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A REVIEW OF A CONCEPTUAL FRAMEWORK FOR DESIGNING AND BUILDING FISHERIES CO-MANAGEMENT

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ABSTRACT

The fisheries management now realizes that sharing power and partnering with fishers is essential. Fishers need to be involved in making decisions and setting rules. This review looks at studies from around the world on fisheries co-management. It examines different models and approaches and how they work in various places. A very important lesson from the review is that fisheries co-management must be adapted to local social, economic, and ecological conditions. Arguing for flexibility removes the idea of a 'best way'. Six easily adaptable basic principles for practical fisheries co-management in specific contexts are subsidiarity, conflict and power, property rights, representation and knowledge, institution building, and management functions.Subsidiarity emphasizes giving management power to the lowest level, to those who know the local conditions best. Conflict and power acknowledge the presence of conflicts in co-management that warrants procedures for fair resolution and building trust. Property Rights explain that ownership systems (state, private, or communal) affect compliance and cooperation. The involvement of all stakeholders in integrating science with local traditional knowledge is stressed in Representation and Knowledge. Community Institution Building emphasizes building solid structures at the community level to support co-management. Management Functions spell out the roles and responsibilities of all concerned and give the process an element of trust and security. Applying these principles should make fisheries co-management effective and long-lasting, which constitutes one of the global fisheries resources management challenges.

Keywords: Co-management; Sustainable fisheries management; Property rights Stakeholder representation; Community institution building

INTRODUCTION

The paper starts with a global review of the literature on co-management, emphasizing fisheries management and still more exclusively on fisheries co-management. It is a global fishery management research study that opens up an in-depth and complete understanding of the subject matter, thereby underscoring the global relevance of the research in fisheries management. In that respect, Section 2 of this paper provides an in-depth review of fisheries co-management. It makes an effort to examine critically the different models and practices of fisheries co-management, explicating how stakeholders work together in the establishment and then the sustaining of fisheries. This section breathes life into these diverging approaches by showing the concrete implications and complexities of 'doing' fisheries co-management in various socio-economic and ecological contexts and, thus, how research turns into practice.

Section 3 elaborates on the issues identified in Section 2 by pointing out basic concepts from the social sciences that underpin fisheries co-management. It is meant to help us understand the implementation of co-management strategies by laying the ground for a general theoretical framework. It critically evaluates the input of disciplines like sociology, anthropology, political science, and ecology to shape and improve the strategies of fisheries co-management. It also desires to make meaningful contributions to the larger discourse on sustainable

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management and governance of fisheries, which falls under the best analytical segments. The current research findings and theoretical insight synthesis are expected to bring valuable perspectives, bolstered with evidence-based recommendations, toward better effectiveness and adaptability of co-management strategies in fisheries worldwide. These could be subsumed under the following: empowerment of local communities; improvement of stakeholder participation; enhancement of the mechanism for conflict resolution; clarification of property rights; integration of scientific and local knowledge; adaptive management planning; transparency and accountability; education and training investment; securing financing support; and monitoring and evaluation—all of which might do much to better the current status of fisheries co-management. Ultimately, this should empower decision-making among policymakers, researchers, and practitioners dealing with fisheries management to strive for sustainable stewardship of marine resources for both current and future generations.

CO-MANAGEMENT DEFINITION

Co-management can take on various meanings depending on the context. Pomeroy (2003) noted that no universal 'blueprint formula', a set of predefined rules or guidelines, applies to every situation. This is because co-management is a broad concept with essential characteristics that can manifest in different organizational forms. According to Loucks et al. (2003), Butler et al. (2016), and Dietz et al. (2018), co-management often mirrors distinct national governance styles and the specific ecological, social, and cultural contexts in which it operates.

As asserted by Loucks et al. (2003), the principles of democracy, transparency, accountability, and sustainability are fundamental attributes of co-management. However, their implementation into concrete management institutions can differ significantly between countries. This variability highlights the flexibility of co-management, making it adaptable to different contexts and practical in its application.

In the relevant literature, co-management encompasses a wide range of partnership arrangements and degrees of power-sharing between local resource users and centralized management systems (Berkes, 2021). According to Pomeroy and Berkes (1997), co-management arrangements exist on a spectrum. At one end, the government consults fishers before regulations are introduced. On the other hand, fishers actively design, implement, and enforce laws and regulations with guidance and support from the government, as illustrated in Figure 1.

