshwater and terrestrial systems in many landscapes, MSPs formed for FWR governance will almost certainly need to deal with multiple resources, such as forest patches and agricultural lands, as well as with urban centers. Cross-sectoral and inter-stakeholder collaboration and planning through MSPs are important for identifying and addressing tradeoffs in landscape objectives (Hart et al. 2016). Supporting communities to develop the capacity to effectively engage in MSPs is essential as discussed below.

Ensuring Inclusive Membership and Participation

MSPs must be inclusive, both with regards to who is involved and how they are engaged, or risk being ineffectual. For example, an MSP responsible for managing surface FWRs may need to include groundwater users because surface and groundwater are connected. MSPs must consider power differentials among stakeholders (including within communities) related to authority, ethnicity, caste, status, wealth, or simply the spatial distribution of FWRs (such as those upstream having greater *de facto* influence on the resources than those downstream). Power differentials can dampen participation of all groups and are an acute challenge with FWRs (Kusters et al. 2017). In India, upper caste elites can take over decision-making in water management, slowing down the formation of inclusive watershed groups due to the upholding of caste impurity norms, even when the value of collaboration is clear to all (Mudliar and Koontz, 2018).

Combining rules requiring equitable and inclusive representation (enabled by secure rights to FWRs discussed above) with efforts to build the capacity of weaker groups (see below) can help reduce power inequities and ensure meaningful participation in MSPs (Faysse 2006). Inclusive representation can be facilitated through appropriate decision-making rules, which can be based on majority agreements, consensus, or different types of voting, as well as rotational leadership. The formulation of such rules is not always driven from within; external actors that are seen as legitimate by all stakeholders can play a constructive facilitation role. d'Armengol et al. (2018) reviewed 91 cases of co-managed fisheries and found that government support of MSPs is not a defining factor of success; other actors, such as NGOs, can also facilitate formation of MSPs and developing procedures. Importantly, a community or region's history of cooperation and outcomes of previous stakeholder dialogues can affect outcomes and willingness to participate in future MSPs (Faysse 2006).

Strong Community Capacity

Community capacity here is the capacity of a community to govern and manage FWRs to which it holds rights, advocate for their own interests and needs, build "counter-power" for accountability in the MSPs through which those rights are continually renegotiated and reinforced, and pursue opportunities for economic development. Community capacity is shaped by levels of community resources, including natural

(e.g., land, freshwater bodies), physical (e.g., technology and infrastructure), financial (e.g., savings), human (e.g., skills, leadership), social (e.g., social cohesion, pro-social norms, trust), political (e.g., power), and institutional capital (e.g., organizations, rules and processes). The Brooks, Waylen, and Mulder (2013) systematic review of CBC projects concluded that capacity building in local communities was a significant predictor of project success. Not only are certain skills necessary for maintaining projects, but community capacity may also help combat elite capture (Baland and Abraham 2002), create opportunities for communities to engage in CBC planning processes, and exercise agency in decision-making (Salerno et al. 2021). Community capacity can lower transaction costs associated with developing and enforcing local rules about resources use and strengthen the ability of community members to coordinate and cooperate (Pretty 2003).

For FWRs, particularly those that cross political and other boundaries and involve multiple user groups, strong community capacity is vital for interaction with stakeholders outside the community (e.g., a factory upstream or government directives) via MSP or co-governance arrangements with government bodies.

Strong local institutions represent a key ingredient for successful governance of shared natural resources, such as groundwater and fisheries (Smith et al. 2017), but do not always emerge. In some cases, strengthening communities' institutional capacity for improved FWR management is needed, but external support for this has been limited (Falk, Kumar, and Srigiri 2019). Moreover, local institutions for resource governance are more likely to be effective if they are internally driven and incorporate traditional governance systems (Vollan 2008). Recent advancements in experiential learning on groundwater governance and common water infrastructure management show promise in improving the understanding of socio-hydrological systems and associated coordination challenges, catalyzing open discussions among FWR users, and facilitating the development of institutions (Falk, Kumar, and Srigiri 2019; Meinzen-Dick et al. 2018).

Because of the complexity of FWRs and the need for solutions to emerge from within communities, capacity building for *f*CBC should support community leadership and the preservation and interweaving of Indigenous knowledge. Recent evidence shows voluntary local leaders play an important role in initiating self-governance institutions because such leaders can directly affect local users' perceived costs and benefits associated with self-rule (Andersson, Chang, and Molina-Garzón 2020). For instance, in the Tanzanian Mkindo catchment, village leadership increased connections among multiple stakeholders, which helped to mitigate and solve FWR disputes (Stein, Ernstson, and Barron 2011).