Many authors, including Jentoft (2000), McCay and Jentoft (1989), Pinkerton (2003), Sen and Nielsen (1996), Wilson (2003), and Perera et al. (2023) argue that the consultative mode should not be considered part of the co-management spectrum. In this mode, government agencies seek advice from user groups before making decisions, but it is optional to follow that advice. These authors maintain that more than consultation is needed to provide meaningful influence in the decision making process. Pinkerton (2003) and Etiegni (2016) suggest that this form of co-management is merely symbolic, aimed at reducing political pressure from user groups, and asserts that genuine co-management necessitates power sharing. Pinkerton (2003) contends that participation is achieved only through shared power. Hara and Nielsen (2003), Armitage et al. (2007) emphasize the critical need for genuine power-sharing to achieve effective and sustainable management outcomes. This emphasis on genuine power-sharing makes the audience feel empowered and integral to the co-management process. From this perspective, power sharing and partnership are essential to co-management. Pinkerton (2003) and Bennett et al. (2016) argue that co-management is inaccurately named unless it includes the authority for stakeholders to engage in decision-making regarding the specifics of fishing activities, such as the timing, locations, methods, and quotas. Fisheries managers increasingly recognize that successful management requires power sharing and partnership with fishers to formulate and implement rules and regulations (Gutierrez et al., 2011; Bene et al., 2007). This growing recognition of the need for greater involvement by resource users is reflected in a wide range of policies and programs globally (Jentoft & McCay, 1995; McCay & Jentoft, 1996; Pomeroy & Berkes, 1997; Rudd et al.,2020). According to studies by Pinkerton (2003), Dale (2011), and Ziebe (2015), the following elements are crucial for practical fisheries co-management:

1. Government involvement as a co-manager is optional, but it should ideally be as an active partner rather than merely a delegator. This active role reassures the audience about the authorities' commitment to the co-management process. Co-management encompasses much more than just controlling fishing activity; it involves comprehensive management strategies. This emphasis on comprehensive strategies instils a sense of security in the audience about the thoroughness of the co-management approach. For sustainable co-management,

community partners must have some control over the terms and conditions of fish sales to buyers. This stress on community control empowers the audience to understand their significant role in co-management. Successfully exercising one set of rights depends on exercising rights at higher and lower levels, including participation in high-level policy agenda-setting and data collection and analysis. As co-management evolves, it should ideally incorporate several horizontal partnerships. These partnerships, which involve collaboration among different user groups or communities, can enhance its inclusivity and effectiveness. For instance, a partnership between a local fishing community and a conservation group can lead to more balanced and sustainable management strategies. The ability to exclude someone from a particular area is essential

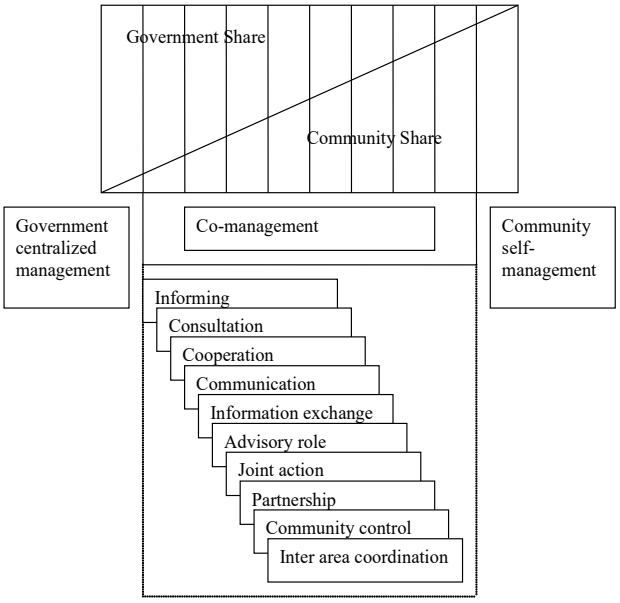

Figure 1. A hierarchy of co-management arrangements (Source: Pomeroy & Berkes, 1997 and Armitage et.al., 2007).

2. Complete co-management relies less on individual rights and more on the collective rights of a group. Pinkerton (2003) argues that comprehensive co-management equips fishery managers with unique tools and strategies unavailable through other institutional arrangements. This approach empowers managers to navigate the complexities of aquatic ecosystems more effectively. The flexibility inherent in co-management allows for timely adjustments to management practices in response to ecological changes, ensuring that the strategies employed are relevant and practical. This adaptability is crucial for addressing the dynamic nature of marine ecosystems and the socio-economic conditions of fishing communities (Jentoft & Chuenpagdee, 2023). By enabling stakeholder participation and incorporating local knowledge, co-management fosters resilience and enhances the effectiveness of fisheries management (Berkes, 2021; Jentoft & Chuenpagdee, 2023). Additionally, co-management adaptability enables managers to integrate new scientific insights and traditional local knowledge, fostering a more holistic understanding of the ecosystem. This comprehensive approach also promotes cautious decision-making, involving continuous stakeholder engagement and iterative feedback processes. By incorporating diverse perspectives and knowledge systems, co-management may mitigate risks and enhance fishery management practices' resilience. Overall, co-management's inclusive and adaptive nature makes it a robust framework for addressing aquatic ecosystem management's dynamic and often unpredictable challenges.