While it has been well-recognized that interweaving different types of knowledge among stakeholders can help to effectively manage FWRs, outside stakeholders often have biases toward certain types of knowledge (such as legal, scientific, and technical knowledge) (Nguyen and Ross 2017). Indigenous knowledge on water flows can complement technical knowledge of hydrology in designing FWR infrastructure (e.g., dams and irrigation canals), and traditional knowledge keepers are often the only experts on Indigenous spiritual and cultural values of FWRs (Baker et al. 2015). In South Australia, for example, Indigenous knowledge of the Ngarrindjeri communities about the Murray River flows and the river's deep cultural and spiritual significance contributed to

improving the river's health and general management (Hemming et al. 2017). Local communities often have a strong interest in learning about, and benefiting from, western scientific approaches in water management as a complement to their existing traditional knowledge (Nguyen and Ross 2017; Hemming et al. 2017). Yet, capacity building support should go beyond training on technical and legislative issues to also address key barriers to interweaving Indigenous knowledge into FWR management, such as difficulty translating Indigenous concepts outside of the original language and place, and biases by some actors against other ways of knowing.

Sustainable Livelihood and Development Opportunities

The success of *f*CBC hinges on viable and managed use of FWRs that sustains well-being and development. Integrated conservation-and-development approaches like CBC-supporting programs are often motivated by dual objectives to benefit both nature and people. Because FWRs are essential for economic and material well-being and non-material aspects such as health, spiritual values, and cultural connection, a holistic perspective is required to systematically assess possible tradeoffs and synergies between FWR uses. Small-scale irrigation in Sub-Saharan Africa, for example, can boost agricultural productivity by 50%, representing a key opportunity for addressing food insecurity and poverty (Xie et al. 2014). Yet, irrigation schemes can harbor mosquitos, contributing to malaria transmission. Integrated cross-sectoral approaches illuminate tradeoffs and support their mitigation, such as improving access to healthcare and bed nets among communities near irrigation structures (Ijumba and Lindsay 2001). Given FWRs' fugitive nature, their variable quantity and quality, and multiple demands from diverse users, these tradeoffs can be especially challenging.

To ensure *f*CBC initiatives deliver sustainable livelihood and development opportunities, it is useful to consider three types of incentives for sustainable FWR management: regulatory, market-based, and normative.

Regulatory incentives are usually issued by government entities, requiring or prohibiting actions and specifying fines or punishment for breaking rules. For example, energy policies involving hydropower dams can impact regional hydrology and freshwater ecosystem services (Schmitt et al. 2019). Communities can enact bylaws within their own governance systems to regulate the availability and safety of FWRs for their members, such as bylaws passed by communities in the Bhajani municipality, Nepal, prohibiting water contamination and fishing using poisonous chemicals and electric-shock tactics (Land Portal 2018).

Market-based incentives can support *f*CBC through income-generating sustainable FWR uses (e.g., fishing, irrigated agriculture), or by providing alternative livelihood options like eco-tourism to reduce pressure on FWRs. Communities can also be financially rewarded for conservation practices that lead to improved freshwater ecosystem services, notably, Payment for Watershed Services (PWS) by the public or private sectors. Markets for watershed protection services are growing but are still uncommon and minor contributors to income streams of local communities (Salzman et al. 2018). A primary challenge is that PWS programs often require clear rights over the resource, which many communities lack for FWRs.

Normative incentives, which include pro-social preferences, cultural values and beliefs, identity, and social norms (Figueroa et al. 2016), are increasingly recognized by the scientific and development communities (Samii et al. 2014). The literature shows that normative incentives are essential to the durability and scalability of PWS programs, as sustained participation of upstream participants hinges on communities feeling that their ways of life and values are respected (Farley and Bremer 2017). In Mexico's National Programme for Hydrological Environmental Services, local residents cited appreciation of cultural and environmental values as reasons for participating, despite lack of significant economic benefits (Arriagada et al. 2018). Relational values—defined as preferences, principles, and virtues associated with meaningful, reciprocal, and just human–nature relationships (Chan et al. 2016)—can motivate “upstream” participation in PWS (Bremer et al. 2018) and influence participants' perceived outcomes of PWS programs (Farley and Bremer 2017).