According to Jentoft & Chuenpagdee (2009), achieving and sustaining complete co-management in fisheries can be a formidable challenge due to various socio-political and ecological complexities. In this context, Pinkerton (2003) raises critical questions about the expected outcomes and the actual degrees of power-sharing that are feasible in specific decision-making areas. They observe that as the concept of co-management gains broader acceptance, there is a significant risk of it being misappropriated or applied in ways that do not genuinely reflect the principles of shared governance. The concept often leads to situations where the appearance of co-management exists, but meaningful power-sharing still needs to be improved. The concept underscores the importance of genuine power-sharing in co-management, as it is a crucial principle that ensures fisheries' effective and sustainable management.

Fishing communities frequently have minimal or no real influence over key decision-making domains in many small-scale co-management agreements

(Cote & Virdin, 2022). This lack of influence undermines co-management's fundamental goals, which aim to empower local stakeholders and integrate their knowledge and perspectives into the management process. Co-management has the potential to be a strategic approach to resolving conflicts in fisheries management, promoting sustainability, and improving compliance with regulations. However, for this potential to be realized, co-management must go beyond tokenism and ensure substantive participation and power-sharing (Jentoft & Chuenpagdee, 2021 a).

When social scientists expect substantial results from small-scale co-management arrangements, they often overlook the superficial nature of these engagements meaning that co-management structures are established but operate only at a minimal level (Jentoft, 2021; Pomeroy & Andrew, 2022). They must achieve the profound, systemic changes necessary for genuine sustainability and effective conflict resolution. This means that, even though the co-management framework is in place, there needs to be more substantial governance improvements or significant stakeholder engagement. It may result in disappointment among local communities and stakeholders, as their involvement does not result in significant decision-making authority or tangible benefits (Jentoft & Chuenpagdee, 2022).

To address these challenges, Gutierrez et al. (2011) argue for developing a more robust predictive model to account for the complexity and variability of different co-management arrangements. They emphasize the need for a comprehensive framework that can compare various scenarios and discern the real benefits that different co-management structures can offer. This comprehensive framework should include criteria for evaluating the effectiveness of power-sharing, the extent of community involvement, and the outcomes regarding resource sustainability and conflict resolution (Jentoft & Chuenpagdee, 2022). This emphasis on a comprehensive framework reassures the audience about thoroughly evaluating co-management arrangements.

Such a framework would enable policymakers, researchers, and practitioners to identify the conditions under which co-management can be most effective and tailor context-specific strategies. It would also help distinguish between superficial and genuine co-management practices, ensuring that efforts to promote co-management lead to meaningful and sustainable improvements in fisheries management. By establishing clear guidelines and benchmarks, this framework can contribute to a deeper understanding of co-management dynamics and facilitate the development of more effective and equitable management systems (Jentoft & Chuenpagdee, 2021 b).

In conclusion, while co-management holds significant promise for enhancing fisheries management, its successful implementation requires careful consideration of the specific socio-political and ecological contexts. It also demands genuine power-sharing and active participation from local communities. By developing a comprehensive framework for evaluating co-management arrangements, stakeholders can better navigate the complexities and work towards more sustainable and equitable fisheries management practices.

CONCEPTUAL BASES FOR FISHERIES CO-MANAGEMENT

Rooted in social science concepts, fisheries co-management integrates various disciplines to enhance the sustainability and efficiency of managing aquatic resources. Hanna (2003) emphasizes the critical economic dimensions of management, particularly its ability to achieve objectives cost-effectively. This perspective is crucial within fisheries management, where the ultimate goal is to ensure sustainable outcomes while minimizing economic burdens.

Hanna (2003) and Gutiérrez et al. (2012) underscore the significance of transaction costs in evaluating the cost-effectiveness of co-management strategies. Transaction costs, in the context of fisheries co-management, encompass the expenses associated with coordinating and conducting economic activities within a co-management framework. These costs include negotiation, monitoring, and enforcement expenditures incurred by stakeholders. Understanding transaction costs is essential because they influence the feasibility and sustainability of co-management initiatives over time. High transaction costs can impede effective collaboration and undermine the overall efficiency of management efforts.

Moreover, the effectiveness of incentives within co-management frameworks is pivotal. Incentives, such as subsidies, quotas, or market-based mechanisms, shape the behaviour of fishers, stakeholders, and management authorities, influencing their participation levels and adherence to regulatory measures. Effective incentives align the interests of diverse stakeholders, promoting sustainable practices and fostering cooperative decision-making processes. By incentivizing compliance with regulations and

promoting responsible resource use, co-management frameworks can enhance fisheries' long-term health and productivity.

Hanna (2003) highlights the intersection of economic principles with ecological, social, and institutional factors within fisheries co-management. Integrating economic analysis into co-management frameworks gives policymakers and researchers better insights into the complex dynamics of resource management. This holistic understanding facilitates the optimization of resource allocation and the design of interventions that are economically efficient and environmentally sustainable.

In summary, Hanna's insights underscore the importance of evaluating fisheries co-management through an economic lens. By prioritizing the achievement of management objectives and assessing the cost-effectiveness of strategies, co-management frameworks can be tailored to maximize their impact. Addressing transaction costs and leveraging effective incentives are critical to enhancing co-management capacity for sustainable fisheries management outcomes. Ultimately, this approach fosters collaboration and stewardship among stakeholders, ensuring the long-term viability of aquatic resources.

Arrow (1974) provides insights into organizations' fundamental role in coordinating decision-making processes involving multiple individuals. They argue that an organization's primary function is to harness individuals' collective efforts and information to achieve specific objectives, particularly in uncertain environments.

In this context, organizations act as coordinators facilitating information and resource flow among participants. Arrow (1974) and Williamson (2018) highlight that the process of coordination within organizations incurs various costs, known as transaction costs. These transaction costs encompass several activities necessary for effective decision-making and management, including:

1. **Gathering Information:** Organizations invest resources in collecting and analyzing relevant data to inform decision-making processes. This involves gathering insights into market trends, consumer preferences, regulatory changes, and other factors influencing organizational outcomes.

2. **Designing Regulations:** Organizations develop rules, policies, and procedures to guide behaviour and ensure compliance with internal standards and external regulations. Designing effective regulations requires balancing organizational goals with legal requirements and industry best practices.

3. **Organizing Participants:** Coordinating the efforts of individuals within an organization involves structuring roles, responsibilities, and workflows to optimize productivity and achieve organizational objectives. This organizational structure helps allocate resources efficiently and streamline decision-making processes.

4. **Monitoring Conditions:** Organizations continuously monitor internal and external conditions to assess performance, identify risks, and adjust strategies as needed. Monitoring involves tracking operational metrics, market dynamics, regulatory changes, and other organizational outcome variables.

5. **Enforcing Regulations:** Ensuring compliance with regulations and organizational policies is essential for maintaining order and achieving desired outcomes. Enforcement mechanisms may include audits, inspections, disciplinary actions, and incentives to encourage adherence to established rules.

Arrow (1974) emphasizes that transaction costs are inherent in organizational operations and management. Effectively managing transaction costs is a challenge and an opportunity to enhance organizational efficiency, minimize waste, and optimize resource allocation. Organizations can improve decision-making processes, foster innovation, and navigate uncertainties more effectively by understanding and addressing transaction costs. This understanding empowers the audience to take control of their organizational operations and make informed decisions.

Arrow (1974) and Birkinshaw & Ridderstrale (2020) underscore the pivotal role of organizations as coordinators of people and information in complex environments. They highlight transaction costs as the expenditures associated with coordinating organizational decision-making activities, including gathering information, designing regulations, organizing participants, monitoring conditions, and enforcing regulations. This recognition of their integral role in the process makes the audience feel valued and appreciated for their contributions to the organization's objectives.

Kuperan & Pomeroy (1998) identifies three distinct transaction costs significantly influencing fisheries management. These costs provide a framework for understanding the economic challenges associated with organizing and coordinating activities within fisheries:

1. **Information Costs:** These are incurred in obtaining and processing relevant data essential for effective fisheries management. Information costs include scientific research, data collection, and analysis expenses. Fisheries management relies heavily on accurate information about fish stocks, ecosystem dynamics, environmental conditions, and socio-economic factors. The costs associated with gathering and interpreting this information can vary depending on the complexity and scope of the management regime.

2. **Collective Decision-Making Costs:** Fisheries management involves making decisions that affect multiple stakeholders, including fishers, government agencies, scientists, and conservation groups. Collective decision-making costs encompass consultations, negotiations, and consensus-building among diverse stakeholders. These costs arise from the need to reconcile conflicting interests, reach agreements on management strategies, and allocate responsibilities effectively.

3. **Collective Operational Costs** pertain to implementing and enforcing fisheries management regulations and policies. Operational costs include expenditures on monitoring fishing activities, enforcing compliance with regulations, conducting patrols, and maintaining surveillance systems. The effectiveness of fisheries management depends on the capacity to enforce rules and regulations consistently, which incurs operational expenses.

Certain transaction costs in fisheries management, such as the production costs of scientific data, are fixed irrespective of the organizational structure of management (Fulton et al., 2019). These costs represent investments necessary to gather accurate information about fish stocks, environmental conditions, and socio-economic factors influencing fisheries. Whether centralized or decentralized, these fixed costs remain essential for informed decision-making and sustainable resource management (Fulton et al.,2019).

In contrast, other transaction costs vary depending on the management structure and the roles assigned to stakeholders, including fishers and government entities, in decision-making processes (Bodin, 2017). For instance, costs related to collective decision-making and operational activities can fluctuate based on stakeholder collaboration, participation, and responsibility-sharing. A decentralized management approach may allocate decision-making authority to local communities or user groups, reducing transaction costs associated with consultation and enforcement at higher administrative levels (Cinner & McClanahan, 2022).