The diversity of stakeholders involved in FWRs means that a diversity of incentive types is likely to be at play in *f*CBC; these should be harmonized, or at least not undermine one another, such as economic incentives crowding out intrinsic incentives (Smith et al. 2017).

Cross-Cutting Elements

Two cross-cutting elements are strategically important for robust *f*CBC: Cultural connections and Equity and power balancing.

Cultural Connections

Culture is a set of shared knowledge, values and beliefs, and conventions (e.g., norms, rules, and rights) that define expectations of behavior within a collective. Strong cultural connections to FWRs provide normative incentives for sustainable FWR management (Ekblom et al. 2019; Figueroa et al. 2016).

Because of the links between water and life, many cultures imbue FWRs with sacred meanings. Religious and cultural rules may affect water rights, duties, and governance. Long histories of FWR use have generated deep cultural repertoires that need to be understood and respected by *f*CBC.

Increasingly, CBC scholars and practitioners advocate preserving cultural services as one of the most compelling reasons for conservation (Satterfield et al. 2013). Conservation initiatives need to connect cultural diversity with biological diversity by incorporating diverse livelihood needs and cultural values into conservation objectives (Robson and Berkes 2010).

Equity and Power Balancing

Power is the ability to affect change against opposition and is derived from capital (natural, physical, financial, human, cultural, social, or political). Equity includes procedural equity (equity of capacity to participate in decision-making, production and marketing processes) and distributional equity (equity of outcomes, such as food and freshwater security). Equity of participation in FWR governance processes is important for shaping

governance outcomes (d'Armengol et al. 2018). Because FWRs often span vast spatial scales and involve multiple users that affect the quality and quantity of the resource, challenges around equity and power balancing may be particularly important for designing robust *f*CBC. Further, procedural and distributional equity are greatly linked to water justice. Vulnerable groups often face water injustice including lack of access to their human right to water, exclusion from water governance, and having knowledge withheld from them (Grafton et al. 2022). Inequities, especially procedural inequities, tend to be self-perpetuating, making it difficult to address the underlying causes of distributional and procedural inequity.

The two cross-cutting elements are interrelated. Equity is also culture-, context-, and time-specific. Different cultures find different levels of procedural and distributional inequity acceptable and cultivate different means of remediation. In many Andean countries, for example, distributional inequity of freshwater access is remediated by giving priority to disadvantaged sectors of water users to ensure at least a subsistence level of access by the majority (Roa-García 2014).

Although high levels of cultural connection to FWRs can contribute to strong FWR governance capacity, this may not necessarily result in equitable distribution of costs and benefits of engaging in *f*CBC, particularly if cultural values and beliefs are not supportive of equity, such as prohibiting low castes from participation because of concerns of ritual pollution (Mudiar and Koontz 2018).

An Application to *f*CBC Projects

Together with the local practitioner team, we (AA and YJM) applied the above framework during the planning of *f*CBC projects in four geographies: Andean Amazon (Ecuador), Bas-Ogooué (Gabon), Upper Okavango basin (Angola), and Lake Tanganyika (Tanzania). The cases were selected with a consideration of project status (with regard to the timing of the planning process) and geographic diversity. Each project site also differs along key contextual variables, such as freshwater types (e.g., lakes, wetlands, rivers) and socioeconomic factors (Table 1). The application focused on identifying opportunities and tackling challenges identified in the adapted framework to support the empowerment of communities in sustainable FWR management. Here, we report on how applying the adapted framework, which elevated considerations needed due to features of FWRs, led to more robust design of *f*CBC projects. Insights from the adapted framework were especially helpful for situation analysis, stakeholder analysis, and strategy selection processes (TNC 2016). Detailed characterization of the geographies through the lens of the adapted themes is presented in Table S2 in Supplemental Material.

Rights to land and FWRs are highly variable, although all sites have some laws and policies in place to support CBC. While land rights face some degree of uncertainty, rights over FWRs are more complex, and legal plurality in some countries led to significant confusion of jurisdiction and user priorities. The adapted framework elevated careful consideration of assessing rights to land and FWRs separately during the situation analysis phase, which led to deeper analysis of the sources of insecurity of rights that ultimately informed strategy selection. A common concern was that even if

Table 1. Characteristics of project sites in Ecuador and Colombia, Gabon, Angola, and Tanzania.