Understanding these transaction costs is crucial for designing effective fisheries management strategies that balance economic efficiency with ecological sustainability. Cinner and McClanahan, (2022) highlight mitigating transaction costs through improved information systems, streamlined decision-making processes, and collaborative governance frameworks. By doing so, fisheries managers can enhance the resilience and adaptive capacity of marine ecosystems while supporting the livelihoods of fishing communities.

Jentoft (1989), Andersson & Agrawal (2019), and Fulton et al. (2019). argue that the legitimacy of fisheries management plays a critical role in influencing transaction costs, particularly in terms of compliance expenses incurred by resource users. Their argument underscores the importance of legitimacy in influencing compliance costs borne by resource users and enforcement costs incurred by management authorities in fisheries. Fisheries management can enhance compliance by fostering legitimacy through transparent and participatory decision-making processes, clear communication of regulations, and fair enforcement practices (Jentoft, 2021). Compliant enhancement, in turn, can lead to more efficient resource management, reduced enforcement expenditures, and improved sustainability outcomes for marine ecosystems and fishing communities.

The literature on fisheries management consistently underscores the importance of incentives in achieving societal goals. Hilborn & Ovando, (2022) state that incentives are crucial in practical fisheries management. Ostrom, E. (2008) argues that the inefficiency of fishing and the economic challenges faced by fishermen stems from the nature of the shared property (open access) of fisheries. In open-access

systems, where anyone can exploit fishery resources without restriction, the incentive of unrestricted access hinders efforts to maximize fishery utilization limited awareness of alternative livelihood options (Allison & Ellis, 2001).

Hanna (2003) argued that incentive issues within centralized management have spurred exploration into alternative institutional frameworks, notably co-management and other decentralized models. These approaches mitigate transaction costs and establish incentive structures less susceptible to short-term interests. However, it is crucial to recognize that these strategies may also introduce conflicting incentives that need careful consideration.

Recent literature reviews have identified six fundamental principles essential for the effective design of sustainable fisheries co-management: subsidiarity, conflict and power dynamics, property rights, representation and knowledge integration, community institution-building, and management functions.

Subsidiarity

Several authors, including Pomeroy (2003) and Pomeroy and Viswanathan (2003). emphasize three subsidiarity principles critical for the sustainable implementation of co-management. These principles delineate how co-management should be applied effectively:

1. **First Subsidiarity Principle:** This principle argues that management authority should be delegated to the lowest feasible level within the organizational structure. Often, this means empowering community-level or other representative units at the village level to manage local fisheries. By decentralizing authority, decision-making can be more responsive to local conditions and needs, fostering a sense of ownership and accountability among local stakeholders.

2. **Second Subsidiarity Principle:** The second principle stresses the role of higher-level organizations in supporting decentralization efforts. External organizations, such as governmental bodies or NGOs, are encouraged to facilitate and promote decentralization processes within fisheries management. This support includes providing technical assistance, capacity building, and institutional frameworks that empower local communities to manage their fisheries resources effectively.

3. **Third Subsidiarity Principle:** This principle highlights the importance of local-level institutions receiving delegated powers from higher authorities. It ensures that local institutions implement decisions made by higher authorities and participate actively in the decision-making process. This participatory approach strengthens local governance structures and enhances the legitimacy and effectiveness of co-management arrangements.

These subsidiarity principles provide a framework for designing co-management systems that promote sustainable fisheries management by leveraging local knowledge, fostering community engagement, and aligning decision-making processes with fisheries' specific socio-economic and ecological contexts.

Conflict and power

Co-management in fisheries represents a significant shift away from traditional government control. It involves sharing decision-making power with local communities, which brings new challenges that can disrupt established government ways of operating (Jentoft & McCay, 2003; and Ostrom, 1990). This change towards collaboration and partnership means government agencies must navigate unfamiliar territory, which could lead to initial doubts and resistance as they adjust to new roles.

Hara and Nielsen (2003) and Jentoft & Chuenpagdee (2009) argue that successful co-management requires a new way of thinking about management. Instead of making decisions alone, managers need to embrace teamwork that values inclusivity and local knowledge. This shift demands skills in facilitating discussions, negotiating agreements, and resolving conflicts to engage effectively with different groups, including fishing communities. Building trust and mutual respect between government officials and local people is crucial for making decisions that benefit everyone and sustain the environment.

While co-management offers benefits like better sustainability and community involvement, governments must change fundamentally. The change means accepting new duties and roles and reshaping decisions to promote openness, fairness, and effective teamwork at all government and community interaction levels.

Co-management involves more than just fostering collaboration among stakeholders in fisheries

management. It also necessitates establishing cooperative relationships with the government, where mutual distrust may have deep historical roots. Therefore, Pinkerton (1989), Pomeroy & Berkes (1997), Pomeroy (2003), Carlsson & Berkes (2005), Jentoft & Chuenpagdee (2009), and Berkes & Ross (2013) argue that building trust is essential for any successful implementation of co-management initiatives.

Pomeroy & Berkes (1997), and Pinkerton (2003), Wilson (2003) argue that conflict is an inherent and potentially constructive aspect of fisheries management within co-management frameworks. Thus, co-management focuses on implementing equitable mechanisms to address conflict rather than eliminating conflict. A shared understanding among stakeholders is essential for successfully implementing co-management strategies (Wilson, 2003).

Property rights

Co-management varies depending on the specific property rights framework within which it operates. It encompasses management and property rights structured around state, private, or communal ownership systems (Ostrom, 1990; Schlager & Ostrom, 1992; Heltberg, 2002; Jentoft & McCay, 2003). The type of property rights system adopted can influence the level of compliance regarding the exchange of various rights and responsibilities. For instance, co-management under a private property rights system, like Individual Transferable Quotas (ITQs), may involve fewer sanctions for rule violations (Jentoft & McCay, 2003). Conversely, in co-management systems based on communal property rights, such as the Dutch model, there is a stronger emphasis on mutual oversight and sanctioning among co-managers (Jentoft & McCay, 2003; Degnbol et al., 2006).

An essential consideration in designing a co-management system is the integration of existing institutions. Co-management is not created in an institutional vacuum but is typically established within the framework of pre-existing institutions (Jentoft, 2000; Jentoft & McCay, 2003; Carlsson & Berkes, 2005; Varjopuro & Salmi, 2003 and Armitage et al., 2007) emphasize that accounting for these existing regimes and institutions is crucial when developing a co-management arrangement. There are two potential outcomes:

1. Co-management could modify or entirely replace current management systems. For instance, producers' organizations within the European Union were initially formed for marketing purposes rather than fisheries co-management but have since evolved to encompass co-management roles (Jentoft, 2000; Carlsson & Berkes, 2005)

2. Co-management can challenge and transform traditional community structures, as seen in Southern, East, and West African communities (Varjopuro & Salmi, 2003).

These examples illustrate how co-management interacts with and reshapes existing institutional frameworks.

The second possibility is that a co-management arrangement may adapt to and coexist with the prevailing institutional framework if the existing institution remains dominant (Jentoft & McCay, 2003; Carlsson & Berkes, 2005; Berkes, 2009). There are several examples of this scenario:

1. In Great Britain, the role of producers' organizations has expanded to include fisheries management functions (Squires & Vestergaard, 2013).

2. Finland's co-management system operates within a fisheries management framework based on private property rights to seawater territories).

3. In Norway, a co-management system is integrated within the Saami indigenous collective ownership of fishing territories (Jentoft & Soreng, 2017).

These examples illustrate how co-management can be tailored to fit within established institutional arrangements while enhancing collaborative management efforts.

Representation and knowledge

In certain situations, fisheries co-management involves numerous stakeholders (Jentoft & McCay, 2003). The involvement of many stakeholders presents both a disadvantage and an advantage that must be considered for successful co-management. The disadvantage is related to the representativeness of the stakeholders, which can be challenging to manage. On the other hand, the advantage lies in the enrichment of experience-based knowledge, which can significantly contribute to the development and effectiveness of the co-management system).

Based on the definition of co-management discussed earlier, co-management should adhere to whom affected by a decision, according to the democratic principle, should have a voice in the decision-making process (Dahl, 1988; Jentoft & McCay: 2009; Gutiérrez et al., 2011). However, determining stakeholder representation in a co-management system is challenging. This difficulty arises because the individuals most dependent on the fishery and have the most pressing concerns are not always the most influential stakeholders (Jentoft & McCay, 2003; Bennett et al., 2016). Therefore, while involving as many stakeholders as possible is essential, achieving this is not always straightforward.

Hanna (2003), Berkes (2009), and Armitage et al. (2007) note that including a large number of stakeholders in the decision-making process can increase complexity, making management processes unmanageable, time-consuming, and costly. Therefore, when designing a democratic co-management system, it is recommended to balance stakeholder involvement to ensure effective and efficient management (Jentoft & McCay, 2003; Berkes, 2009).

Including numerous stakeholders in co-management presents the advantage of expanding the knowledge base, leading to improved management outcomes. Jentoft and McCay (2003), Pomeroy (2003), Berkes (2009) and Jentoft, S., & Chuenpagdee (2009) highlight that diverse participants contribute specific insights and concerns to the management process, helping to clearly define problems from ecological and social, and economic perspectives. Furthermore, knowledge is cultivated through an interactive learning process when stakeholders participate and communicate within a democratic framework (Pateman, 1970; Jentoft & McCay, 2003; Berkes, 2009; Wost, 2009).

The Community

Co-management involves the community exchanging resource rights and establishing a shared governance model for managing fisheries resources (Jentoft & McCay, 2003; Gutiérrez et al., 2011). In creating an effective co-management system, two critical issues must be addressed: the scale of the co-management system and the institutional setup.