Relevant countries	Andean Amazon		Bas-Ogooué	Upper Okavango Basin		Lake Tanganyika
	Ecuador, Colombia	Gabon		Angola, Namibia, Botswana		Tanzania, Zambia, Burundi, Democratic Republic of the Congo
Focal country ^a	Ecuador	Gabon		Angola		Tanzania
Freshwater context	Napo watershed in the Andean Amazon. The landscape is characterized by wetlands, floodplains, and free-flowing rivers in montane and foothill settings which then transition to the Amazon plain.	Flat alluvial plain of the Ogooué River. The landscape is a network of tributary channels that flow through a delta to the Atlantic Ocean. At high water the channels inundate a large matrix of flooded forests and herbaceous wetlands.	<ul style="list-style-type: none"> • Sparsely populated, with rural villages consisting of a few permanent households that are concentrated along roads. • Influx of temporary migrants from urban areas during the summer. To engage in fishing and other activities. • Mixed ethnic group composition in the region. 	<ul style="list-style-type: none"> • Human settlements heavily influenced by colonialism and Angola's 27-year civil war. • Postwar in-migration resulting in agricultural expansion and development, but region faces land mine contamination that hinders access to lands and waters. • High rates of fertility, infant and child mortality, and in-migration. • Several ethnic groups, although the majority are Nguanguela. • Rely on FWRs for drinking water, fish. 	<ul style="list-style-type: none"> • The Greater Mahale Ecosystem is home to approximately 160,000 people in 44 villages. Rely heavily on fish stocks and rainfed agriculture for food security. • Limited access to markets via lakes and roads, but roads become impassable during the rainy season. • Food insecurity is a challenge in communities. 	Large, deep rift valley lake. Second largest lake by volume in the world, containing 17% of the planet's surface freshwater.
Socioeconomic context	<ul style="list-style-type: none"> • >20 indigenous groups, along with residents with mixed descent. • 35% of area is indigenous lands, 21% protected areas • Rely on fish, rivers for transport, and for drinking water 	<ul style="list-style-type: none"> • • • 				

^aCountries that are the focus of project efforts. ^bInformation on the pillars and cross-cutting elements at each project site is presented in Table S1.

communities have rights to FWRs, FWRs are frequently over-allocated across multiple users without regard to the implication on availability and quality across temporal and spatial scales. In Ecuador's Andean Amazon, where Indigenous communities have formally recognized lands, freshwater is recognized as a human right, and communities are permitted to use FWRs (e.g., plants, animals, water) for subsistence use without any permits. Any commercial use of FWRs requires authorization from the central government and the community, where the community articulates use plans through a community management plan and the management and governance of FWRs is characterized by legal pluralism. In contrast, in post-conflict Angola, statutory community rights to land and waters lack clarity and customary rights are prevalent. Whether and to what extent customary rights are recognized and enforced by those outside the communities varies. If customary rights remain uncontested by outsiders, then land and water tenure security are likely strong; with migrants and businesses returning to the area, there is a need to clarify these rights. Across all sites, the FWR lens of the adapted framework elevated the importance of clarifying whether communities have customary or legal rights to FWRs, as well as their rights to land to access the FWR. This resulted in local teams developing strategies that assessed threats to the security of rights to both land and FWRs, took into consideration the insecurity in their strategies and identified future work to help communities strengthen their rights. For example, in Ecuador a critical first step was providing access to data and information needed to ensure a broad understanding of their rights so they can take actionable steps for legal recourse when rights are infringed upon by external parties. This was done by converting a complex legal rights analysis to a fact sheet that is shared via cell phone.

During our situation and stakeholder analyses we found that, by and large, the four geographies have MSPs that provide opportunities for community members to voice their preferences about managing FWRs. These MSPs range in scale from the local (e.g., Beach Management Units (BMU) in Tanzania and fishing cooperatives in Gabon and Angola) to the regional (e.g., Coordinator of Indigenous Organizations of the Amazon River Basin (COICA)). These MSPs, with varying geographic scale (e.g., community-level vs. watershed-level) and strength, are often customary institutions that have evolved over time to suit community needs to manage their resources and have resulted in community management plans, such as those in Ecuador and Tanzania (Table S2). But given FWRs are mobile, prone to negative externalities based on other resource users, and challenging to monitor, there is a need to increase community capacity and opportunities to participate in MSPs at all relevant scales. This insight is informing the development of strategies to elevate community voices outside their traditional boundaries. For example, in post-civil war Angola, some communities have institutions that lack consistent and widespread recognition from government of their legitimacy. At a higher geographic scale, the Okavango Reference Group (OKG) spans Namibia, Angola, and Botswana, providing opportunities for government stakeholders and civil society organizations to participate and shape FWR management. Communities currently miss opportunities to participate in the OKG due to limited capacity, and so strategies are being developed to support development of this capacity.