Scale of the Co-management System

The scale of the co-management system refers to the geographic and organizational scope within which co-management operates (Pinkerton, 2003).

The scale encompasses the spatial boundaries of the fisheries, the number of communities involved, and the extent of the resource area under management. Determining the appropriate scale is crucial because it impacts the effectiveness and sustainability of the management efforts (Armitage et al., 2007; Bavinck & Chuenpagdee, 2013). A well-defined scale ensures the management practices are tailored to the area's specific ecological characteristics and social dynamics. For instance, a localized co-management system might focus on a single community or a specific fishery, enabling more targeted and precise management strategies. In contrast, a broader co-management system might involve multiple communities or regions, requiring more complex coordination and integration of various stakeholders' interests.

Institutional Setup

The institutional setup pertains to the governance structures, legal frameworks, and organizational arrangements that underpin the co-management system (Pomeroy & Berkes, 1997). The institutional setup includes the roles and responsibilities of different stakeholders, the mechanisms for decision-making, and the processes for conflict resolution and enforcement of regulations (Pinkerton, 2003; Berkes, 2009; Jentoft & Chuenpagdee, 2009). An effective institutional setup is essential for ensuring that the co-management system is inclusive, transparent, and capable of adapting to changing conditions.

Critical aspects of the institutional setup include:

- **Legal Framework:** Establish clear legal rights and responsibilities for all stakeholders involved in the co-management system. This includes defining property rights, access rights, and the legal mechanisms for enforcing regulations (Ostrom, 1990; McCay & Jentoft, 1996; Pomeroy & Berkes, 1997).
- **Governance Structures:** Creating governance bodies that include representatives from the community, government agencies, and other relevant stakeholders (Pinkerton, 2003; Jentoft & Chuenpagdee, 2009). These bodies should facilitate collaborative decision-making and ensure that all voices are heard.
- **Capacity Building:** Providing training and resources to enhance the skills and knowledge of community members and other stakeholders (Armitage et al., 2007; Jentoft

& Chuenpagdee, 2009). The capacity building includes building expertise in resource monitoring, conflict resolution, and sustainable fishing practices.

- **Monitoring and Evaluation:** Implement systems for ongoing monitoring and evaluation of the co-management efforts. This allows for assessing the effectiveness of the management practices and identifying areas for improvement.

Co-management systems must operate at various scale levels depending on the characteristics of the resource system and its users (Jentoft & McCay, 2003; Berkes, 2006). When the resource system extends beyond the local level, a regional approach to co-management becomes necessary (Jentoft & McCay, 2003; Wilson, 2003; Margerum, 2008; Berkes, 2009; Armitage et al., 2007). Co-management is inherently part of a broader institutional network, requiring integration of the cultural and social values embedded in human communities to ensure its legitimacy (Jentoft & McCay, 2003). Often, these cultural and social values can be sources of management conflicts.

Additionally, the institution must consider enabling legislation that supports partnerships between communities and governments (Pomeroy & Viswanathan, 2003; Wilson, 2003; Berkes, 2004; Jentoft, 2005; Berkes, 2009; Jentoft & Chuenpagdee, 2009). To strengthen this partnership, Loucks et al. (2003) and Bene et al. (2007) suggest methods to enhance the community's role within social and political systems and develop their capacity to generate revenue for community well-being and growth. This approach emphasizes the importance of community empowerment and economic development as essential components of effective co-management.

Institution-building and management functions

Pomeroy & Berkes (1997). Pretty (2003) and Gutiérrez et.al., (2011) argue that the success of a sustainable co-management regime hinges on the fishers' capacity to come together and collaborate. This principle highlights two critical elements. Firstly, it stresses the importance of having appropriate local institutions that facilitate collective action among individuals or groups of fishers. These institutions serve as platforms where fishers can organize themselves to participate effectively in co-management initiatives.

Establishing such institutions is only sometimes straightforward and can vary significantly from country to country. It often requires time and effort to develop institutional frameworks that enable fishers to coordinate their efforts and engage meaningfully in decision-making processes related to fisheries management. (Carlsson & Berkes, 2005; Gutiérrez et al., 2011; Pomeroy and Berkes, 1997; Pinkerton and John, 2008; Gutiérrez et al., 2011; Scholtens et al.,2012; Cinner and McClanahan, 2015) provide examples from different contexts to illustrate how the presence or absence of these local institutions can influence the feasibility and success of co-management arrangements. In essence, their argument underscores the foundational role of local institutions in fostering cooperation among fishers and enabling them to play an active role in managing their fisheries sustainably through co-management approaches.

In the Philippines, establishing a self-sufficient organization for fisheries management took approximately 3 to 5 years (Christie et al., 2002). During this period, efforts were likely focused on building local institutions that could effectively support collective action among fishers. This timeline suggests a relatively swift development compared to other regions.

Conversely, in St. Lucia, West Indies, the timeline stretched from 5 to 10 years (Sandersen & Koester, 2000; Renard, 2001). The extended period may reflect challenges in establishing robust local institutions supporting effective co-management initiatives. Factors such as bureaucratic hurdles, resource constraints, or initial stakeholder resistance could have contributed to this extended timeframe (Jentoft, 2000; Pinkerton & John, 2008).

These examples illustrate that the timeline for developing self-sufficient organizations for co-management can vary significantly depending on several factors, including local contexts, government support, bureaucratic efficiency, and the level of cooperation among stakeholders. Each case underscores the importance of tailored approaches and sustained efforts in institution-building to facilitate successful co-management of fisheries resources.

The second aspect pertains to the willingness and preparedness of certain groups of resource users to assume responsibility for fisheries management. A key consideration here is identifying which specific resource management functions are most effectively managed at the local community level. Pinkerton (1989) outlines seven such functions that can be delegated to local communities:

1. Data gathering: Collecting information about fish stocks, ecosystem health, and other relevant data.
2. Logistical decisions: Determining who can fish, when, and under what conditions.
3. Allocation decisions: Distributing fishing rights or quotas among community members.
4. Protection from environmental damage: Implementing measures to safeguard marine resources and habitats.
5. Enforcement of regulations: Ensuring compliance with fishing regulations and addressing violations.
6. Long-term planning: Developing strategies for sustainable resource use and conservation.
7. Inclusive decision-making: Facilitating participatory processes that involve all stakeholders in decision-making.

The community's practical management ability to perform these functions depends on specific country and site conditions, political support, and local governance structures (Pomeroy & Berkes, 1997; Armitage et al., 2007; Berkes & Ross, 2013). Successfully delegating these responsibilities requires robust local institutions, adequate resources, and supportive policies that empower communities to participate meaningfully in fisheries management. Each community's capacity to handle these functions varies based on its unique socio-economic, environmental, and political context, highlighting the need for tailored approaches in co-management strategies.

CONCLUSION

By reviewing a conceptual framework for designing and building fisheries co-management, we better understand that Co-management represents a significant innovation in fisheries governance by integrating diverse disciplines and stakeholder perspectives. This approach effectively addresses the complexities of fisheries management by aiming for long-term sustainability and enhancing community well-being on a global scale. By fostering collaboration between fishers, government agencies, scientists, and other stakeholders, co-management advances inclusive and adaptive resource management strategies, underscoring its pioneering role in modern fisheries governance.

Co-management represents a versatile and adaptive fisheries governance approach tailored to diverse socio-political and ecological contexts. Its effectiveness hinges on genuine power-sharing and meaningful participation from local stakeholders, which is crucial for achieving sustainability and resolving conflicts. Despite challenges, robust frameworks for evaluation and adaptation offer a clear pathway forward. Embracing these frameworks and fostering collaboration among governments, communities, and researchers is critical to realizing co-management's full potential in fostering worldwide resilient, equitable, and sustainable fisheries management practices.

Fisheries co-management integrates economic principles with ecological, social, and institutional factors to enhance sustainability and efficiency in aquatic resource management. By managing transaction costs and designing effective incentives, co-management aligns stakeholders' interests, promotes collaborative decision-making, and ensures responsible stewardship of fisheries resources. The co-management approach addresses current challenges and facilitates the groundwork for sustainable practices safeguarding aquatic ecosystems for future generations.

Arrow (1974) and Williamson (2018) highlight the role of organizations in facilitating effective coordination in fisheries management. These costs encompass critical activities like information gathering and enforcement, which are essential for operational efficiency and resource allocation optimization. Mitigating transaction costs through enhanced information systems and collaborative governance frameworks promotes economic efficiency and ecological sustainability, supporting marine ecosystems and fishing communities amid evolving challenges.

Legitimacy, emphasized by Andersson & Agrawal (2019), and Fulton et al., (2019) is crucial for reducing compliance and enforcement costs in fisheries management. Transparent decision-making and fair enforcement practices enhance sustainable resource management outcomes, aligning incentives for long-term stewardship of marine ecosystems and livelihood sustainability for fishing communities.

As Hanna (2003) and noted, addressing challenges in open-access fisheries requires effective incentive structures to mitigate overexploitation and promote sustainability. Decentralized models like co-management align incentives with conservation goals but require careful consideration of conflicts to balance short-term economic interests with long-term sustainability.

Enhancing fisheries management effectiveness requires research into incentive mechanisms, adaptive governance approaches, and stakeholder engagement. These complexities can foster resilient fisheries management frameworks that sustain marine resources and support fishing communities worldwide.

The practical design and implementation of sustainable fisheries co-management depend on principles like subsidiarity, conflict management, property rights, representation, community institution-building, and precise management functions. By adhering to these principles, co-management can effectively navigate fisheries management complexities, promote sustainable practices, and enhance the well-being of fishing communities worldwide. Continued research, adaptive governance, and stakeholder collaboration are essential for advancing fisheries co-management towards achieving long-term ecological and socio-economic sustainability.

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