Consistent with the literature, during the situation analysis we found that community capacity and leadership are critical components of effective *f*CBC at all project sites.

Strong within-community leadership is common, but capacity to influence decisions at large, ecologically-relevant scales is limited. As our review shows, this is particularly important because FWRs are highly vulnerable to negative externalities brought on by other actors and institutions (e.g., dam development, unsustainable extractive use by commercial interests) that could over-ride any benefits from sustainable local management of FWRs. Communities and institutions in the Andean Amazon have greater levels of capacity, in part because there is a history of government and civil society support for community participation in FWR management in Ecuador. The availability of resources (e.g., financial, human, social, political, etc.) is a notable difference among sites, which likely influences a community's overall capacity to both manage their own FWRs and influence resource users outside the community.

Considerations around MSPs and community capacity and leadership from the adapted framework led to several actions by the implementation team, in particular focusing on long-term strategies to create systemic change. Compared to terrestrial CBC programs, we found that there is greater need to work with partners who have access to MSPs that operate at larger scales because communities often lack the political capital and capacity to access and exercise their voices in these types of MSPs. Leveraging partners that could introduce or elevate community voices is especially important, such as for communities to meaningfully participate in the transboundary OKG.

During the situation and stakeholder analysis, all four projects identified a need to increase alternative income sources to support the sustainable management of FWRs and to increase community resilience to shocks. There are opportunities for sustainable livelihood and development, such as beekeeping, increasing value of fish products, aquaculture, and agriculture, but technical know-how, access to markets and credit, and access to equipment and other capital are major barriers to widespread adoption. Because of the high risk of negative externalities of FWRs, we found that across sites there is an imperative to identify and create conditions for communities to engage in alternative livelihood activities. Support for alternative livelihoods includes easing access to credit and markets and providing technical assistance and training. In the Bas-Ogooué (Gabon), communities reported that in recent years the tilapia fishery—a primary income source—had been decimated by a virus in the lake system, which led to significant decreases in food security and incomes. Here, alternative livelihoods that do not rely on fish can help households cope with this kind of income shock, yet the factors outlined above (e.g., lack of access to credit) have hindered community members from developing alternative livelihoods to date.

Our conservation planning process focused on assessing gender dimensions of procedural inequity. This focused on women's lack of participation in decision-making within households and natural resource management institutions, due partly to the lack of capacity to engage in decision-making processes but also other marginalizing factors such as gender norms and power relations that discourage women's participation. It also focused on distributional inequity, including women disproportionately bearing the burden of resource decline due to their roles in households and productive activities. This became apparent during stakeholder analysis, which included a step to identify social norms and power dimensions within and outside communities. Across all sites, work and responsibilities around FWR management are gendered, especially for

livelihood activities. For example, at the Lake Tanganyika project, women often engage in processing and selling fish, in addition to their childcare and household responsibilities, leaving them little time to engage in MSPs or pursue leadership opportunities. In contrast, men engage mainly in fishing, with more time for activities outside the home. Men and women also are able to exercise different rights given the patriarchal context. Men often represent households on key decisions around natural resource management even though men and women are all involved in getting fish to market. A key step toward addressing procedural and distributional inequities for women to engage in *f*CBC lies in making gender equality an intrinsic goal in MSP bylaws and challenging or unsettling system attributes, positions and beliefs that perpetuate gender inequalities (Lawless et al. 2022).

For cultural connections, we found during the situation analysis that there were differences in the ways in which communities relate to their lands and waters. Most communities reported strong cultural connections to FWRs, such as in Gabon where initiation rituals hold spiritual and cultural importance and Ecuador where freshwater deities and animals feature prominently in mythologies. In comparison, communities in Angola reported less spiritual or cultural connections, likely due to disruptions from the recent civil war, but still noted the importance of FWRs and some communities have developed customary rules and institutions to manage them. The explicit differentiation between freshwater and terrestrial resources in the adapted framework provided critical insights on how communities relate to the management, use, and relational values of FWRs. This led to some strategies, such as those in Gabon, leaning more heavily on the cultural importance of sustainable management of FWRs compared to more utilitarian uses of FWRs for livelihood and other goals in Angola.

Discussion

To achieve their potential, *f*CBC projects must take into account the physical and social drivers unique to freshwater resources. To better support *f*CBC, our review highlights elements identified in the literature within the six themes from the VCA framework. This is complemented by additional insights from applying the adapted framework to four case studies. Table S1 in Supplemental Material summarizes (1) themes of the VCA framework, (2) adapted themes for *f*CBC, (3) freshwater differences and justification of the adaptation based on literature review, and (4) additional insights from applying the adapted framework to case studies.

Socio-ecological freshwater systems are complex yet intimately connected to many aspects of human well-being. As such, robust *f*CBC requires a systems perspective, assessing and predicting possible cascading effects of intervention options in order to minimize tradeoffs and maximize synergies across scales and sectors. Our review highlights the importance of strengthening elements within each pillar and coordinating activities across pillars so that they are mutually reinforcing. Secure rights and fair externality conditions are closely tied to effective MSPs, sustainable livelihood options, and power among stakeholder groups. Procedural and distributional equity can be important for robust governance systems and outcomes stemming from them. Strong community capacity is needed for communities to effectively participate in MSPs that

involve diverse FWR users across the significant scale of freshwater systems. The four pillars describe critical enabling conditions for the success of *f*CBC; the absence of or substantial weakness in any of them would risk jeopardizing CBC programs. Further, all of the pillars work toward preserving cultural connections, achieving equity and water justice, and resolving power imbalances in *f*CBC. These latter cross-cutting elements are both strategic means of achieving *f*CBC objectives and ends in themselves.

While we highlight the internal elements needed for robust *f*CBC, we note that it does not capture all factors found in CBC programs. For instance, CBC programs are often funded by external stakeholders (e.g., multilateral funds), and a common challenge with these programs may be the discrepancy between project duration and the time needed for changes to happen or to have an impact. Strengthening a community's institutional capacity, for example, can be a slow process (de Montalvo and Alaerts 2013), and interventions that nudge human behavior (e.g., toward greater inclusivity and participation) are better done gradually. There is growing consensus that to achieve enduring conservation and development outcomes, social and cultural values, water justice and equity considerations should be integrated into CBC planning and implementation, especially for FWRs. The integration of these considerations requires longer-term commitments of external stakeholders to support communities.

As interest in CBC grows and rights are devolved back to communities, there is a need to understand how conservation practitioners can help support CBC programs. Our study contributes to filling a research gap regarding the development of common effective *f*CBC approaches, with the flexibility to accommodate a wide variety of local contexts encountered by CBC practitioners (Infield and Tolisano 2019). Our review and insights from case studies provide practitioners with recommendations on ways to strengthen support to *f*CBC, such as the need for deeper analysis of sources of insecurity of rights and linkage to land rights. Compared to terrestrial CBC programs, there is a greater need to increase community capacity and opportunities to participate in MSPs at all scales and to work with partners that have access to larger-scale MSPs. Practitioners should help to strengthen external-facing leadership that could influence decisions at large ecologically relevant scales. To capture opportunities for sustainable livelihoods and development, projects should help to address barriers such as access to markets, equipment, credit and technical knowledge, in a gender-responsive manner. Projects should also explore strategies that lean more heavily on the cultural importance of sustainable management of FWRs, keeping in mind that institutional capacity building can be a slow process and equity- and social inclusion-oriented interventions require longer-term commitment.

Implications

Projects that take an inclusive community-based approach to the conservation and sustainable management of FWRs and aim to improve both freshwater biodiversity and local communities' livelihoods and wellbeing benefit from this study. In particular, projects at the planning stage can benefit from applying the adapted VCA framework to their strategy selection processes and situation and stakeholder analyses to capture unique features of FWRs and develop holistic strategies to create critical enabling

conditions for robust *f*CBC capable of preserving cultural connections, achieving equity and water justice, and resolving power imbalance. The six themes of the adapted framework also point to the need for specific expertise and capacities of practitioners implementing *f*CBC projects to ensure that the projects are well-equipped to support communities in the sustainable management of FWRs.

Notes

1. <https://www.nature.org/en-us/what-we-do/our-insights/perspectives/strong-voices-active-choices/>
2. The focus of the VCA framework (TNC 2017) on terrestrial, rather than water resources is acknowledged by the primary authors of the document, and reflected in the examples, which refer only to terrestrial resources. As a result, TNC incorporated the results from the present study into a second version (TNC 2022).

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